11.3.4.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

The Sacramento River channel and bank would be affected by construction of one north Delta intake, Intake 1, at RM 44 (south of Freeport). The locations, dimensions, and construction footprints of Intake 1 are provided in Table 11-7, along with estimates of temporary and permanent in-water habitat effects.

Alternative 5 is expected to result in the same suite of potential construction impacts as Alternative 1A, except that the effects would be reduced in scale and extent commensurate with the reduced scale of in-water construction activities. Alternative 5 includes construction of only one intake (Intake 1) versus the five intakes planned under Alternative 1A. The total permanent in-water footprint of the one intake would be about 1.0–3.8 acres, and the total length of permanent bank protection would be approximately 2,050 feet (9,080 feet less than Alternative 1A) (see Table 11-7). The six barge landings under Alternative 5 would be in the same locations, and operate the same as the landings under Alternative 1A. As such, the effects of the barge landing construction and operation would be identical to those described for Alternative 1A. All other upland construction, except for the pipelines between Intake 1 and the intermediate forebay, are identical to Alternative 1A. The conveyance system would be the same under Alternative 5 as under Alternative 1A; therefore, all impacts related to construction of the conveyance tunnel and pipelines, including those associated with barge unloading facilities, would be the same.

The number of barge trips required under Alternative 5 would be somewhat less than the estimated 3,000 barge trips under Alternative 1A, because one intake facility would be constructed under Alternative 5 compared to five intakes under Alternative 1A. All other in-water aspects of construction would be the same under Alternative 5 as described for Alternative 1A.

Delta Smelt

Construction and Maintenance of CM1

Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June during a portion of the in-water construction period for the intake facilities. Small numbers could also be present in June or July during construction of the barge landings in the east Delta and south Delta (see Table 11-4).

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The types of potential effects of construction of the water conveyance facilities on delta smelt would be similar to those described for Alternative 1A (Impact AQUA-1) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-1 environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt.

CEQA Conclusion: As described in Impact AQUA-1 in Alternative 1A, the impact of the construction of water conveyance facilities on delta smelt would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-2) except that only one intake would need to be maintained in Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt.

CEQA Conclusion: As described in Impact AQUA-2 in Alternative 1A, the impact of the maintenance of water conveyance facilities on delta smelt would be less than significant and no mitigation is required.

Water Operations of CM1

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Water Exports from SWP/CVP South Delta Facilities

Overall, operational activities under Alternative 5 at the south Delta facilities would result in minimal (<4%) changes in average proportional entrainment of delta smelt compared to NAA (Table 11-5-1, Figure 11-5-1 and Figure 11-5-2).

Average juvenile proportional entrainment across all water year types under Alternative 5 would be 0.15 (15% of the juvenile population), which is 0.006 greater than NAA (a 4% relative increase) (Figure 11-5-1, Table 11-5-1). Average adult proportional entrainment would be 0.072 (7.2% of the population), which is 0.003 less compared to NAA (a 3% relative decrease) (Figure 11-5-2, Table 11-5-1). Differences by water year type were slight, with greater reductions under Alternative 5 in wetter years for both juvenile and adult proportional entrainment

Table 11-5-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities

	Proportional Entrainment[a] Difference in Proportions (Relative Change in Proportions)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Total Population (December–June)		
Wet	0.021 (19%)	-0.005 (-4%)
Above Normal	0.024 (15%)	-0.004 (-2%)
Below Normal	0.037 (17%)	0.008 (3%)
Dry	0.030 (11%)	0.011 (4%)
Critical	0.009 (3%)	0.009 (3%)
All Years	0.024 (12%)	0.003 (1%)
Juvenile Delta Smelt (March–June)		
Wet	0.026 (68%)	0.0 (0%)
Above Normal	0.029 (35%)	0.0 (0%)
Below Normal	0.042 (30%)	0.010 (6%)
Dry	0.032 (18%)	0.012 (6%)
Critical	0.014 (6%)	0.009 (4%)
All Years	0.029 (23%)	0.006 (4%)
Adult Delta Smelt[b] (December–March)		
Wet	-0.005 (-7%)	-0.005 (-7%)
Above Normal	-0.005 (-6%)	-0.004 (-5%)
Below Normal	-0.004 (-5%)	-0.002 (-3%)
Dry	-0.002 (-3%)	-0.001 (-1%)
Critical	-0.006 (-8%)	0.0 (-1%)
All Years	-0.004 (-6%)	-0.003 (-3%)

Shading indicates >5% or more increased entrainment.

Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.

[a] Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).

[b] Adult proportional entrainment adjusted according to Kimmerer (2011).

Water Exports from SWP/CVP North Delta Intake Facilities

As described for Alternative 1A, potential entrainment and impingement risks at the proposed north Delta facilities would be limited since delta smelt rarely occur in the vicinity of the proposed intake site. The intake would be screened to exclude fish larger than 15mm. Alternative 5 would have only one SWP/CVP north delta intake, compared to five intakes for Alternative 1A (0–2% entrainment as modeled by PTM), and therefore potential entrainment and impingement risks would be even lower.

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 models was low, averaging 1.3% under Alternative 5 compared to 2.0% for NAA, a 35% relative reduction (Table 11-5-2).

Table 11-5-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 5 and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A5_LLT	A5_LLT vs. EXISTING CONDITIONS	A5_LLT 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

Pre-screen loss at the south Delta facilities, typically attributed to predation and other unfavorable habitat conditions near the pumps (Castillo et al. 2012), would be negligibly changed under Alternative 5 commensurate with proportional entrainment estimates. Predation loss at the proposed north Delta intake would be limited because few delta smelt occur that far upstream.

NEPA Effects: Under Alternative 5 proportional delta smelt entrainment at the south Delta facilities would be similar to NAA. Potential entrainment of juvenile and adult delta smelt would be reduced at the NBA. Entrainment and impingement could potentially occur at the proposed north Delta intake, but the risk would be low due to the location, design, and operation of intakes. Furthermore, any potential effects would be reduced by real-time monitoring and adaptive management response by the Real-Time Response Team. Therefore, the effect on delta smelt entrainment would not be adverse.

CEQA Conclusion: As described above, under Alternative 5 average juvenile delta smelt proportional entrainment an associated pre-screen predation loss at the south Delta facilities would increase 0.029 (2.9% of the juvenile population, a 23% relative increase). Average adult proportional entrainment would decrease 0.004 (a 6% relative decrease) compared to Existing Conditions (Table 11-5-1). Furthermore, potential impacts would be reduced by monitoring and adaptive management by the Real-Time Response Team. This CEQA interpretation of the biological modeling differs from the NEPA analysis, which is likely attributable to different modeling assumptions (as described fully in Section 11.3.3 and Alternative 1A Impact AQUA-3). Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. Note that the analysis for larvae and juveniles includes both OMR flows and X2 as predictors of proportional entrainment; primarily because of sea level rise assumptions, X2 would be further upstream in the ELT and LLT even with similar water operations, so that the comparison of the action alternative in the ELT and LLT to Existing Conditions is confounded.

Therefore, the impact analysis is better informed by the results from the NEPA analysis presented above, which accounts for sea level rise by considering the NAA in the LLT. When climate change is factored in, average delta smelt proportional entrainment under Alternative 5 is reduced for larvae and juveniles (0.006 less, a 4% relative decrease) and adults (3% relative decrease) compared to conditions without BDCP (Table 11-5A-1).

Modeled entrainment of larval delta smelt at the NBA facility under Alternative 5 would be similar to Existing Conditions (Table 11-5-2). Entrainment and impingement would potentially occur at the proposed north Delta intake, but the magnitude of this effect would be low because delta smelt occur infrequently here and the intake would be equipped with state-of-the-art screens to reduce the entrainment risk. Overall, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

NEPA Effects: The effects of operations under Alternative 5 on abiotic spawning habitat would be the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intake would not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning timing, would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect of Alternative 5 operations on spawning would not be adverse, because there would be little change in abiotic spawning conditions for delta smelt.

CEQA Conclusion: As described above, operations under Alternative 5 would not reduce abiotic spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

NEPA Effects: As described for other Alternatives (Impact AQUA-5), rearing habitat conditions for juvenile delta smelt were evaluated using the fall abiotic habitat index (Feyrer et al. 2011) with and without the assumption that BDCP habitat restoration benefits are realized. Alternative 5 includes the USFWS BiOp Fall X2 requirements, thus, the abiotic habitat index under Alternative 5 without restoration would be similar to the NAA (Table 11-5-3, Figure 11-5-3). However, Alternative 5 may also benefit delta smelt by habitat restoration (CM2 and CM4), particularly in the Suisun Marsh, West Delta, and Cache Slough ROAs, which are closer to delta smelt's main area of occurrence. Habitat restoration has the potential to increase suitable areas of spawning and rearing habitat and is intended to supplement food production and export to other rearing areas.

The effect of Alternative 5 on delta smelt would depend on the extent to which restored habitats are utilized by delta smelt. Assuming all the habitats restored under Alternative 5 are fully utilized by delta smelt, there would be an increase in the abiotic habitat index of about 28%, compared to NAA, when averaged across water year types. These effects are a result of the inundation of new areas of the Delta resulting from habitat restoration, which is expected to open up additional habitat for delta smelt. Alternative 5 includes restoration of 25,000 acres of tidal habitat restored compared to the 55,000 acres under Alternative 1A. When analyzing effects by water year types, the relative increase in abiotic habitat index would be greatest in dry years (34% NAA) and below normal years (33% NAA).

Table 11-5-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 5 and Baseline Scenarios, with and without Habitat Restoration, Averaged by Prior Water Year Type

	Without Restoration		With Restoration	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All	948 (24%)	62 (1%)	2,264 (57%)	1,378 (28%)
Wet	2,136 (45%)	-60 (-1%)	4,010 (85%)	1,814 (26%)
Above Normal	1,639 (43%)	-29 (-1%)	3,128 (82%)	1,460 (27%)
Below Normal	59 (1%)	207 (5%)	1,186 (29%)	1,334 (33%)
Dry	118 (3%)	210 (6%)	1,081 (30%)	1,173 (34%)
Critical	21 (1%)	21 (1%)	718 (24%)	718 (24%)

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.

CEQA Conclusion: Alternative 5 would not result in less rearing habitat area for delta smelt. Without BDCP habitat restoration efforts, delta smelt fall abiotic habitat index under Alternative 5 would increase 24% relative to Existing Conditions. With the implementation of the BDCP habitat restoration actions (CM2, CM4, CM5, CM6, and CM7), the abiotic habitat index would increase by 57% when averaged across all water year types. The increase in abiotic habitat would be most substantial in wetter water year types (an 82–85% increase).

Note that the CEQA analysis predicts a greater increase in the abiotic habitat index relative to baseline than the NEPA analysis. It is unclear whether this increase under Alternative 5 compared to Existing Conditions is a function of Project operations, or attributable to differences in modeling assumptions (Existing Conditions does not include Fall X2). The NEPA analysis is a better approach for isolating the effect of the Alternative from the effects of sea level rise, climate change, future water demands, and implementation of required actions such as the Fall X2 requirement. When compared to the NAA and informed by the NEPA analysis, the average delta smelt abiotic habitat index under Alternative 5 would be similar compared to NAA without restoration, and 28% greater with restoration (Table 11-5-3).

The impact on delta smelt rearing habitat would be considered less than significant and may provide a benefit to the species because of the increase in abiotic habitat with the planned habitat restoration measures. No mitigation would be required.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: The effects of operations under Alternative 5 on migration conditions would be similar to those described for Alternative 1A (Impact AQUA-6). Alternative 5 would not affect the first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration, although some amount of sediment may be removed by the north Delta facilities. Effects on suspended sediment concentrations at times of the year other than first flush will be minimized through the reintroduction of sediment collected at the north Delta intake into tidal natural communities restoration projects (CM4), consistent with the Environmental Commitment addressing Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material.

In-Delta water temperatures would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes under BDCP operations. There would be no substantial change in the number of stressful or lethal condition days under Alternative 5. Thus the effect on delta smelt migration conditions is not adverse.

CEQA Conclusion: As described above, operations under Alternative 5 would not substantially alter the turbidity cues associated with winter flush events that may initiate migration, nor would there be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt migration conditions would be less than significant, and no mitigation would be required.

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

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

NEPA Effects: The types of potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 55,000 acres for Alternative 1A) (see Impact AQUA-7 for Alternative 1A). As concluded in Alternative 1A, Impact AQUA-7, the effect of restoration construction activities on delta smelt would not be adverse.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-7 for delta smelt, the potential impact of restoration construction activities would be less than significant, and no mitigation would be required.

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-8). Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-8, the effects of contaminants associated with restoration measures on delta smelt would not be adverse with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: As described in Impact AQUA-8 for delta smelt in Alternative 1A, the potential impact of contaminants associated with restoration measures would be less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

NEPA Effects: The types of potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-9). However, under Alternative 5, there would be reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 55,000 acres for Alternative 1A). As concluded in Alternative 1A, Impact AQUA-9 under Alternative 1A, restored tidal habitat may be beneficial for delta smelt although the reduced acreage would reduce the benefit. Alternative 5 includes restored tidal habitat proportionally distributed across the five ROAs that may provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is approximately 60% less than the Alternative 1A acreage.

The restored tidal habitat may provide benefits to delta smelt occupying the Suisun Marsh ROA and Cache Slough ROA because of increased suitable habitat and because of improved food production, Increased food production from all ROAs that is exported into the Delta may also benefit delta smelt, especially in the low salinity zone. The overall improved habitat connectivity is intended to benefit all species including delta smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-9 for delta smelt, the potential impact of restored habitat conditions on delta smelt is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 5 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated in the affected environment under Alternative 5 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for delta smelt under Alternative 1A (Impacts AQUA-10 through AQUA-18) also appropriately characterize effects under Alternative 5.

The following impacts are those presented under Alternative 1A that are identical for Alternative 5.

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on delta smelt are the same as those described under Alternative 1A (Impacts AQUA-10 through AQUA-18). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Longfin Smelt

Construction and Maintenance of CM1

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: The potential effects of construction of the water conveyance facilities on longfin smelt would be similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-19, the impact of the construction of water conveyance facilities on longfin smelt would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-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 5 would be the same as those described for Alternative 1A (see Impact AQUA-20) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-20, the effect would not be adverse for delta 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 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

For larval longfin smelt entrainment risk was simulated using particle tracking modeling. Average entrainment under Alternative 5 with the wetter starting distribution was 1.1% compared to 1.6% for NAA, a 35% relative reduction (Table 11-5-4). Under the drier starting distribution, average entrainment loss was 1.4% under Alternative 1 compared to 2.2A% for NAA, a 38% decrease in relative terms. Overall, larval longfin smelt entrainment at the south Delta intakes would be reduced under Alternative 5 compared to baseline conditions (NAA).

Table 11-5-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 5 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Starting Distribution	EXISTING CONDITIONS	NAA	A5_LLT	A5_LLT vs. EXISTING CONDITIONS	A5_LLT vs. NAA
Wetter	1.9	1.6	1.1	-0.78 (-42%)	-0.60 (-35%)
Drier	2.5	2.2	1.4	-1.13 (-45%)	-0.86 (-38%)

Entrainment under Alternative 5 would be reduced compared to NAA, in above normal, below normal, and dry years, when it would be similar to the NAA. Entrainment for juvenile longfin smelt averaged across all water year types would be reduced slightly by 6% compared to NAA; adult longfin smelt entrainment would be reduced by 10% compared to NAA (Table 11-5-5). For Alternative 5 entrainment would be highest in dry and critical water year types for juvenile longfin smelt and in critical water year types for adult longfin smelt. In critical water year types, juvenile entrainment would be reduced by 18% and adult entrainment would be reduced by 15% compared to NAA. This reduction in entrainment is associated with reduced reverse OMR flows under Alternative 5 during December to May.

Table 11-5-5. Longfin Smelt Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 5

		Absolute Difference (Percent Difference)	
Life Stage	Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Juvenile (March–June)	Wet	2,571 (4%)	-2,871 (-4%)
	Above Normal	292 (6%)	3 (0%)
	Below Normal	301 (10%)	92 (3%)
	Dry	60,701 (11%)	2,394 (0%)
	Critical	-163,206 (-29%)	-89,335 (-18%)
	All Years	6,739 (3%)	-18,272 (-6%)
Adult (December–March)	Wet	-9 (-7%)	-12 (-9%)
	Above Normal	-6 (-1%)	-46 (-7%)
	Below Normal	-41 (-2%)	37 (2%)
	Dry	-178 (-15)	-112 (-10%)
	Critical	-5,427 (-22%)	-3,293 (-15%)
	All Years	-382 (-11%)	-346 (-10%)
	Shading indicates entrainment increased by 10% or more.		

[a] Estimated annual number of fish lost, based on normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed north Delta intake could increase entrainment potential and locally attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species is only expected to occur occasionally in very low numbers this far upstream on the Sacramento River.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Particle entrainment at the NBA, representing potential larval longfin smelt entrainment, was low for both starting distributions (wetter and drier), averaged 12-15% under Alternative 5, which was 0.04% more than NAA, or a 41-54% relative increase (Table 11-5-6; Table 11-5-7).

Table 11-5-6. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt Entrained by the North Bay Aqueduct under Alternative 5 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Distribution	EXISTING CONDITIONS	NAA	A5_LLT	A5_LLT vs. EXISTING CONDITIONS	A5_LLT vs. NAA
Wetter	0.20	0.08	0.12	-0.08 (-39.3%)	0.04 (53.7%)
Drier	0.25	0.11	0.15	-0.10 (-39.1%)	0.04 (41.3%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

Table 11-5-7. Average Difference (Number of Particle Tracking Runs) in Simulated Entrainment of Larval Longfin Smelt at the North Bay Aqueduct under Alternative 5 and Baseline Scenarios

Starting Distribution of Particles in Wetter or Drier conditions	Average Difference in Percent Particles Entrained (Number of Runs)	
	A5_LLT v. EXISTING CONDITIONS	A5_LLT v. NAA
Wetter Distribution		
Higher entrainment	0.1 (4)	0.1 (8)
Lower entrainment	-0.2 (8)	0.0 (4)
Drier Distribution		
Higher entrainment	0.2 (5)	0.2 (4)
Lower entrainment	-2.9 (5)	-1.7 (6)

Note: 60-day runs of PTM. Average Values represent the difference in the percentage of particles reaching this destination. Negative values indicate lower entrainment under the alternative compared to the baseline scenario.

Predation Associated with Entrainment

Pre-screen loss at the south Delta facilities, typically attributed to predation, would be negligibly changed under Alternative 5 commensurate with entrainment (similar to Impact AQUA-3). Predation loss at the proposed north Delta intake and the alternate NBA intake would be limited because only few longfin smelt would rarely occur that far upstream.

NEPA Effects: In conclusion, the effect on entrainment and entrainment-related predation loss under Alternative 5 would not be adverse, because of the slight reduction in entrainment and predation loss at the south Delta facilities. At the SWP/CVP south Delta facilities entrainment of juvenile longfin smelt would be slightly reduced compared to the NAA, while adult entrainment would be reduced, especially in critical water year types when longfin smelt distribution extends further into the Delta. Longfin smelt entrainment to the NBA would increase negligibly compared to the NAA. Entrainment loss of longfin smelt at the proposed north Delta intake would be rare since longfin smelt are not expected to occur in that area of the Sacramento River.

CEQA Conclusion: The results of the PTM model indicate slightly reduced larval entrainment at the south Delta facilities, agricultural diversions, and the NBA for all distributions (wetter and drier) compared to Existing Conditions. At the south Delta facilities, juvenile entrainment would be similar (<5% change) to Existing Conditions while adult entrainment would be reduced 11%. Entrainment to the north Delta intake would be low since longfin smelt would not occur in the vicinity of the intake. Predation loss at the south Delta facilities compared to Existing Conditions would be similar for juveniles, and reduced by 11% for adults. Predation loss at the proposed north Delta intake and the alternate NBA intake would be minimal because longfin smelt rarely occur in that vicinity. The impact for the risk of predation associated with the NPB structures would be the same as described for Alternative 1A.

The impact on longfin smelt would be less than significant and may provide a benefit to the species because of the reduced entrainment and predation loss for adults.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and Bay Midwater trawl data has been correlated to outflow (expressed as the location of X2) in the preceding winter and spring months, when spawning and rearing is occurring (January through June) (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer et al. (2009), reduced outflows in January through June under Alternative 5 (up to 10% lower than the NAA) has the potential to reduce longfin smelt abundance. However, other components of Alternative 5 have the potential to increase recruitment per unit of flow.

NEPA Effects: Modeling results based on Kimmerer et al. (2009) indicate that relative longfin smelt abundance averaged across all years would be 3% less (based on Fall Midwater Trawl indices) to 4% less (based on Bay Otter Trawl indices) under Alternative 5, compared to NAA (Table 11-5-8). When analyzing individual water year types, longfin smelt abundances are 10-11% lower in critical years, and 7-9% lower in above normal water years compared to NAA. This analysis does not take into account any potential changes in spawning or rearing conditions related to non-operational components of Alternative 5, including habitat restoration.

Table 11-5-8. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl[a]

	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All	-1,606 (-31%)	-129 (-3%)	-5,154 (-36%)	-398 (-4%)
Wet	-5,697 (-31%)	667 (6%)	-23,519 (-36%)	2,630 (7%)
Above Normal	-3,245 (-38%)	-413 (-7%)	-11,437 (-43%)	-1,391 (-9%)
Below Normal	-1,499 (-35%)	-201 (-7%)	-4,614 (-40%)	-594 (-8%)
Dry	-648 (-31%)	-155 (-10%)	-1,742 (-35%)	-405 (-11%)
Critical	-180 (-19%)	-45 (-6%)	-418 (-22%)	-103 (-7%)
	Shading indicates a decrease of 10% or greater in relative abundance.			

[a] Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

Longfin smelt may benefit from habitat restoration actions (CM2, *Yolo Bypass Fisheries Enhancement* and CM4, *Tidal Natural Communities Restoration*) intended to provide additional food production and export to longfin smelt rearing areas. This potential benefit is not reflected in the X2-longfin smelt abundance regression results presented above.

CEQA Conclusion: Average Delta outflows under Alternative 5 during January through April are similar to Existing Conditions, but reduced 18–19% in May and June.

Average longfin smelt relative abundance based on Kimmerer et al. (2009) is reduced 31–36% compared to Existing Conditions (Table 11-5-8), due to reduced spring Delta outflow.

Contrary to the NEPA conclusion set forth above, these results indicate that the difference between Existing Conditions and Alternative 5 could be significant because the alternative could substantially reduce relative abundance based on Kimmerer 2009. However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed above (Section 11.3.3), because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA) models anticipated future conditions that would occur in 2060 (LLT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the NEPA analysis, which compares results between the alternative and NAA, is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA and informed by the NEPA analysis above, the average longfin smelt abundance, based on Kimmerer et al. (2009), decreased 3-4% under Alternative 5 (Table 11-5-8). These results represent the increment of change attributable to the alternative, and address the limitations of the comparison the CEQA baseline (Existing Conditions).

In general, under Alternative 5 water operations, the quantity and quality of rearing habitat for longfin smelt would be reduced relative to Existing Conditions. As described for Alternative 1A, the differences between the anticipated future conditions under this alternative and Existing Conditions are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, these differences may either overstate the effects of Alternative 5 or indicate significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 5.

Habitat restoration conservation measures (CM4) may also improve the quality of spawning and rearing habitat for longfin smelt by increasing suitable habitat area and food production in the Delta. However, given the uncertainty of the outcome related to habitat restoration, the uncertainty regarding the actual mechanism for the outflow-abundance relationship included in Kimmerer et al. (2009), and the modeled change in winter-spring outflow, the impact may be significant, and mitigation would be required. With implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced larval entrainment would reduce this impact to less than significant, so no additional mitigation would be required.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Spawning and Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt

Discussion provided above, under Impact AQUA-22.

Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt

Discussion provided above, under Impact AQUA-22.

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

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-25 in Alternative 1A). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-25 in Alternative 1A, restoration construction activities are not expected to adversely affect longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-25 in Alternative 1A for longfin smelt, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-26). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides, and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-26, contaminants associated with restoration measures are not expected to adversely affect longfin smelt with respect to selenium, copper, ammonia and pesticides. The effects of mercury on longfin smelt are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-26 for longfin smelt, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-27). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally

Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Alternative 1A, Impact AQUA-27 under Alternative 1A, restored tidal habitat is expected to be beneficial for longfin smelt although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to longfin smelt primarily through the export of improved food production from the five ROAs into the deeper channels of the Delta system. The overall improved habitat connectivity will benefit all species including longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-27 for longfin smelt, the potential impact of restored habitat conditions on longfin smelt is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on longfin smelt are the same as those described under Alternative 1A (Impacts AQUA-28 through AQUA-36). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Winter-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The types of potential effects of construction of the water conveyance facilities on winter-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-37) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the construction effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for winter-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The types of potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-38) except that only one intake would need to be maintained for Alternative 5, rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 5 would reduce entrainment and associated pre-screen predation losses at the SWP/CVP south Delta facilities compared to NAA by about 9% averaged across all water year types compared to NAA (Table 11-5-9). As discussed for Alternative 1A (Impact AQUA-39), entrainment would be highest in wet years and would decrease with reduced flows. The greatest relative reductions under Alternative 5 would occur in wet and above normal years decrease 11-12% compared to NAA (Table 11-5-9).

Table 11-5-9. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-1,008 (-9%)	-1,428 (-12%)
Above Normal	-633 (-10%)	-757 (-11%)
Below Normal	-818 (-11%)	-394 (-6%)
Dry	-359 (-9%)	-52 (-1%)
Critical	-163 (-13%)	-24 (-2%)
All Years	-661 (-10%)	-602 (-9%)

[a] Estimated annual number of fish lost, based on normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A (with five intakes), but the degree of the effect would be less because Alternative 5 has only one intake. The state-of-the-art, positive barrier screen would be designed and built to specifications developed to reduce the risk of entrainment and impingement, and are expected to be effective at excluding all life stages of winter-run Chinook salmon that would occur in the vicinity. Combined with an adaptive management program, this effect is expected to be minimal.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce overall entrainment losses of juvenile winter-run Chinook salmon relative to NAA. This effect would not be adverse and may provide a benefit to the species because of the reductions in entrainment loss and mortality.

CEQA Conclusion: As described above, entrainment losses of juvenile winter-run Chinook salmon at the south Delta facilities would decrease under Alternative 5 compared to Existing Conditions (Table 11-5-9). Overall, impacts of water operations on entrainment of juvenile Chinook salmon (winter-run ESU) would be less than significant and may be beneficial. 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 5 would not affect 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 A5_LLT would generally be similar to or greater than flows under NAA, except in dry years during August (14% to 15% lower) and below normal water years during September (14% to 15% lower).

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. Storage under A5_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-5-10).

Table 11-5-10. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-11 (-0.2%)	23 (1%)
Above Normal	-53 (-1%)	33 (1%)
Below Normal	-91 (-2%)	107 (3%)
Dry	-220 (-6%)	224 (7%)
Critical	-241 (-10%)	343 (18%)

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be lower than mortality under NAA in all water years except below normal (53% higher) (Table 11-5-11). However, the change in below normal years would be 1%, indicating that this effect would be negligible to the winter-run population.

Table 11-5-11. 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. A5_LLT	NAA vs. A5_LLT
Wet	1 (253%)	-0.1 (-7%)
Above Normal	1 (317%)	-0.2 (-8%)
Below Normal	2 (186%)	1 (53%)
Dry	5 (343%)	-1 (-8%)
Critical	39 (146%)	-5 (-7%)
All	8 (167%)	-1 (-6%)

SacEFT predicts that there would be a 9% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to NAA, which would be negligible at an absolute scale (3% difference) (Table 11-5-12). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A5_LLT would be similar to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A5_LLT would be similar to (<5% difference) that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A5_LLT would be similar to the percentages under NAA. These results indicate that there would be negligible positive effects of Alternative 5 on spawning and egg incubation habitat.

Table 11-5-12. 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. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-29 (-50%)	-3 (-9%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-22 (-23%)	1 (1%)
Redd Dewatering Risk	5 (20%)	1 (3%)
Juvenile Rearing WUA	-24 (-48%)	1 (4%)
Juvenile Stranding Risk	5 (25%)	-6 (-19%)

WUA = Weighted Usable Area.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-40 which indicates that there would generally be no effects on water temperature in the Sacramento River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. All flow and temperature effects under Alternative 5 are negligible or small relative to NAA such that they would not affect winter-run Chinook salmon at a biologically meaningful level.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon would not be affected relative to the CEQA baseline.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in wet and below normal water years during May (18% to 23% and 6% to 7% lower, depending on location), critical years during July (10% to 11% lower), dry and critical years during August (11% to 12% and 23% to 26% lower, respectively), and below normal and dry years during September (12% to 13% and 24% to 27% lower, respectively).

Shasta Reservoir storage volume at the end of May under A5_LLT would be similar to Existing Conditions in all water years, except dry (6% lower) and critical water years (10% lower) (Table 11-5-10). This indicates that there would be a small to negligible effect of Alternative 5 on flows during the spawning and egg incubation period relative to Existing Conditions.

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be 146% to 343% greater than mortality under Existing Conditions depending on water year type (Table 11-5-11). These increases would only affect the winter-run population during dry and critical years, in which the absolute percent increase of the winter-run population would be 5 and 39%, respectively. These results indicate that Alternative 5 would cause increased winter-run Chinook salmon mortality in the Sacramento River during drier water years.

SacEFT predicts that there would be a 50% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-12). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A5_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of years with good egg incubation conditions under A5_LLT would be 23% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A5_LLT would 20% greater than the percentage of years under Existing Conditions. These results indicate that Alternative 5 would cause moderate reductions in spawning WUA and egg incubation conditions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-40, which indicates there would be increased exceedances of NMFS temperature thresholds in the Sacramento River relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. The extent of spawning habitat would be 50% lower due to Alternative 5 compared to Existing Conditions (Table 11-5-12), which represents a substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying capacity. Further, egg mortality in drier years, during which winter-run Chinook salmon would already be stressed due to reduced flows and increased temperatures. This effect was also found by SacEFT in that egg incubation habitat would be reduced under Alternative 5 (Table 11-5-12). There were also higher exceedances under Alternative 5 above NMFS temperature thresholds.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the

months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 5 would not affect the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to NAA.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under NAA during August through October and December.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A5_LLT would be similar (<5% difference) to percentage under NAA (Table 11-5-12). The percentage of years with good (low) juvenile stranding risk under A5_LLT is predicted to be 19% lower than that under NAA, although this would be 6% difference on an absolute scale.

SALMOD predicts that mean winter-run smolt equivalent habitat-related mortality under A5_LLT would be have a negligible (<5%) difference in habitat-related mortality between A5_LLT and NAA.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-41, which indicates that there would be no effect on mean monthly temperatures during the winter-run juvenile rearing period relative to Existing Conditions.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. The effects of Alternative 5 on flows and temperatures would not affect winter-run Chinook salmon fry and juvenile rearing habitat in a biologically meaningful way. Although there is a small reduction in stranding risk predicted by SacEFT, combined with all other results indicating that Alternative 5 would have no effect on winter-run Chinook salmon rearing, it is concluded that the effect would not be adverse.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of fry and juvenile rearing habitat for winter-run Chinook salmon would not be affected relative to the CEQA baseline.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during August through October and December, although flows would generally be up to 10% lower during November.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A5_LLT would be 48% lower than under Existing Conditions (Table 11-5-12). In addition, the percentage of years with good (low) juvenile stranding risk under A5_LLT is predicted to be 25% greater than under Existing Conditions, although this difference is 5% on an absolute scale. These results indicate that the quantity of juvenile rearing habitat in the Sacramento River would be substantially lower under A5_LLT relative to Existing Conditions although risk of stranding would be marginally higher.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A5_LLT would be 17% higher than under Existing Conditions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-41, which indicates that there would be small temperature increases under Alternative 1A relative to Existing Conditions during some months in the Sacramento River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. The 48% reduction in rearing habitat availability under Alternative 5 would reduce upstream habitat conditions for winter-run fry and juveniles. SALOD also predicts increased habitat-related mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

In general, the effects of Alternative 5 on winter-run Chinook salmon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined for the July through November juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run Chinook salmon to migrate effectively down the Sacramento River. Flows under A5_LLT would up to 17% lower than under NAA during November depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). However, except for very few water year types each month, flows under A5_LLT would be similar to or greater than flows under NAA during the rest of the juvenile winter-run Chinook salmon migration period (July through October).

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August). A reduction in flows may reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the upper Sacramento River. Flows under A5_LLT would generally be similar to or greater than those under NAA except in dry water years during January (5% lower) and August (14% lower).

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-42 which indicates there would be no differences in water temperatures between NAA and Alternative 1A.

Through-Delta

Juveniles

During the juvenile winter-run Chinook salmon emigration period (November to early May), mean monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged across years would be lower (up to 17% lower) compared to NAA. Flows would be up to 23% lower in November of above normal years.

The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The single new intake would remove or modify habitat along that portion of the migration corridor (3.8 acres aquatic habitat and 2,050 linear feet of shoreline). Bioenergetics modeling of a single intake with a median predator density predicts a predation loss of about 0.3% of the juvenile winter-run juvenile population (Table 11-5-13). A conservative assumption of 5% loss per intake would result in a loss of 4% of juvenile winter-run Chinook that reach the north Delta.

Table 11-5-13. Chinook Salmon Predation Loss at the Proposed North Delta Diversion Intake (One Intake)

Striped Bass Numbers		Estimated Number of Juvenile Salmon Consumed				Percentage of Annual Juvenile Production (%) Consumed			
Per 1,000 Feet of Intake	Total	Winter	Spring	Fall	Late Fall	Winter	Spring	Fall	Late Fall
18 (Low)	20	1,005	1,407	21,571	4,082	0.04	0.03	0.04	0.09
119 (Median)	131	6,647	9,301	142,610	26,983	0.26	0.22	0.23	0.63
219 (High)	241	12,233	17,117	262,451	49,658	0.47	0.41	0.43	1.15

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was modeled by the DPM. Average survival under Alternative 5 would be 34% across all years, 27% in drier years, and 45% in wetter years, which is similar to survival under baseline conditions (Table 11-5-14).

Table 11-5-14. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 5

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Types	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wetter Years	46.3	46.1	45.3	-1.0 (-2%)	-0.8 (-2%)
Drier Years	28.0	27.1	26.7	-1.3 (-5%)	-0.4 (-2%)
All Years	34.9	34.2	33.7	-1.2 (-3%)	-0.6 (-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).

Adults

The importance of attraction flows and olfactory cues to adult Chinook salmon migrating upstream through the Delta is described in detail in Impact AQUA-42 for Alternative 1A. During the adult winter-run Chinook salmon migration period in the Delta (December to February), olfactory cues, based on the proportion of Sacramento River flows, would be similar (<7% difference) compared to NAA (Table 11-5-15).

Table 11-5-15. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 5

Month	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Sacramento River					
September	60	65	67	7	2
October	60	68	66	6	-2
November	60	66	65	5	-1
December	67	66	72	5	6
January	76	75	70	-6	-5
February	75	72	71	-4	-1
March	78	76	70	-8	-6
April	77	75	62	-15	-13
May	69	65	59	-10	-6
San Joaquin River					
September	0.3	0.1	0.5	0.2	0.4
October	0.2	0.3	1.3	1.1	1.0
November	0.4	1.0	2.4	2.0	1.4
December	0.9	1.0	1.9	1.0	0.9
January	1.6	1.7	2.0	0.4	0.3
February	1.4	1.5	1.7	0.3	0.2
March	2.6	2.8	3.0	0.4	0.2
April	6.3	6.6	6.8	0.5	0.2

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.*

NEPA Effects:. Overall, the effect of Alternative 5 is uncertain due to absence of information regarding the near-field effects of a new intake structure in the north Delta on migrating juvenile winter-run Chinook salmon.

Upstream flows and water temperatures would generally be similar between Alternative 5 and NAA during the juvenile and adult migration periods. Although some small to moderate reductions in upstream flows would occur in November (up to 17% lower), there are generally no effects of Alternative 5 on flows or temperatures in the Sacramento River.

Adult attraction flows in the Delta under Alternative 5 would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 5 NDD on winter-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 1 new intake would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to larger effects (~

4% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the 1 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 5 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 5 on winter-run Chinook salmon migration remains uncertain.

CEQA Conclusion: In general, Alternative 5 would not affect migration conditions for winter-run Chinook salmon relative to Existing Conditions.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined during the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT for juvenile migrants would generally be greater than or similar to flows under Existing Conditions during all months except November, in which flows would be up to 10% lower depending on water year type.

Flows in the Sacramento River upstream of Red Bluff were examined during the December through August adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions with few exceptions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-42, which indicates that there would be small increase in water temperatures under Alternative 5 relative to Existing Conditions during large portions of the juvenile and adult migration periods.

Through-Delta

During the juvenile winter-run Chinook salmon emigration period (November to early May), mean monthly flows in the Sacramento River below the north Delta intake would be reduced (6% to 20% lower) under Alternative 5 compared to Existing Conditions. Potential predation losses across the single intake structure would be less than 5%. Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon would be about 1% lower (2% to 5% relative decrease) than under Existing Conditions (Table 11-5-14).

Adults

As described above, during the adult winter-run Chinook salmon migration period in the Delta (December to February), olfactory cues, based on the proportion of Sacramento River flows, would be similar (<7% difference) compared to Existing Conditions (Table 11-5-15).

Summary of CEQA Conclusion

Collectively, the impact would be less than significant and no mitigation would be necessary. Upstream flows and water temperatures, during the juvenile and adult migration periods, would generally be similar between Alternative 5 and Existing Conditions. There would be no upstream flow-related effects on winter-run Chinook salmon juvenile and adult migration. Water temperatures would increase slightly during the migration periods, but these small increases are not expected to substantially affect migratory abilities of either life stage. Due to the similarity in through-Delta migration flows between Alternative 5 and the baselines, migration habitat conditions and movement are not substantially reduced.

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

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The types of potential effects of restoration construction activities under Alternative 5 would be similar to Alternative 1A, but of a lesser magnitude because of the reduced acreage of tidal habitat that would be restored (25,000 acres under Alternative 5 rather than 55,000 acres under Alternative 1A) (see Impact AQUA-43 in Alternative 1A). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-43, restoration construction activities are not expected to adversely affect Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-43 for winter-run Chinook salmon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-44). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides, and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 55,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-44, contaminants associated with restoration measures are not expected to adversely affect Chinook salmon with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on Chinook salmon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-44 for Chinook salmon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-45). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 55,000 acres). As concluded in Impact AQUA-45 under Alternative 1A, restored tidal habitat is expected to be beneficial for Chinook salmon although the reduced acreage would reduce the benefit. The restored tidal habitat under Alternative 5 would be proportionally distributed across the five ROAs and would provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is approximately 60% less than the Alternative 1A acreage.

The restored tidal habitat may provide benefits to juvenile Chinook salmon occupying all ROAs (except the Cosumnes/Mokelumne) because of increased acreage providing additional habitat and because of improved food production. Increased food production from all ROAs that is exported into the Delta may also benefit Chinook salmon. The overall improved habitat connectivity Is likely to benefit all species including Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-45 for Chinook salmon, the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures] (CM12–CM19 and CM21)

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on winter-run Chinook salmon are the same as those described under Alternative 1A (Impacts AQUA-46 through AQUA-54). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Spring-Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 5 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.

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of construction of the water conveyance facilities on spring-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for spring-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-55, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than under Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-56) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-56, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-56, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Overall entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities, averaged across all water year types, would be similar under Alternative 5 compared to NAA (Table 11-5-16). As discussed for Alternative 1A (Impact AQUA-57), entrainment is highest in wet years and lowest in below normal water years. Under Alternative 5, entrainment would be reduced or similar (<10% difference) to NAA in in all water year types, except for a 12% increase in dry years (Table 11-5-16). Pre-screen losses, typically attributed to predation, would be expected to change commensurate with entrainment at the south Delta facilities. The proportion of the annual production lost to entrainment was similar for both Alternative 5 and NAA, averaging about 5% across all years

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intake would be greater than baseline, but the effects would be minimal because it would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce the total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be a beneficial impact. This effect would not be adverse and would provide a benefit to the species because of the reductions in entrainment loss and mortality.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta facilities would slightly increase (~3%) across all water years under Alternative 5 compared to Existing Conditions (Table 11-5-16; Existing Conditions). The greatest increase is expected to occur during dry water years (~20%) with the greatest decrease occurring during critical water years (~13%). Overall, impacts on juvenile spring-run Chinook salmon would be less than significant and no mitigation would be required.

Table 11-5-16. Juvenile Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-3,140 (-4%)	-6,768 (-7%)
Above Normal	2,123 (8%)	-945 (-3%)
Below Normal	859 (13%)	65 (1%)
Dry	3,324 (20%)	2,130 (12%)
Critical	-1,545 (-13%)	76 (1%)
All Years	1,162 (3%)	-448 (-1%)

Shading indicates 10% or greater increased annual entrainment.

[a] Estimated annual number of fish lost, based on normalized data.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, the effects of Alternative 5 on spawning and egg incubation habitat conditions for spring-run Chinook salmon relative to NAA are uncertain.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would generally be no effects of Alternative 5 on water temperatures during the spring-run spawning and egg incubation period in the Sacramento River relative to NAA.

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A5_LLT would generally be similar to or greater than flows under NAA during all months except November, in which flows would be up to 14% lower than under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir storage volume at the end of September influences flows downstream of the dam during the spring-run spawning and egg incubation period (September through January). Storage under A5_LLT would be similar to (<5% difference) storage under NAA in all water year types (Table 11-5-17).

Table 11-5-17. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-623 (-19%)	-111 (-4%)
Above Normal	-661 (-21%)	-46 (-2%)
Below Normal	-450 (-16%)	-96 (-4%)
Dry	-493 (-20%)	18 (1%)
Critical	-374 (-32%)	8 (1%)

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be lower than or similar to mortality under NAA in above normal, dry, and critical years, but greater in wet (14% greater) and below normal (32% greater) water years. Absolute scale increases of 3% of the spring-run population in wet water years would be negligible to the overall population (Table 11-5-18). However, the 13% increase in mortality in below normal years is considered a small effect on the spring-run population. Combining all water years, there would be no effect of Alternative 5 on egg mortality (3% absolute change).

Table 11-5-18. 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. A5_LLT	NAA vs. A5_LLT
Wet	18 (180%)	3 (14%)
Above Normal	23 (171%)	1 (2%)
Below Normal	43 (359%)	13 (32%)
Dry	56 (284%)	-1 (-1%)
Critical	22 (30%)	0 (0%)
All	32 (143%)	3 (7%)

SacEFT predicts that there would be no difference in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-19). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A5_LLT relative to NAA. SacEFT predicts that there would be a 41% decrease (14% on an absolute scale) in the percentage of years with good (lower) egg incubation conditions under A5_LLT relative to NAA. SacEFT predicts that there would be an 18% decrease (6% on an absolute scale) in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to NAA. These results indicate that there would be a small to moderate reduction in egg incubation conditions and redd dewatering risk under Alternative 5 relative to NAA.

Table 11-5-19. 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. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-66 (-77%)	-14 (-41%)
Redd Dewatering Risk	-21 (-43%)	-6 (-18%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-2 (-11%)	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 (14% absolute scale decrease) and the Reclamation egg mortality model predicts that overall egg mortality would be unaffected by Alternative 5, except in below normal water years. The SacEFT uses mid-August through early March as the egg incubation period, based on Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations. The Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August) that it takes to accumulate 750 temperature units to hatching and another 750 temperature units to emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and are computed on a daily basis. As a result, egg incubation duration is generally mid-August through January, but is dependent on river temperature. The Reclamation model uses the reach between ACID Dam and Jelly's Ferry (approximately 5 river miles downstream of Battle Creek), which includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data (Reclamation 2008). These differences in egg incubation period and location likely account for the difference between model results. Although the SacEFT model has been peer-reviewed, the Reclamation egg mortality model has been extensively reviewed and used in prior biological assessments and BiOps. Therefore, both results are considered valid and were considered in drawing conclusions about spring-run egg mortality in the Sacramento River.

Clear Creek

Flows in Clear Creek were examined during the spring-run Chinook salmon spawning and egg incubation period (September through January). Flows under A5_LLT would be similar to or greater than flows under NAA in all months and water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A5_LLT would be the same or of a lower magnitude as that under NAA in all water year types (Table 11-5-20).

Water temperatures were not modeled in Clear Creek.

Table 11-5-20. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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.

[a] 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.

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) where spring-run primarily spawn during September through January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_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.

Oroville Reservoir storage volume at the end of September influence flows downstream of the dam during the spring-run spawning and egg incubation period. Storage under A5_LLT would be similar to or greater than storage under NAA depending on water year type (Table 11-5-21). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 5.

Table 11-5-21. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-885 (-31%)	129 (7%)
Above Normal	-630 (-27%)	161 (10%)
Below Normal	-549 (-27%)	60 (4%)
Dry	-178 (-13%)	175 (17%)
Critical	-76 (-8%)	112 (14%)

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month over the egg incubation period compared to the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel during October through January were identical among A5_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on redd dewatering in the Feather River low-flow channel.

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be no effect of Alternative 1A on water temperatures in the Feather River relative to NAA during the spring-run spawning and egg incubation period.

NEPA Effects: Available analytical tools show conflicting results regarding the temperature effects of relatively small changes in predicted summer and fall flows in the Sacramento River. Several models (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in upstream conditions as a result of Alternative 5. However, one model, SacEFT, shows adverse effects under some conditions. After extensive investigation of these results, they appear to be a function of high model sensitivity to relatively small changes in estimated upstream conditions, which may or may not accurately predict adverse effects. The new NDD structures allow for spring time deliveries of water south of the Delta that are currently constrained under the NAA. For this reason, additional spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion, Alternative 5 modeling results support a finding that effects are uncertain. Modeled results are mixed and operations that match the CALSIM modeling are not assured. Model results will be submitted to independent peer review to confirm that adverse effects are not reasonably anticipated to occur.

There would be no effects of Alternative 5 on spawning and egg incubation habitat for spring-run Chinook salmon in the Feather River or in Clear Creek relative to the NAA.

CEQA Conclusion: In general, Alternative 5 would not affect spawning and egg incubation habitat conditions for spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the exceedances of NMFS temperature thresholds under Alternative 5 relative to Existing Conditions.

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during all months of the period except November with few exceptions (up to 24% lower, depending on month and water year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower (up to 10%, depending on water year type) than those under Existing Conditions during November.

Shasta Reservoir Storage volume at the end of September would be 16% to 32% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be 30% to 359% greater than mortality under Existing Conditions depending on water year type (22% to 56% increase on an absolute scale) (Table 11-5-18).

SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table

11-5-19). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 77% decrease in the percentage of years with good (lower) egg incubation conditions under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 43% decrease in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A5_LLT would generally be similar to or greater than flows under Existing Conditions except in critical years during September and October (28% and 7% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 (Table 11-5-20). The greatest reduction in flows under A5_LLT would be 50% lower (more negative) than Existing Conditions in critical years and be 27% and 67% lower (could not calculate relative change because dividing by 0) in above normal and dry years, respectively.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the exceedances of NMFS temperature thresholds under Alternative 5 relative to Existing Conditions.

Flows in the Feather River low-flow channel under A5_LLT are not different from Existing Conditions during the spring-run spawning and egg incubation period (September through January) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

Oroville Reservoir storage volume at the end of September would be 8% to 31% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-21).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during October through January were identical between A5_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on redd dewatering in the Feather River low-flow channel.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. The quality and quantity of spawning and incubation habitat for spring-run Chinook salmon in the Sacramento River would be lower under Alternative 5 relative to Existing Conditions (Table 11-5-19), which would reduce the ability of spring-run Chinook salmon to spawn successfully. SacEFT and the Reclamation egg mortality both predict lower spawning and egg incubation conditions under Alternative 5 in the Sacramento River. Water temperatures would be higher in both the Sacramento and Feather Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 5 would not affect the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to NAA.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-59, which indicates that 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.

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would mostly be similar to or greater than flows under NAA, although flows would be up to 9% lower in some months and water year types. During November, flows under A5_LLT would be 6% to 21% lower than flows under NAA depending on location and water year type.

As reported in Impact AQUA-40, May Shasta storage volume under A5_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-5-10).

As reported in Impact AQUA-58, September Shasta storage volume would be similar to (<5% difference) storage under NAA in all water year types (Table 11-5-17).

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A5_LLT would be greater than that under NAA (Table 11-5-19). The percentage of years with good (lower) juvenile stranding risk conditions under A5_LLT would be 21% greater than under NAA.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A5_LLT would be 7% lower than NAA.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A5_LLT would generally be similar to or greater than flows under NAA except for below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A Impact AQUA-59, which indicates that mean monthly water temperatures would generally be similar between NAA and Alternative 1A during the period.

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT would not differ from those under NAA. Flows under A5_LLT would be mostly similar to or greater than flows under NAA during the entire period with some exceptions (up to 12% lower depending on month and water year type).

May Oroville storage under A5_LLT would be similar to storage under NAA in wet and above normal water years (Table 11-5-22). Storage under A5_LLT would be similar to storage under NAA in all water year types.

As reported in Impact AQUA-58, September Oroville storage volume under A5_LLT would be similar to or greater than storage under NAA depending on water year type (Table 11-5-21). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 5.

Table 11-5-22. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-45 (-1%)	1 (0.03%)
Above Normal	-140 (-4%)	16 (0.5%)
Below Normal	-282 (-9%)	71 (2%)
Dry	-504 (-18%)	16 (1%)
Critical	-332 (-18%)	-16 (-1%)

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because habitat would not be substantially reduced. There would be no substantial effects of Alternative 5 on flows in the Sacramento, Feather Rivers or in Clear Creek and no substantial effects on water temperatures in the Sacramento and Feather Rivers that would affect spring-run Chinook salmon rearing habitat.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon would not be affected relative to the CEQA baseline.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A Impact AQUA-59, which indicates that there would be no differences in mean monthly water temperature between Existing Conditions and Alternative 1A.

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be generally similar to or greater than those under Existing Conditions with some exceptions for all months (up to 27% lower), except during February (Keswick only) and November (up to 14% lower).

As reported in Impact AQUA-59, Shasta Reservoir storage volume at the end of May under A5_LLT would be similar to Existing Conditions except in dry and critical water years (6% and 10% lower, respectively)(Table 11-5-10). As reported in Impact AQUA-58, storage volume at the end of September under A5_LLT would be 16% to 32% lower relative to Existing Conditions depending on water year type (Table 11-5-17).

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A5_LLT would be 14% greater than that under Existing Conditions (Table 11-5-19). The percentage of years with good (lower) juvenile stranding risk conditions under A5_LLT would be 11% lower than under Existing Conditions. On an absolute scale, neither of these results (3% for rearing WUA and 2% for stranding risk) would be biologically meaningful.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A5_LLT would be 37% lower than under Existing Conditions.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A5_LLT would generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A5_LLT would be mostly lower (up to 45%) during November and January and similar to or greater than flows under Existing Conditions during the rest of the year with some exceptions, during which flows would be up to 59% lower under A5_LLT.

May Oroville storage volume under A5_LLT would be similar to storage under Existing Conditions in wet and above normal water years (Table 11-5-22). Storage volume under A5_LLT would be 9% to 18% lower than storage under Existing Conditions in below normal, dry, and critical water years.

As reported in Impact AQUA-58 under Alternative 1A, September Oroville storage volume would be 8% to 31% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-21).

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the exceedances of NMFS temperature thresholds Alternative 5 relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. Rearing habitat conditions in the Sacramento River would be somewhat reduced by Alternative 5 in some months. Although SacEFT predicts no effects on rearing habitat, SALMOD predicts that habitat-related mortality would be substantially lower under Alternative 5 relative to the Existing Conditions. There would be substantial increases in the exceedances of NMFS temperature thresholds Alternative 5 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in

the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

In general, the effects of Alternative 5 on spring-run Chinook salmon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A Impact AQUA-60, which indicates that there would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during December through May would nearly always be similar to or greater than flows under NAA, except in dry years during January (5% lower).

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or greater than flows under NAA during all months except August in dry years (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A5_LLT would generally be similar to or greater than flows under NAA except in critical years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A5_LLT would be similar to or greater than flows under NAA in all months and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A Impact AQUA-60, which indicates that there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

Flows in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be mostly similar to or greater than under NAA except in above normal years during November and December (6% lower for both).

Flows in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during April through July would generally be similar to or greater than flows under NAA except in dry and critical water year types during July (19% and 34% lower, respectively). Flows during August under A5_LLT would generally be lower than flows under NAA (up to 31% lower).

Through-Delta

Juveniles

During the juvenile spring-run Chinook salmon emigration period (November to May), mean monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged across years would be 6% to 11% lower in most months, and 17% lower in November compared to NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

As described above in Impact AQUA-39, the north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. Estimates of potential predation losses at the single intake range from about 0.2% (bioenergetics model, Table 11-5-13) to 4.2% (based on a fixed 5% loss per intake) of the juvenile spring-run population that reaches the Delta (Appendix 5F, *Biological Stressors*).

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was modeled by the DPM. Average survival under Alternative 5 would be 30% across all years, 24% in drier years, and 39% in wetter years, which is similar to modeled survival under baseline conditions (Table 11-5-23).

Table 11-5-23. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Baseline and Alternative 5 Scenarios, by Year Type

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Types	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wetter Years	42.1	40.4	38.8	-3.4 (-8%)	-1.7 (-4%)
Drier Years	24.8	24.3	24.3	-0.5 (-2%)	0.0 (0%)
All Years	31.3	30.3	29.7	-1.6 (-5%)	-0.6 (-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).

Adults

The importance of attraction flows and olfactory cues to adult Chinook salmon migrating upstream is described in detail in Impact AQUA-42 for Alternative 1A. Olfactory cues, based on the proportion of Sacramento River flows during the spring-run adult migration, the proportion of Sacramento River flows at Collinsville would be 59% to 70% during March to May (the peak of the migration is March and April), 6% to 13% lower than NAA (Table 11-5-9). As suggested by adult sockeye salmon, attraction due to olfactory cues could be adversely affected by dilution greater than 20%, but was not been discernibly affected by dilution of 10% or less (Fretwell 1989).

NEPA Effects: Upstream of the Delta, the results indicate that the effects of water operations on migration conditions under Alternative 5 would not be adverse because it would not have the potential to substantially interfere with the movement of fish. Flows under A5_LLT would generally be similar to or greater than flows under NAA, with exceptions during some months and water year types. However, this frequency of reduced flows would not be enough to cause population level effects. There would be no effects on water temperatures in the Sacramento and Feather Rivers.

Near-field effects of Alternative 5 NDD on spring-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 1 new intake would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to larger effects (~ 4% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the 1 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for spring-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 5 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 5 on spring-run Chinook salmon migration remains uncertain.

CEQA Conclusion: In general, Alternative 5 would not affect migration conditions for spring-run Chinook salmon relative to Existing Conditions.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean monthly water temperature between NAA and Alternative 1A.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in wet and below normal water years during December (9% and 6% lower, respectively) and May (18% and 6% lower, respectively) and below normal years during March (10% lower).

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than Existing Conditions with occasional exceptions (up to 23% lower).

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A5_LLT would always be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A5_LLT would almost always be similar to or greater than flows under

Existing Conditions except during August in critical water years (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A Impact AQUA-60, which indicates flows under Alternative 1A would be 5% greater than those under Existing Conditions in November and December, but similar during January through May.

Flows were examined for the Feather River at the confluence with the Sacramento River during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November under A5_LLT would generally be lower than flows under Existing Conditions by up to 21%. Flows under A5_LLT during December through May would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 28% lower).

Flows were examined for the Feather River at the confluence with the Sacramento River during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during the entire period under A5_LLT would generally be similar to or greater than flows under Existing Conditions with some exceptions (up to 51% lower), especially in critical water years.

Through-Delta

During the juvenile spring-run Chinook salmon emigration period (November to May), mean monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged across years would be 6% to 11% lower in most months, and 20% lower in November compared to Existing Conditions. Flows would be up to 23% lower in November of above normal years and 31% lower in May of wet years compared to Existing Conditions.

As described above, estimates of potential predation losses at the single intake range from about 0.2% to 4.2% of the juvenile spring-run population that reaches the Delta.

Through-Delta survival to Chipps Island by emigrating juvenile spring-run Chinook salmon under Alternative 5 would be slightly decreased under Existing Conditions, up to 3.4% lower (8% relative decrease) in wetter years (Table 11-5-23).

Attraction flows and olfactory cues for adults migrating through the Delta, as indicated by the proportion of Sacramento River flow at Collinsville during March to May, would be 8% to 15% lower than under Existing Conditions, but would still make up 59% to 70% of overall flows.

Summary of CEQA Conclusion

Collectively, the results indicate that the effect would be less than significant because the alternative would not substantially reduce suitable migration habitat or interfere with the movement of fish. No mitigation would be necessary. Flows would generally be similar between Existing Conditions and Alternative 5 in the Sacramento and Feather Rivers and in Clear Creek. Additionally, water temperatures would generally not differ between Existing Conditions and Alternative 5 in the

Sacramento and Feather Rivers. In addition, through-Delta survival of juvenile Chinook salmon and olfactory cues under Alternative 5 would be similar to those under NAA.

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

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

The effects on construction of restoration measures on spring-run Chinook would be identical to those on winter-run Chinook; please refer to the discussion of Alternative 5, Impact AQUA-43 above.

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

The effects of contaminants associated with restoration measures would be the same for all four ESUs. Accordingly, please refer to the discussion of Alternative 5, Impact AQUA-44 for winter-run Chinook salmon.

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

The effects of restored habitat conditions on spring-run Chinook would be the same as for described for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact AQUA-45 above. The only difference is that spring run Chinook also occur in the Cosumnes/Mokelumne ROA and would receive the benefits of increased habitat acreage and food production in this location.

CEQA Conclusion: As described in Alternative 5, Impact AQUA-45 for winter-run Chinook salmon, the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on spring-run Chinook salmon are the same as those described under Alternative 1A (Impacts AQUA-64 through AQUA-72). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 5 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.

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: The potential effects of construction of the water conveyance facilities on fall-run/late-fall run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-73) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for fall-run/late-fall run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-38) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

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

Fall-Run

Alternative 5 would reduce overall entrainment of juvenile fall-run Chinook salmon at the south Delta export facilities compared to NAA. Under Alternative 5, juvenile fall-run Chinook salmon entrainment, estimated as salvage density, would be reduced by 30% (Table 11-5-24) across all water year types compared to NAA. The greatest reduction in juvenile fall-run Chinook salmon entrainment under Alternative 5 would occur in wet years (76% decrease). Entrainment would increase 6% in dry years compared to NAA. Overall, Alternative 5 would provide a beneficial effect on juvenile fall-run Chinook salmon due to the reduction in entrainment and associated pre-screen predation loss at the south Delta export facilities compared to NAA (Table 11-5-24).

Late Fall–Run

Average entrainment of juvenile late fall–run Chinook salmon at the south Delta export facilities under Alternative 5 would be reduced by 6% compared to NAA (Table 11-5-24). The greatest relative reduction would occur in above normal (10% decrease) and critical years (14% decrease).

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the single north Delta intake under Alternative 5 would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce overall entrainment of juvenile Chinook salmon relative to NAA. This effect would be beneficial.

CEQA Conclusion: Entrainment losses of juvenile fall-run and late fall–run Chinook salmon at the south Delta export facilities would generally be reduced under Alternative 5 compared to Existing Conditions (Table 11-5-24). Overall, impacts of water operations on fall-run Chinook salmon would be beneficial and impacts of water operations on late fall–run Chinook salmon would be less than significant and may be beneficial because of the reductions in entrainment loss at the south Delta facilities compared to Existing Conditions (Table 11-5-24). No mitigation would be required.

Table 11-5-24. Juvenile Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Fall-Run Chinook Salmon		
Wet	-96,754 (-76%)	-96,931 (-76%)
Above Normal	-1,662 (-5%)	-2,136 (-6%)
Below Normal	-38 (0%)	-397 (-3%)
Dry	2,836 (14%)	1,188 (6%)
Critical	-10,063 (-25%)	-4,886 (-14%)
All Years	-16,453 (-30%)	-16,509 (-30%)
Late Fall–Run Chinook Salmon		
Wet	-468 (-8%)	-381 (-6%)
Above Normal	-68 (-12%)	-54 (-10%)
Below Normal	-3 (-6%)	0 (1%)
Dry	-11 (-8%)	5 (4%)
Critical	-34 (-21%)	-21 (-14%)
All Years	-189 (-10%)	-108 (-6%)

Shading indicates10% or greater increased entrainment.

[a] Estimated annual number of fish lost, based on normalized data.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 5 would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall–run Chinook salmon relative to NAA.

Sacramento River

Water temperatures in the Sacramento River for Alternative 5 are not different from those for Alternative 1A, Impact AQUA-76, which indicates that there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

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 A5_LLT during October, December, and January would generally be greater than or similar to NAA, except in dry years during January (5% lower).

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, storage under A5_LLT would be similar to (<5% difference) storage under NAA in all water year types (Table 11-5-17).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be lower than or similar to mortality under NAA in all water year types including below normal years (14% greater relative to NAA, but absolute increase of 3% of fall-run population) (Table 11-5-25). These results indicate that climate change would increase fall-run Chinook salmon egg mortality, but Alternative 5 would have negligible effects.

Table 11-5-25. 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. A5_LLT	NAA vs. A5_LLT
Wet	11 (110%)	1 (6%)
Above Normal	12 (108%)	1 (3%)
Below Normal	14 (134%)	3 (14%)
Dry	17 (118%)	0.5 (1%)
Critical	9 (32%)	-0.2 (-1%)
All	13 (91%)	1 (4%)

SacEFT predicts that there would be a 29% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-26). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under A5_LLT relative to NAA. SacEFT predicts that there would be a negligible difference (<5%) in the percentage of years between A5_LLT and NAA. SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to NAA.

Table 11-5-26. 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. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-3 (-6%)	10 (29%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-28 (-30%)	-3 (-4%)
Redd Dewatering Risk	1 (4%)	1 (4%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-11 (-35%)	0 (0%)

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 A5_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, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-5-17).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A5_LLT would similar to mortality under NAA in all water years, including below normal water years in which, although there would be a 10% relative increase, the absolute increase would be 1% of the late fall–run population (Table 11-5-27).

Table 11-5-27. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	4 (201%)	-0.2 (-2%)
Above Normal	4 (153%)	-1 (-12%)
Below Normal	5 (308%)	1 (10%)
Dry	5 (173%)	-0.2 (-3%)
Critical	3 (147%)	0.05 (1%)
All	4 (191%)	-0.1 (-2%)

SacEFT predicts that there would be a 4% decrease in the percentage of years with good spawning availability for late fall–run Chinook salmon, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-28). SacEFT predicts that there would be a 0% reduction in the percentage of years with good (lower) redd scour risk under A5_LLT relative to NAA. SacEFT predicts that there would be no or negligible (<5%) differences in the percentage of years with good (lower) egg incubation conditions and redd dewatering risk between A5_LLT and NAA.

Table 11-5-28. 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. A5_LLT	NAA vs. A5_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	-2 (-4%)	-20 (-32%)
Juvenile Stranding Risk	-24 (-33%)	2 (4%)

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 A5_LLT would be similar to or greater than flows under NAA throughout the period.

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 A5_LLT would be to the same as the reduction under NAA for all water year types (Table 11-5-29).

Table 11-5-29. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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.

[a] 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.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-76, which indicates that temperatures conditions under Alternative 1A would be similar to or better than those under NAA.

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel under A5_LLT would be identical to those under NAA. Flows in the high-flow channel under A5_LLT would generally be similar to or greater than those under NAA except in wet and above normal years during November (5% and 10% lower, respectively), above normal years during December (11% lower), and critical years in January (12% lower).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during November through January were identical between A5_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A5_LLT would be similar (<5% difference on an absolute scale) to or lower than mortality under NAA in all water years (Table 11-5-30).

Table 11-5-30. 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. A5_LLT	NAA vs. A5_LLT
Wet	15 (1,058%)	-4 (-21%)
Above Normal	7 (654%)	-5 (-37%)
Below Normal	12 (684%)	-1 (-6%)
Dry	16 (731%)	-3 (-13%)
Critical	23 (460%)	-1 (-3%)
All	15 (695%)	-3 (-15%)

American River

Water temperatures in the American River under Alternative 5 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 A5_LLT during November through January would generally be similar to or greater than flows under NAA, except in above and below normal years during November (9% lower for both) and dry years during January (8% lower). Flows during October would generally be up to 15% lower than those under NAA.

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 A5_LLT would generally be similar to or greater than NAA flows except in below normal and critical years (33% and 52% lower, respectively) (Table 11-5-31).

Table 11-5-31. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-24 (-111%)	1 (2%)
Above Normal	-3 (-10%)	7 (18%)
Below Normal	-43 (-224%)	-16 (-33%)
Dry	5 (10%)	2 (6%)
Critical	-9 (-18%)	-21 (-52%)

NA = could not be calculated because the denominator was 0.

[a] 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.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A5_LLT would be similar to mortality under NAA in all water years (Table 11-5-32).

Table 11-5-32. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	24 (157%)	0 (0%)
Above Normal	22 (212%)	-0.2 (-1%)
Below Normal	21 (174%)	-1 (-2%)
Dry	16 (96%)	-1 (-2%)
Critical	9 (41%)	-1 (-4%)
All	19 (127%)	-0.4 (-1%)

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River 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 Alternative 5 would be similar to flows under NAA throughout the period.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 5 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis 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 Alternative 5 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta 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 Alternative 5 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect would not be adverse because habitat conditions are not substantially reduced. There are no reductions in flows under Alternative 5 or increases in temperatures that would translate into adverse biological effects on fall-run or late fall–run Chinook salmon spawning and egg incubation habitat.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of spawning and egg incubation habitat for fall-/late fall–run Chinook salmon would not be affected relative to the CEQA baseline.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large effects of Alternative 1A on temperature in the Sacramento River relative to Existing Conditions.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A5_LLT would generally be greater than or similar to Existing Conditions during October, December, and January, except in wet and below normal years during December (9% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During November, flows under A5_LLT would be generally lower than under Existing Conditions (up to 10% lower).

Storage volume at the end of September would be 16% to 32% lower under A5_LLT relative to Existing Conditions (Table 11-5-17).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be 32% to 134% greater (9% to 17% greater on an absolute difference scale) than mortality under Existing Conditions (Table 11-5-28).

SacEFT predicts that there would be a 6% reduction in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-26). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 30% decrease in the percentage of years with good (lower) egg incubation conditions under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 4% increase in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing Conditions.

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A5_LLT would generally be greater than or similar to flows under Existing Conditions, except in below normal years during March and May (10% and 6% lower, respectively) and wet years during March (18% lower).

Storage volume at the end of September would be 16% to 32% lower under A5_LLT relative to Existing Conditions (Table 11-5-17).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A5_LLT would be 147% to 308% greater than mortality under Existing Conditions (Table 11-5-29). However, absolute differences in the percent of the late-fall population subject to mortality would be minimal in all but below normal and dry years, in which there is a 5% increase in mortality.

SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-30). SacEFT predicts that there would be a 7% decrease in the percentage of years with good (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be no difference in the percentage of years with good (lower) egg incubation conditions between A5_LLT and Existing Conditions. SacEFT predicts that there would be a 5% decrease in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were reviewed during the September through February fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal and critical water years during September (6% and 7% lower, respectively).

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 occurred. The greatest monthly reduction in Clear Creek flows during September through January under A5_LLT would be similar to or lower magnitude than those under Existing Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33% greater (absolute, not relative, differences) under A5_LLT in above normal, dry, and critical water years, respectively (Table 11-5-29).

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, which indicates there would be moderate to large effects of Alternative 1A on temperatures relative to Existing Conditions.

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel A5_LLT would be identical to those under Existing Conditions. Flows during October and December in the high-flow channel under A5_LLT would be generally similar to or greater than flows under Existing Conditions with some exceptions (up to 33% lower). During November and January, flows under A5_LLT would generally be lower by up to 45% than flows under Existing Conditions.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel were identical between A5_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A5_LLT would be 460% to 1,058% greater than mortality under Existing Conditions (Table 11-5-30).

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-76, which indicates there would be moderate to large effects of Alternative 1A on temperatures relative to Existing Conditions.

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 A5_LLT would generally be lower by up to 33% than flows under NAA during the entire period.

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 monthly reduction in American

River flows under A5_LLT during November through January would be up to 224% lower magnitude than under Existing Conditions in all but dry water years (Table 11-5-31).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A5_LLT would be 41% to 212% greater than mortality under Existing Conditions (Table 11-5-32).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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*). Mean monthly flows under Alternative 5 would be 6% to 7% lower than those under Existing Conditions in all months except January, in which mean flows would be similar between Existing Conditions and Alternative 5.

Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under Alternative 1A. Conclusions from Alternative 1A,Impact 76 indicate that mean monthly water temperatures under Alternative 1A would not be different from those under Existing Conditions during October, but 6% higher during November through January.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis 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*). Mean monthly flows under Alternative 5 would be similar in all months of the period except October, in which flows would be 5% lower under Alternative 5, and January, in which flows would be 5% greater under Alternative 5.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta 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 Alternative 5 would be up to 14% lower than flows under Existing Conditions during October and November and up to 18% greater than flows under Existing Conditions during December and January.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA conclusion set forth above. There would be flow reductions in the Feather and American Rivers due to Alternative 5 relative to Existing Conditions that would affect the fall-run population. These reductions would reduce the quantity and quality of spawning and egg incubation habitat for fall-run Chinook salmon in these rivers. The Reclamation egg mortality model predicted substantial increases in fall- and late fall-run egg mortality in the Sacramento, Feather, and American Rivers under Alternative 5 relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 5 would not reduce the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to NAA.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on temperatures relative to NAA.

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would nearly always be greater than or similar to flows under NAA except in dry years during January (5% lower).

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-5-17).

SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-28). SacEFT predicts that there would be no change relative to NAA.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A5_LLT would be similar to mortality under NAA.

Late Fall–Run

Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during the period would be generally similar to or greater than those under NAA with two exceptions (5% and 15% lower).

Shasta Reservoir storage at the end of September and May would affect flows during the late fall–run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-5-17).

As reported in Impact AQUA-40, Shasta storage at the end of May under A5_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-5-10).

SacEFT predicts that there would be 32% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-30). SacEFT predicts that there would be a negligible change in the percentage of years with "good" (lower) juvenile stranding risk under A5_LLT relative to NAA.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A5_LLT would be similar to mortality under NAA.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would nearly always be similar to or greater than flows under NAA, except in below normal years during March (6% lower).

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, which indicates there would be no effects of Alternative 1A on temperatures relative to NAA.

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT would not differ from those under NAA. In the high-flow channel, flows under A5_LLT would generally be similar to or greater than flows under NAA except in above normal years during December (11% lower), critical years during January (12% lower), and below normal years during March (11% lower).

As reported in Impact AQUA-59, May Oroville storage under A5_LLT would be similar to storage under NAA in all water year types (Table 11-5-22).

As reported in AQUA-58, September Oroville storage volume would be similar to or greater than storage under NAA depending on water year type (Table 11-5-21). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 5.

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on temperatures relative to NAA.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would nearly always be similar to or greater than flows under NAA, except in dry years during January (8% lower).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 5 would not be different from those under NAA for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Stanislaus River under alternative 5 would be similar to those under Alternative 1A. Conclusions for Alternative 1A, Impact AQUA-77 indicate that there would be no difference in mean monthly water temperatures between NAA and Alternative 1A throughout the January through May fall-run Chinook salmon juvenile rearing period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis for Alternative 5 would not be different from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta for Alternative 5 would not be different from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat for fish. Changes in flow rates and water temperatures are generally small and infrequent under Alternative 5 relative to the NAA. Therefore, there would be no biologically meaningful effects to fall- or late fall-run Chinook salmon, except for a moderate reduction in juvenile rearing habitat for late fall-run Chinook salmon as predicted by SacEFT. Because this effect is isolated, it would not cause the impact to be adverse, particularly in combination with modeled flow outputs indicating that flows, which drive rearing habitat availability, would increase during the rearing period. Additionally, SALMOD does not predict habitat-related effects on late fall-run Chinook salmon in the Sacramento River. There would be no other substantial changes fall-/late fall-run Chinook salmon rearing habitat for under Alternative 5.

CEQA Conclusion: In general, Alternative 5 would not affect the quantity or quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to Existing Conditions.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on temperatures relative to Existing Conditions.

Fall-Run

Flow Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be greater than or similar to flows under Existing Conditions, except in below normal years during March and May (10% and 6% lower, respectively) and wet years during May (18%).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 16% to 32% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

SacEFT predicts that there would be a 15% increase in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-26). SacEFT predicts that there would be a 35% reduction in the percentage of years with “good” (lower) juvenile stranding risk under A5_LLT relative to Existing Conditions.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A5_LLT would be 8% lower than mortality under Existing Conditions.

Late Fall–Run

Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during most months would generally be similar to or greater than those under Existing Conditions with six exceptions (6%, 7%, 7%, 11%, 18%, and 23% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 16% to 32% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

As reported in Impact AQUA-40, end of May Shasta storage under A5_LLT would be similar to Existing Conditions in all water years, except dry (6% lower) and critical water years (10% lower) (Table 11-5-10).

SacEFT predicts that there would be a 4% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-30). SacEFT predicts that there would be a 33% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A5_LLT relative to Existing Conditions.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A5_LLT would be 8% higher than mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined during the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or greater than flows under Existing Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher during substantial portions of the periods evaluated relative to Existing Conditions.

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under A5_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during December and from February through June with some exceptions (up to 48% lower). Flows during January under A5_LLT would generally be lower than under Existing Conditions (up to 45% lower).

As reported in Impact AQUA-59, May Oroville storage volume under A5_LLT would be similar to storage under Existing Conditions in wet and above normal water years (Table 11-5-22). Storage volume under A5_LLT would be 9% to 18% lower than storage under Existing Conditions in below normal, dry, and critical water years

As reported in Impact AQUA-58, September Oroville storage volume would be 8% to 31% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-21).

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher under Alternative 1A in 3 months during the 5-month period evaluated relative to Existing Conditions.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during February through April, except in critical years during February and March (18% and 7% lower, respectively) and above and below normal years during April (9% and 7% lower, respectively). Flows under A5_LLT would be mostly lower (by up to 34%) than flows under Existing Conditions during January and May.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 5 would be up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Stanislaus River under Alternative 5 would be similar to those under Alternative1A. Conclusions for Alternative 1A, Impact AQUA-77, indicate that mean monthly water temperatures under Alternative 1A would be 6% greater than those under Existing Conditions in all months during the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would be similar to flows under Existing Conditions throughout the period except during January, in which flows would be greater under Alternative 5.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 14% and 12% greater than flows under Existing Conditions during January and February, respectively, similar to flows under Existing Conditions during March, and 8% and 12% lower than flows under Existing Conditions during April and May, respectively.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth above. There are substantial flow reductions and water temperature increases in multiple waterways, as well as substantial reductions in rearing conditions predicted by biological models.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, the effects of Alternative 5 on fall- and late fall-run Chinook salmon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on temperatures throughout the period evaluated relative to NAA.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants during February through May. Flows under A5_LLT would be similar to or greater than flows under NAA throughout the juvenile fall-run migration period in all water year types) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run Chinook salmon upstream migration period (September through October). Flows under A5_LLT would almost always be similar to or greater than those under NAA except in below normal years during September (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A5_LLT would generally be similar to or greater than flows under NAA except in dry years during January (5% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall–run Chinook salmon upstream migration period (December through February). Flows under A5_LLT would nearly always be similar to or greater than flows under NAA except in dry years during January (5% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants during February through May. Flows under A5_LLT would almost always be similar to or greater than those under NAA, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run Chinook salmon upstream migration period (September through October). Flows under A5_LLT would always be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on temperatures throughout the period evaluated relative to NAA.

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were reviewed during the February through May fall-run juvenile migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would always be similar to or greater than flows under NAA.

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A5_LLT would generally be lower by up to 47% than flows under NAA during September and similar to or greater than flows under NAA during October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on temperatures throughout the period evaluated relative to NAA.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would always be similar to or greater than flows under NAA.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during September and October under A5_LLT would generally be similar to flows under NAA during September except during wet and below normal years (8% and 16% lower, respectively). Flows during October under A5_LLT would generally be lower than flows under NAA (up to 15% lower).

Stanislaus River

Flows and water temperatures in the Stanislaus River for Alternative 5 are not different from those for Alternative 1A, AQUA-78, which indicates there would be no effect of Alternative 1A on temperatures throughout the period evaluated relative to NAA.

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be nearly identical to flows under NAA throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be nearly identical to flows under NAA throughout the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Fall-Run

Juveniles

During the juvenile fall-run Chinook salmon emigration period (November to early May), mean monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged across years would be 6% to 11% lower in most months, and 17% lower in November compared to NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

As described above in Impact AQUA-39, the north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. Estimates of potential predation losses at the single intake range from about 0.2% (bioenergetics model, Table 11-5-13) to 4.5% (based on a fixed 5% loss per intake) of the juvenile fall-run population that reaches the Delta (Appendix 5F, *Biological Stressors*).

Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 (A5_LLT) would average 24.6% across all years. Under Alternative 5, juvenile survival was similar to NAA (Table 11-5-33).

Table 11-5-33. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Baseline and Alternative 5 Scenarios

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Types	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Sacramento River					
Wetter Years	34.5	31.1	30.1	-4.4 (-13%)	-1.0 (-3%)
Drier Years	20.6	20.8	21.3	0.8 (4%)	0.6 (3%)
All Years	25.8	24.7	24.6	-1.2 (-4%)	0.0 (0%)
Mokelumne River					
Wetter Years	17.2	15.7	15.6	-1.6 (-9%)	-0.1 (-1%)
Drier Years	15.6	15.9	15.8	0.2 (1%)	-0.1 (-1%)
All Years	16.2	15.9	15.7	-0.5 (-3%)	-0.1 (-1%)
San Joaquin River					
Wetter Years	19.3	20.3	19.3	0.0 (0%)	-0.9 (-5%)
Drier Years	10.0	9.5	9.8	-0.1 (-1%)	0.3 (3%)
All Years	13.5	13.6	13.4	-0.1 (-1%)	-0.2 (-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).

Adults

The adult fall-run migration extends from September-December. The proportion of Sacramento River water in the Delta under Alternative 5 would be similar (<10% change) to NAA during the entire migration period (Table 11-5-15). Olfactory cues for fall-run adults would likely still be strong, as the proportion of Sacramento River under Alternative 5 would still represent 66–72% of Delta outflows. Flows at Rio Vista would be greater (1–121% increase) under Alternative 5 than under Alternative 1A in September, November and December, but substantially lower (25%) in October. However, because the proportion of Sacramento River water in the Delta would not substantially change during the peak adult migration period under Alternative 5, there would not be an adverse effect on adult fall-run migration success through the Delta.

Late Fall–Run

Juveniles

During the juvenile late fall-run Chinook salmon emigration period (October-February), mean monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged across years would be 6% to 9% lower in most months, and 17% lower in November compared to NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

Estimates of potential predation losses at the single intake range from about 0.2% (bioenergetics model, Table 11-5-13) to 4.5% (based on a fixed 5% loss per intake) of the juvenile late fall-run population that reaches the Delta (Appendix 5F, *Biological Stressors*).

Through-Delta survival by emigrating juvenile late fall–run Chinook salmon under Alternative 5 (A5_LLT) would average 23% across all years, ranging from 21% in drier years to 27% in wetter years. Under Alternative 5, juvenile survival would be slightly greater (0.4% greater survival, or 3% more in relative percentage) compared to NAA (Table 11-5-34). Overall, Alternative 5 would not have an adverse effect on late fall–run Chinook salmon juvenile survival through the Delta.

Table 11-5-34. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon under Baseline and Alternative 5 Scenarios

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Types	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wetter Years	28.8	27.3	27.4	-1.4 (-5%)	0.1 (<1%)
Drier Years	18.8	20.2	20.8	2.1 (11%)	0.6 (3%)
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 water years (6 years).
Drier = Below normal, dry and critical water years (10 years).

Adults

The adult late fall–run migration is from November through March, peaking in January through March. Mean monthly flows in Sacramento River at Rio Vista under Alternative 5 would be similar in December through March, and reduced about 20% in November compared to NAA. The proportion of Sacramento River water in the Delta would be similar (<10%) to NAA throughout the migration period (Table 11-5-15). Based on the similarity in Sacramento River olfactory cues and increase in Rio Vista flows during the adult late fall–run migration, it is assumed that adult migration success through the Delta would be similar or improved relative to those described for Alternative 1A. Therefore, Alternative 5 would not have an adverse effect on late fall–run adult migration.

Mokelumne River

Juveniles

Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would be 15.7%, which is similar to NAA (Table 11-5-33).

San Joaquin River

Fall-Run

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There no flow changes associated with the alternatives. Alternative 5 would have no effect on fall-run migration success through the Delta (Table 11-5-33).

Adults

Alternative 5 would slightly increase the proportion of San Joaquin River water in the Delta in September through December by 0.4 to 1.4 % (compared to NAA) (Table 11-5-15). The proportion of San Joaquin River water would be similar to or slightly more than NAA. Therefore migration conditions under Alternative 5 would be similar to slightly improved to those described for Alternative 1A. Alternative 5 would have no effect to a slight beneficial effect on the fall-run adult migration, because of the relative increase in olfactory cues from the San Joaquin River basin.

NEPA Effects: Upstream of the Delta, the results indicate that the impact would be adverse because it has the potential to substantially reduce the quantity or quality of migration habitat or interfere with the movement of fish. Upstream flows under Alternative 5 would be 47% lower in the Feather River and 15% lower in the American River during one of two months of the fall-run Chinook salmon adult migration period, compared to NAA, Combined, these reductions represent an adverse effect of the alternative on fall-/late fall-run Chinook salmon migration. There would be no other effects of Alternative 5 on flow or temperatures in upstream rivers. Near-field effects of Alternative 5 NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 1 new intake would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to larger effects (~ 5% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the 1 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 5 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 5 on fall-/late fall-run Chinook salmon migration conditions would be adverse. While the implementation of the mitigation measures described below would address these impacts, these measures are not anticipated to reduce the impact to a level considered not adverse.

CEQA Conclusion:

In general, Alternative 5 would reduce migration conditions for fall-/late fall–run Chinook salmon relative to Existing Conditions.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on temperatures throughout the period evaluated.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants were evaluated during February through May. Flows under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in wet years during May (18% lower) and below normal years during March and May (10% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff were evaluated during the adult fall-run Chinook salmon upstream migration period (September through October). Flows would generally be similar to or greater than those under Existing Conditions except in below normal and dry years (12% and 24% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile late fall–run migrants (January through March). Flows under A5_LLT would almost always be similar to or greater than flows under Existing Conditions, except in below normal water years during March (10% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall–run Chinook salmon upstream migration period (December through February). Flows under A5_LLT would generally be similar to or greater than those under Existing Conditions except in wet and below normal years during December (9% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run Chinook salmon upstream migration period (February through May). Flows under A5_LLT would be similar to or greater than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run Chinook salmon upstream migration period (September through October). Flows under A5_LLT would generally be similar to or greater than those under Existing Conditions except in critical years during September and October (28% and 7% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no differences in temperatures under Alternative 1A during the periods evaluated.

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were evaluated during the fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal years during February and March (12% and 18% lower, respectively) and wet and above normal years during May (18% and 14% lower, respectively).

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A5_LLT would generally be similar to or greater than flows under Existing Conditions except in below normal and dry water years during September (30% and 34% lower, respectively) and in wet years during October (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher during substantial portions of the periods evaluated.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during February through April would generally be similar to or greater than flows under Existing Conditions, except for critical years during February and March (18% and 7% lower, respectively) and above and below normal years during April (9% and 7% lower, respectively). Flows during May under A5_LLT would generally be up to 34% lower than flows under Existing Conditions.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under Existing Conditions by up to 47%.

Stanislaus River

Water temperatures in the Stanislaus River for Alternative 5 are not different from those for Alternative 1A, which indicates that temperatures under Alternative 1A would be higher during substantial portions of the periods evaluated relative to Existing Conditions.

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would predominantly be lower than flows under Existing Conditions by up to 36%.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during September would generally be similar to flows under Existing Conditions, except during wet and above normal years (17% and 6% lower, respectively). Flows under A5_LLT during October would be 5% to 10% lower than flows under Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would generally be similar to flows under Existing Conditions in all months. Wetter water years under Alternative 5 would have similar or greater flows than those under Existing Conditions, whereas drier years would have lower flows under Alternative 5.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 8% lower than those under Existing Conditions in September and similar in October.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to or up to 15% greater than those under Existing Conditions during February and March, but up to 18% lower than flows under Existing Conditions during April and May.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized* *in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 27% and 5% lower than under Existing Conditions during September and October, respectively.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

As described above, Sacramento River flows below the north Delta intake would be reduced under Alternative 5 compared to Existing Conditions. Estimates of potential predation losses at the single intake range from 0.2% to 4.5% of the population that reaches the Delta. Compared to Existing Conditions, through-Delta survival by emigrating juveniles under Alternative 5 would be 2.1% greater (11% relative increase) in drier years for late-fall run Chinook salmon and 4.4% lower (13% relative decrease) in wetter years for fall-run Chinook salmon (Table 11-5-33).

Mokelumne River

Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would be 15.7% (Table 11-5-33). Compared to Existing Conditions, survival would be similar in most years, but 1.6% lower (9% relative decrease) in wetter years.

San Joaquin River

Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would be similar to Existing Conditions (Table 11-5-33).

Summary of CEQA Conclusion

Collectively, the upstream impacts of Alternative 5 would be significant because the alternative could substantially reduce rearing habitat. Flows in the American, Stanislaus, Mokelumne, and San Joaquin Rivers would be lower than flows in under the CEQA baseline during substantial portions of the migration periods evaluated. Water temperatures in the Feather, American, and Stanislaus Rivers would be lower during most or all of the periods evaluated. Through-Delta migration conditions for juvenile fall-run and juvenile and adult late fall-run Chinook salmon under Alternative 5 would be similar to Existing Conditions.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall–Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have significant and unavoidable adverse effects on migration habitat, this conclusion was based on the best available scientific information at the time and may prove to have been over- or understated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 5

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 5 operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 5.

Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 5. 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).

Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on fall-run/late fall-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to either effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-78a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 5 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under Alternative 5 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run Chinook salmon would remain significant and unavoidable.

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

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

The effects on construction of restoration measures on fall-/late-fall-run Chinook would be identical to those on winter-run Chinook; please refer to the discussion of Alternative 5, Impact AQUA-43 above.

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

The effects of contaminants associated with restoration measures would be the same for all four ESUs. Accordingly, please refer to the discussion of Alternative 5, Impact AQUA-44 for winter-run Chinook salmon.

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

The effects of restored habitat conditions on fall-/late fall–run Chinook would be the same as for described for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact AQUA-45 above. The only difference is that fall-/late fall–run Chinook also occur in the Cosumnes/Mokelumne ROA and would receive the benefits of increased habitat acreage and food production in this location.

CEQA Conclusion: As described in Alternative 5, Impact AQUA-45 for winter-run Chinook salmon, the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on Chinook salmon are the same as those described under Alternative 1A (Impacts AQUA-82 through AQUA-90). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Steelhead

Construction and Maintenance of CM1

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

NEPA Effects: The potential effects of construction of the water conveyance facilities on steelhead would be similar to those described for Alternative 1A (Impact AQUA-91) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-91, the impact of the construction of water conveyance facilities on steelhead would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-92) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-92, the effect would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Water Exports from SWP/CVP South Delta Facilities

Under Alternative 5, average entrainment of juvenile steelhead at the south Delta export facilities, estimated by the salvage density method across all years, would be reduced 9% compared to NAA (Table 11-5-35). Pre-screen losses typically attributed to predation would also be expected to decrease commensurate with entrainment.

Table 11-5-35. Juvenile Steelhead Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-605 (-10%)	-697 (-11%)
Above Normal	-958 (-7%)	-1,302 (-10%)
Below Normal	-1,467 (-12%)	-736 (-7%)
Dry	-683 (-9%)	-92 (-1%)
Critical	-253 (-4%)	98 (2%)
All Years	-904 (-10%)	-763 (-9%)

[a] Estimated annual number of fish lost, based on non-normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intake would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: Because entrainment loss would be reduced at the south Delta facilities and minimized at the north Delta intake and NBA, the effect under Alternative 5 would not be adverse.

CEQA Conclusion: Entrainment losses of juvenile steelhead would be reduced 10% under Alternative 5 compared to Existing Conditions (Table 11-5-35). Overall, impacts would be less than significant and may be beneficial to steelhead because of the reduction in entrainment loss and no mitigation would be required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, effects of Alternative 5 on steelhead spawning conditions would be negligible relative to the NAA.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under A5_LLT throughout the period would generally be similar to those under NAA except in below normal years during January (11% higher) and critical years in March and below normal years in April (6% higher) and during above normal and dry years during January (8% and 9% lower) and during dry years in March (5% lower).

SacEFT predicts that there would be negligible effects (4%) on the percentage of years with good spawning availability (measured as weighted usable area), and the same redd scour risk and egg incubation conditions under A5_LLT relative to NAA (Table 11-5-36). These results indicate that there would be a low effect of Alternative 5 on spawning habitat quantity but no difference in redd scour risk or temperature related egg incubation conditions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Alternative 1A and NAA would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

Overall in the Sacramento River, Alternative 5 would have negligible effects on water temperatures, negligible effects (<5%) on mean monthly flows, and negligible (<5%) to small effects (<10%) on egg survival, redd scour, and redd dewatering habitat metrics computed using SacEFT, resulting in no biologically meaningful effects on steelhead spawning in the Sacramento River.

Table 11-5-36. Difference and Percent Difference in Percentage of Years with "Good" Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	1 (2%)	-2 (-4%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	2 (4%)	5 (9%)
Juvenile Rearing WUA	-3 (-7%)	-7 (-16%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A5_LLT would generally be similar to flows under NAA throughout the period, except in critical years during February (7% higher), and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between NAA and A5_LLT for all water year types except for a small difference in critical years (Table 11-5-37).

No water temperature modeling was conducted for Clear Creek.

Overall in Clear Creek, Alternative 5 would have primarily negligible effects (<5%) on mean monthly flows for the January to April steelhead spawning and egg incubation period, and project-related effects on flow reductions during the incubation period would be negligible (<5%) with the exception of an infrequent flow reduction of relatively small magnitude in critical years that would not pose substantial redd dewatering risk.

Table 11-5-37. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	A5_LLT vs. EXISTING CONDITIONS	A5_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	-19 (NA)	-19 (NA)

NA = could not be calculated because the denominator was 0.

[a] 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.

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 A5_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 A5_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA (up to 34% higher), except in critical years during January (12% lower) and in below normal years during March (11% 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 A5_LLT would be similar to or up to 17% greater than storage under

NAA depending on water year type (Table 11-5-21). May Oroville storage under A5_LLT would be similar to storage under NAA (Table 11-5-22).

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Alternative 1A and NAA would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

Overall in the Feather River low-flow channel, Alternative 5 would not have any effect (0% change) on mean monthly flows and negligible effects on water temperatures. Overall in the Feather River above Thermalito Afterbay, Alternative 5 would result primarily in negligible effects (<5%) on mean monthly flow or increases in flow (to 34%) that would have a beneficial effect on spawning conditions, with two isolated occurrences of small flow reductions (to -12%) that would not have biologically meaningful effects, and negligible effects on water temperatures.

American River

Water temperatures in the American River under Alterative 5 would be the same as those under Alternative 1A, Impact AQUA-94, which indicates there would be no effects of Alternative 1A on temperatures during the periods evaluated.

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to flows under NAA during the period except in critical and dry years during January and February (12% and 10% higher, respectively) and dry years during March (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Stanislaus River

Water temperatures in the Stanislaus River under Alterative 5 would be the same as those under Alternative 1A, Impact AQUA-94, which indicates there would be no effects of Alternative 1A on temperatures during the periods evaluated relative to NAA.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to flows under NAA.

Mokelumne River

Flows in the Mokelumne River at the confluence were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be the same as flows under NAA.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 5 on flow consist of negligible effects (<5%), small decreases in mean monthly flow (up to -12%) that would not have biologically meaningful effects, or increases in mean monthly flow (up to 12% for all locations, with more substantial increases up to 34% in the Feather River) that would have a beneficial effect on steelhead spawning conditions. Results of SacEFT and flow reduction analyses indicate negligible (<5%) or small effects (up to 9% change) that would not have biologically meaningful effects on redd scour risk for all locations analyzed.

CEQA Conclusion: In general, effects of Alternative 5 on steelhead spawning conditions would be negligible relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows under A5_LLT would generally be similar to under Existing Conditions in April, and mixed in the other months with both lower and higher flows depending on the water year type. In January flows would be lower in above normal and dry years (9% and 7%, respectively) and higher in wet and critical years (12% and 16%, respectively), in February flow would be lower in below normal, dry and critical years (9%, 5%, and 6%, respectively) and higher in wet and above normal years (12% and 6%, respectively), and in March flows would be lower in below normal and dry years (18% and 7%, respectively) and higher in wet and critical years (6% and 9%, respectively). Upstream of Red Bluff Diversion Dam, A5_LLT flows would generally be similar to or higher than Existing Conditions throughout the period with lower flows in below normal years during March (10%).

SacEFT predicts no differences in spawning habitat, egg incubation, redd scour and dewatering risk between Existing Conditions and Alternative 5 (Table 11-5-36).

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Existing Conditions and Alternative 1A would be comparable.

Overall in the Sacramento River, Alternative 5 would have negligible effects (<5%) or cause small increases in mean monthly flow (11%) that would not affect steelhead spawning conditions in a biologically meaningful way. SacEFT indicates that steelhead egg incubation and redd survival metrics would not be affected by Alternative 5. Effects of Alternative 5 on water temperature would be negligible.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A5_LLT would be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between Existing Conditions and A5_LLT for all water year types except wet, in which the reduction would be 38% lower (worse) under A5_LLT than under Existing Conditions (Table 11-5-37).

No temperature modeling was conducted for Clear Creek.

Overall in Clear Creek, Alternative 5 would have negligible effects (<5%) or contribute to increases in mean monthly flow (to 54%) that would be beneficial for steelhead spawning conditions. Alternative 5 would have primarily negligible effects (<5%) on flow reductions with the exception of a moderate flow reduction (-38%) during wet years when effects on spawning conditions would not be as critical, and a small reduction in critical years (-13%) that would not have biologically meaningful effects.

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 A5_LLT would not differ from Existing Conditions 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 A5_LLT at Thermalito Afterbay would generally be similar to or greater than flows under Existing Conditions, except in above, below normal and dry water years during January (38%, 45% and 18% lower, respectively), above and below normal years during February (8% and 46% lower, respectively), below normal years during March (48% lower), and wet and above normal years during April (37% and 7% lower, respectively).

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. Oroville Reservoir storage volume at the end of September would be 7% to 36% lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-21). May Oroville storage volume under A5_LLT would be lower than Existing Conditions by 1% to 18% depending on water year type (Table 11-5-22).

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94, which indicates there would be substantial increases in temperatures under Alternative 1A during the periods examined relative to Existing Conditions.

Overall in the Feather River, effects of Alternative 5 on mean monthly flow would be negligible (no difference) in the low-flow channel and negligible (<5% difference) or beneficial (increases to 84%) at Thermalito Afterbay. Small (-8%) to substantial (to -48%) flow reductions at Thermalito Afterbay would occur for some months and water year types but would occur infrequently enough to not have biologically meaningful effects. There would be negative effects of Alternative 5 on water temperatures in the Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions in January through April except that they would be substantially lower in below normal, dry and critical years in January, critical years in February and March and in below normal, wet, and above normal years during April. Overall, these results indicate that the effects of Alternative 5 on flow in the American River would be minor.

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, which indicates that there would be substantial increases in temperatures under Alternative 1A during the periods evaluated relative to Existing Conditions.

Stanislaus River

Flows in the Stanislaus River for Alternative 5 are substantially below those under Existing Conditions in all months and for most water months in the January through April period.

Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94, which indicates that temperatures under Alternative 1A would be greater during the entire period evaluated relative to Existing Conditions.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River for Alternative 5 are generally similar to or higher than Existing Conditions in January and February (up to 18% higher) and lower than Existing Conditions in March and April (up to 14% lower).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Effects to flow would generally be negligible in the Sacramento, Feather, and American Rivers, and in Clear Creek. However, flows would be substantially lower in in the Stanislaus River and water temperatures would be substantially lower in the Feather, American, and Stanislaus Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, Alternative 5 would reduce the quantity and quality of steelhead rearing habitat relative to NAA.

Sacramento River

Juvenile steelhead rear in the Sacramento River for 1 to 2 years before migrating downstream to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May would be generally greater (up to 11%), flows in November would be lower (up to 20%), flows in the other months of the year would be similar or greater than under NAA except for August, September, October, and December which have single water years above and single water years below NAA.

SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions under A5_LLT would be 16% lower than that under NAA (Table 11-5-36). Also, the percentage of years with good (lower) juvenile stranding risk conditions under A5_LLT would be the same as under NAA. These results indicate that Alternative 5 would cause a small decrease in rearing habitat conditions and no increase in juvenile mortality risk resulting from stranding in the Sacramento River.

Water temperatures in the Sacramento River under Alternative 5 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.

Overall in the Sacramento River, Alternative 5 would have negligible effects on juvenile steelhead rearing conditions based on negligible effects (<5%) on mean monthly flows with the exception of a moderate reduction (-15%) in wet years, a relatively small decrease (-16%) in the number of years classified as "good" rearing habitat, and no effect on juvenile stranding risk, which collectively are not expected to contribute to biologically meaningful effects in the Sacramento River.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A5_LLT would generally be similar to or sometimes greater than flows under NAA, except for below normal years in March in which flows would be 6% 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 5 relative to NAA in wet, above normal, and critical water year types (Table 11-5-38). Minimum flows would be the same as NAA in all water years except it would be 8% lower in critical water 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.

Overall, these results indicate that Alternative 5 would not affect juvenile rearing conditions in Clear Creek.

Table 11-5-38. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
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 (-8%)

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 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 A5_LLT would not differ from those under NAA. In the high flow channel, flows under A5_LLT would be mostly lower (up to 61%) during July, August, and September and mostly greater (up to 47%) than flows under NAA in other months.

May Oroville storage under A5_LLT would be similar to storage under NAA (Table 11-5-22). September Oroville storage volume would be similar to or up to 17% greater than under NAA depending on water year type (Table 11-5-21).

Water temperatures in the Feather River low-flow and high-flow channel under Alternative 5 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.

Overall in the Feather River, Alternative 5 would have negligible effects in the low-flow channel and would not have biologically meaningful effects on juvenile rearing conditions at that location.

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94, which indicates that water temperatures under A1A_LLT would be similar to those under NAA.

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to flows under NAA during January through April and December, greater than flows under NAA during May and June, lower than flows under NAA during July through September (up to 43% lower), and with both higher and lower flows in October and November.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to flows under NAA for the entire year with few exceptions.

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that there would be no effect of Alternative 1A on temperatures during the period evaluated relative to NAA.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 5 were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) and the flows are not different from those under NAA.

Water temperature modeling was not conducted in the Mokelumne River.

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 fry and juvenile mortality. There would be substantial reductions in flows in the Feather River (up to 61% lower) and the American River (up to 43% lower). Reduced flows would increase the potential for degradation and loss of juvenile rearing habitat. There would be no other effects on flows or water temperatures in the rivers evaluated.

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 mitigation measures listed below (AQUA-95a through AQUA-95c) would be expected to reduce the severity of effects on steelhead rearing habitat, these would not necessarily result in a not adverse determination.

CEQA Conclusion: In general, Alternative 5 would reduce the quantity and quality of steelhead rearing habitat relative Existing Conditions.

Sacramento River

Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during October and between December and July under A5_LLT would generally be similar to or greater than those under Existing Conditions. Flows during January, February March, May, July and September would be mixed with some water years below and some water years above Existing Conditions. Flows during April, August, November and December would generally be lower under A5_LLT than under Existing Conditions.

SacEFT predicts that there would be a 7% decrease in the percentage of years with good rearing availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table 11-5-11). SacEFT predicts that there would be a more substantial reduction (-41%) in the number of years with good (lower) juvenile stranding risk under A5_LLT relative to Existing Conditions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would generally not be affected by Alternative 1A relative to Existing Conditions.

Overall in the Sacramento River, Alternative 5 would have negligible effects on water temperature, but would result in substantial increased risk of juvenile stranding (-41%) and moderate reductions in minimum flows in drier water years (to -25%) when effects of flow reductions have the greatest potential to affect rearing conditions.

Clear Creek

Flows in Clear Creek during the year-round rearing period under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years in August through October in which flows would be 7% to 28% lower and in below normal years in October when flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was conducted in Clear Creek.

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 11-5-38. Results indicate that Alternative 5 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to Existing Conditions in all water years except for that they would be 8% lower in critical water years.

These results indicate that the effects of Alternative 5 on flows consist primarily of negligible or beneficial effects (increases in mean monthly flow to 54%) with only infrequent, small to moderate flow reductions (-6% to -28%) that would not have biologically meaningful effects on juvenile rearing habitat in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 5 relative to Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows under A5_LLT would be mostly lower (up to 45% lower) during January, May, November and December, mostly similar to or higher (up to 86% higher) in February, March, April, June, July, and October, and mixed with some water years higher and some lower in August and September.

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-95, which indicate that temperatures would increase under Alternative 1A during the year-round period relative to Existing Conditions.

Overall in the Feather River, Alternative 5 would have negligible effects on juvenile rearing conditions in the low-flow channel based on results of effects on water temperatures and mean monthly flows. In the high-flow channel, Alternative 5 would have beneficial effects on rearing conditions through increases in flow for March through July and October (ranging from 5% to 141%). However, Alternative 5 would cause substantial decreases in mean monthly flow (to -59%), in January, February, August, September, November, and December, and particularly in drier water years for July through December when effects of flow reductions would be most critical for rearing conditions. Alternative 5 would cause an increase water temperatures in the high-flow channel Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be generally lower than flows under Existing Conditions (up to 61% lower) in May through December (although there are individual water years with high flows in May and June), generally higher flows in February and March (up to 27% higher), and mixed higher and lower flows depending on water year in January and April

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under Alternative 1A during the year-round period relative to Existing Conditions.

Overall in the American River, Alternative 5 would cause substantial flow reductions (to -61%) for much of the year (depending on water year type), including various months throughout the year in drier water years and the warmer summer months in all water years. Increases in flow (to 27%) during January to March in wetter years would have a small beneficial effect but would not offset the prevalence of reductions in flow predicted for other months and water year types. It is also predicted that Alternative 5 would result in flows less than 1,500 cfs for occurrences (June in critical years, August in dry years, September in below normal and dry years) which has been identified as a critical threshold for availability of riffle habitat.

Stanislaus River

Flows in the Stanislaus River for Alternative 5 are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January, in wet years in March and June and in below normal years in December.

Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under Alternative 1A during most of the year-round period relative to Existing Conditions.

San Joaquin River

Flows in the San Joaquin River for Alternative 5 are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January and in wet years in January, February and March (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 5 are generally lower than Existing Conditions in all months and all water years except that they are similar in March, and generally higher in January and February (up to 18% higher depending on water year) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, these results indicate the impact would be significant because it has the potential to substantially reduce rearing habitat and substantially reduce the number of fish as a result of fry and juvenile mortality. Effects of Alternative 5 on flow would have biologically meaningful effects on fry and juvenile steelhead rearing habitats in the Sacramento, Feather American, Stanislaus, San Joaquin, and Mokelumne Rivers through flow reductions prevalent for much of the rearing period and particularly during drier water year types and in the warmer summer and early fall months. Effects of Alternative 5 on flows in Clear Creek would not be as negative. Alternative 5 would also have substantial effects on stranding risk based on SacEFT metrics (decrease in years classified as "good" in terms of stranding risk of -41%).

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 5 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 5.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 5 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 5.

Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts on Steelhead Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 5. 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).

Mitigation Measure AQUA-95c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Steelhead Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on steelhead habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife 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-95a.

If feasible means are identified to reduce impacts on spawning habitat consistent with the overall operational framework of Alternative 5 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 5 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on steelhead would remain significant and unavoidable.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

Upstream of the Delta

In general, the effects of Alternative 5 on steelhead migration conditions relative to the NAA are uncertain.

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would be higher than NAA in some water years in October (up to 13% higher), 8% to 21% lower than flows under NAA during November depending on water year type, lower and higher in individual water years in December and January, higher in most water years (up to 11% higher) in May and generally similar in February, March and April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be higher than NAA in wet and critical water years (6% and 23%, respectively) and lower in below normal water years (15% lower) in September, higher than NAA in some water years in October (up to 13% higher), 8% to 21% lower than flows under NAA during November depending on water year type, lower and higher in individual water years in December and January, and generally similar in February and March.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during these two months would be minimally different between NAA and A5_LLT with lower flows in dry years (5% lower) and higher flows in critical years (6% higher) in March and somewhat higher flows in above normal (5%) and below normal (6%) years in April.

Overall in the Sacramento River, Alternative 5 would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration based on mean monthly flows and water temperatures.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period under A5_LLT would generally be similar to or greater than flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A5_LLT would generally be similar to or greater than flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A5_LLT would generally be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in Clear Creek would not be affected by Alternative 5.

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows under NAA in all months and water years except during November in above normal years (6% lower).

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be up to 47% lower than flows under NAA during September, up to 39% higher than flows under NAA during October, and generally similar to flows under NAA in the remaining five months of the period.

Kelts

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to those under NAA in March and up to 12% greater than flows under NAA in April.

Overall, these results indicate that there would be negligible effects of Alternative 5 on steelhead juvenile, adult, and kelt migration conditions. There would be some flow-based beneficial effects in some months.

American River

Water temperatures in the American River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different between NAA and Alternative 1A during the periods evaluated.

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would generally be similar to flows under NAA except in wet, above normal and critical water years during October (10%, 15% and 12% lower, respectively), above normal and below normal water years during November (9% lower for each), and dry water years during January (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to flows under NAA except in wet and below normal years during September (8% and 16% lower, respectively), in wet, above normal and critical water years during October (10%, 15% and 12% lower, respectively), above normal and below normal water years during November (9% lower for each), and dry water years during January (8% lower).

Kelts

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A5_LLT would generally be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Overall in the American River, Alternative 5 would have negligible effects on water temperatures and effects on flow consist of negligible effects (<5%), increases in flow (to 33%) that would have a beneficial effect on migration conditions, or infrequent and small-magnitude decreases in flow that would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration in the American River.

Stanislaus River

Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different between NAA and Alternative 1A during the periods evaluated.

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April kelt migration period. Flows under A5_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Juveniles

Flows in the San Joaquin River at Vernalis were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the San Joaquin River at Vernalis were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the San Joaquin River at Vernalis were evaluated for the March and April kelt migration period. Flows under A5_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mokelumne River

Water temperature modeling was not conducted in the Mokelumne River.

Juveniles

Flows in the Mokelumne River were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the Mokelumne River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the Mokelumne River were evaluated for the March and April kelt migration period. Flows under A5_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Through-Delta

Sacramento River

Juveniles

Based on DPM results for winter-run Chinook salmon (migration period November to May) (Impact AQUA-42), survival of migrating juvenile steelhead under Alternative 5 would be expected to be similar to baseline (Table 11-5-14).

The new north Delta intake structure of Alternative 5 would increase potential predation loss of migrating juvenile salmonids and would displace 3.8 acres of aquatic habitat. Losses of juvenile winter-run Chinook salmon were estimated ranging from 2% to 4% of juveniles reaching the Delta (Impact AQUA-42 for Alternative 5). However, juvenile steelhead would be less vulnerable than winter-run Chinook salmon to predation associated with the intake facilities because of their greater size and strong swimming ability.

Adults

As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin water at Collinsville under Alternative 5 was within 6% of proportions for NAA during the September-March steelhead upstream migration period (Table 11-5-15). For a discussion of the topic see the analysis for Alternative 1A.

Alternative 5 would not have an adverse effect on adult and kelt steelhead migration through the Delta.

San Joaquin River

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There no flow changes associated with the Alternatives. Alternative 5 would have no effect on steelhead migration success through the Delta.

Adults

The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run migration period (September to December) is small, typically 0.1% to less than 3% under NAA. Alternative 1A operations conditions would incrementally increase olfactory cues associated with the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River. For a discussion of the topic see the analysis for Alternative 1A.

NEPA Effects: Upstream of the Delta, these results indicate the effect of Alternative 5 would not be adverse, because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of steelhead. The upstream effects would range from negligible effects on water temperature, and negligible effects (<5%) on flow, substantial increases in flow (to 47%) that would have beneficial effects on migration conditions, isolated occurrences of small to modest decreases (to -17%) that would not have biologically meaningful effects on migration conditions, and more substantial decreases in mean monthly flow in the Feather River (to -61%) that would only occur during September (the start of the adult migration period) in some water years and would not be prevalent enough to have biologically meaningful effects on adult migration conditions. There would be no effects of Alternative 5 on water temperatures in any river evaluate.

Near-field effects of Alternative 5 NDD on Sacramento River steelhead related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 1 new intake would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 4% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the 1 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 5 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for steelhead. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 5 on steelhead migration remains uncertain.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of migration habitat for steelhead would not be affected relative to the CEQA baseline.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A from Existing Conditions during the periods evaluated.

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A5_LLT would be up to 10%, 9% and 18% lower than flows under Existing Conditions during individual water years during November, December and May, respectively, but would not differ between model scenarios for the remaining seven months of the migration period except for somewhat higher flows in individual water years in October, January, February and March (up to 22% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be variable compared to Existing Conditions in September with higher flows in wet and above normal water years (43% and 64%, respectively) and lower flows in below normal and dry water years (12% and 24%, respectively). Flows under A5_LLT would be up to 10%, 9% and 18% lower than flows under Existing Conditions during individual water years during November, December and May, respectively, but would not differ between model scenarios for the remaining seven months of the migration period except for somewhat higher flows in individual water years in October, January, February and March (up to 22% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to those under Existing Conditions except in below normal water years during March (10% lower). Overall in the Sacramento River, these results indicate that there would be no biologically meaningful impacts of Alternative 5 on juvenile, adult, and kelt migration.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period under A5_LLT would generally be similar to or greater than flows under Existing Conditions (up to

54% greater) except in below normal and critical years during October (6% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A5_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in critical years during September (28% lower) and October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A5_LLT would generally be similar to or greater than flows under Existing Conditions (up to 29% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, Alternative 5 would have primarily negligible effects (<5%) on flows or would cause increases in mean monthly flow that would be beneficial for migration conditions (to 54%).

Feather River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to Existing Conditions.

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be generally lower than flows under Existing Conditions during November and May (up to 28% lower), higher flows during October (up to 39% higher), similar or greater flows in January, February, March, and April and mixed flows during December with lower flows in wet and critical water years (11% and 14%, respectively) and greater in above normal, below normal and dry water years (8%, 11% and 6%, respectively).

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be generally lower than flows under Existing Conditions during November May (up to 21% lower), higher flows during October (up to 39% higher), similar or greater flows in January, February, and March, and mixed flows during December with lower flows in wet and critical water years (11% and 14%, respectively) and greater in above normal, below normal and dry water years (8%, 11% and 6%, respectively).

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or up to 15% greater than flows under Existing Conditions except in below normal water years during March (18% lower).

Overall, these results indicate that migration conditions for steelhead in the Feather River would be degraded by Alternative 5. Although flows would be mostly similar between Existing Conditions and Alternative 5, water temperatures would be greater under Alternative 5 that would have biologically meaningful effects on steelhead migration conditions.

American River

Water temperatures in the Feather River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would higher under Alternative 1A during substantial portions of the juvenile and adult migration periods relative to Existing Conditions.

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 27% greater than flows under Existing Conditions during February and March. Flows under A5_LLT would generally be up to 34% lower than flows under Existing Conditions during October through December, April and May. Flows would generally be higher than those under Existing Conditions during February and March.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 27% greater than flows under Existing Conditions during February and March. Flows under A5_LLT would generally be up to 48% lower than flows under Existing Conditions during September through December. Flows would generally be higher than those under Existing Conditions during February and March.

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A5_LLT would generally be up to 14% greater than flows under Existing Conditions during March and lower than flows under Existing Conditions in above normal and below normal water year during April and higher than Existing Conditions in critical water years in April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall, these results indicate that Alternative 5 would reduce juvenile and adult migration conditions during a portion of their respective migration periods, but not kelt migration.

Stanislaus River

Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under Alternative 1A, which indicates that temperatures would be higher under Alternative 1A during substantial portions of the periods evaluated relative to Existing Conditions.

Flows in the Stanislaus River for Alternative 5 are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 29% lower in wet water years during September).

San Joaquin River

Flows in the San Joaquin River for Alternative 5 are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 16% lower in below normal years during March and 38% lower in wet years during May) except for similar flow conditions in November and December and somewhat higher flow conditions in some water years for January (up to 10% higher).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 5 are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 14% lower in below normal years during April) except for somewhat higher flow conditions in some water years for January and February (up to 18% higher) and generally higher flows for all water years in December (up to 15% higher).

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Juveniles

During the juvenile steelhead emigration period (October through May), mean monthly flows in the Sacramento River below the north Delta intake would be reduced (6% to 20% lower) under Alternative 5 compared to Existing Conditions. Based on DPM results for winter-run Chinook salmon (migration period November to May) (Impact AQUA-42), survival of migrating juvenile steelhead under Alternative 5 would be expected to be similar to baseline (Table 11-5-14). As discussed above in Impact AQUA-42, potential predation loss at the new north Delta intake would be 2% to 4% for migrating juvenile winter-run Chinook salmon, but this would be even lower for juvenile steelhead because of their greater size and strong swimming ability. The impact to juvenile steelhead migration through the Delta would be less than significant, and no mitigation would be required.

Adults

As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin water at Collinsville under Alternative 5 was within 6% of proportions for Existing Conditions during the September-March steelhead upstream migration period (Table 11-5-15).

San Joaquin River

The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run migration period (September to December) is small, typically 0.1% to less than 3% under NAA. Alternative 1A operations conditions would incrementally increase olfactory cues associated with the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River. For a discussion of the topic see the analysis for Alternative 1A.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce migration conditions, contrary to the NEPA conclusion set forth above. Alternative 5 would have biologically meaningful effects on juvenile and adult steelhead migration conditions in the Feather, American, Stanislaus, San Joaquin, and Mokelumne Rivers). Alternative 5 would not have biologically meaningful effects on migration conditions in the Sacramento and Feather Rivers or in Clear Creek. There would be no effects of Alternative 5 on in-Delta migration conditions, including through-Delta juvenile survival and adult olfactory cues.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-97). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Impact AQUA-97, restoration construction activities are not expected to adversely affect steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-97 for steelhead, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-98). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-98, contaminants associated with restoration measures are not expected to adversely affect steelhead with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-98 for steelhead, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

NEPA Effects: The effects of restored habitat conditions on steelhead would be the same as described for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact AQUA-45 above. However, steelhead are assumed and/or known to occur within the Plan Area for relatively short periods of time as both juveniles and adults. As noted for other salmonids, the benefits of the restoration in the Plan Area include a substantial increase in tidal, floodplain, channel margin, and riparian habitat, which is anticipated to provide improved habitat for occupancy and appreciably greater food production for juvenile steelhead; however, because most juvenile steelhead are typically migrants passing quite quickly through the Plan Area, the effect of food benefits and habitat change would be limited for rearing. Additionally, steelhead also occur in the Cosumnes/Mokelumne ROA and would receive the benefits of increased habitat acreage and food production in this location.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-99, the potential impact of restored habitat conditions on steelhead is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on steelhead are the same as those described under Alternative 1A (Impacts AQUA-100 through AQUA-108). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Sacramento Splittail

Construction and Maintenance of CM1

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: The potential effects of construction of the water conveyance facilities on Sacramento splittail would be similar to those described for Alternative 1A (Impact AQUA-109) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-109, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-109 for Sacramento splittail, the impact of the construction of water conveyance facilities on Sacramento splittail would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than under Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-110) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance of water conveyance facilities on Sacramento splittail would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Water Exports from SWP/CVP South Delta Facilities

Total entrainment of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass inundation) averaged across all water years would be 877% greater under Alternative 5 compared NAA) (Table 11-5-39). The greatest increase in total entrainment would be in above normal water years (1,732%). However, this effect is related to the expected increase in overall juvenile splittail abundance resulting from additional floodplain habitat in wetter years. The per capita juvenile splittail entrainment averaged across all years would be relative unchanged (3% decrease) under Alternative 5 compared to NAA (Table 11-5-40). Average adult entrainment would be reduced 9% across all water years (Table 11-5-41). The relative impact of entrainment on the splittail population would be similar or reduced under Alternative 5 relative to NAA because the per capita entrainment risk would be similar to NAA. The decrease in per capita entrainment of splittail is due to reductions in south Delta water exports during the main May–June entrainment period.

Table 11-5-39. Juvenile Sacramento Splittail Entrainment Index[a] (Yolo Bypass Days of Inundation Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	8,044,574 (838%)	7,857,888 (685%)
Above Normal	635,108 (1,388%)	643,713 (1,732%)
Below Normal	20,311 (595%)	20,743 (695%)
Dry	2,912 (101%)	3,257 (128%)
Critical	1 (0%)	452 (42%)
All Years	2,647,760 (874%)	2,590,050 (700%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost, based on normalized data, estimated from Yolo Bypass Inundation Method.

Table 11-5-40. Juvenile Sacramento Splittail Entrainment Index[a] (per Capita Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-351,540 (-18%)	-27,221 (-2%)
Above Normal	-19,920 (-15%)	-2,088 (-2%)
Below Normal	448 (4%)	765 (8%)
Dry	-630 (-31%)	-139 (-9%)
Critical	-515 (-39%)	-257 (-24%)
All Years	-116,454 (-21%)	-14,906 (-3%)

Shading indicates entrainment increased by 10% or more.

[a] Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

Table 11-5-41. Adult Sacramento Splittail Entrainment Index[a] (Salvage Density Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-370 (-9%)	-505 (-12%)
Above Normal	-548 (-11%)	-564 (-12%)
Below Normal	-441 (-13%)	-176 (-6%)
Dry	262 (-11%)	-97 (-4%)
Critical	-212 (-6%)	10 (0%)
All Years	-401 (-11%)	-323 (-9%)

Shading indicates entrainment increased by 10% or more.

[a] Estimated annual number of fish lost, based on normalized data. Average (December–March).

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A (with five intakes), but the degree would be less because Alternative 5 would only have one north Delta intake. Therefore, under Alternative 5 there would be about an 80% reduction in impingement and predation risk associated with the north Delta facilities relative to Alternative 1A (Impact AQUA-111).

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effect of implementing dual conveyance for the NBA with an alternative Sacramento River intake would be the same as described under Alternative 1A (Impact AQUA-111). Screens on the Barker Slough pumping plant currently exclude fish greater than 25 mm, and the alternate intake on the Sacramento River would be screened to effectively exclude splittail greater than 10 mm in length (detailed in *BDCP Effects Analysis – Appendix 5.8, Entrainment, Section 6.2.4.2*).

Predation Associated with Entrainment

Under Alternative 5, per capita juvenile splittail entrainment and associated predation losses at the south Delta would be fairly similar (3% decreased) to NAA.

Predation at the north Delta would increase due to the construction of the proposed water export facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was not a factor currently limiting splittail abundance.

NEPA Effects: In conclusion, under Alternative 5 the effect of entrainment risk on the splittail population would not be adverse, because per capita entrainment would be similar for juveniles and reduced for adults compared to NAA. Additionally, the effect of predation loss, particularly at the north Delta intake, would have no effect on the splittail population since it is relatively minor compared to the magnitude of south Delta entrainment loss and would be offset by increased production of juveniles due to *CM2 Yolo Bypass Fisheries Enhancement.*

CEQA Conclusion: Under Alternative 5 total juvenile entrainment (based on Yolo Bypass inundation) would be 838% greater averaged across all years compared to Existing Conditions. However, operational activities associated with reduced south Delta water exports would result in an overall decrease in the proportion of splittail population entrained for all water year types. At the south Delta facilities, estimated per capita juvenile entrainment would be reduced by 21% (116,000 juveniles) and adult entrainment would be reduced 11% (400 adults) relative to Existing Conditions. Entrainment and hence pre-screen predation loss at the south Delta facilities would be reduced. Entrainment of splittail would also be reduced at the NBA. The impact and conclusion for predation associated with entrainment would be the same as described above.

In conclusion, the impact from entrainment and associated predation loss under Alternative 5 would be less than significant, because of improvements in overall entrainment and the increased production of juvenile splittail from CM2 actions. No mitigation would be required.

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

In general, Alternative 5 would have beneficial effects on splittail spawning habitat relative to NAA due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo Bypass. There would also be beneficial effects on channel margin and side-channel spawning habitat due to small to moderate increases in mean monthly flow in the Sacramento River and the Feather River for a portion of the spawning period.

Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning overwhelmingly dominates production in wet years. During low-flow years when floodplains are not inundated, spawning in side channels and channel margins would be much more critical.

Floodplain Habitat

Effects of Alternative 5 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the

Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow velocity was generally very low throughout the modeled area for most conditions, with generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo Bypass inundation events compared to NAA; the changes are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of the analyses provided here. For the drier type years (below normal, dry, and critical), Alternative 5 results in an increase in frequency of inundation events greater than 30 days compared to NAA (Table 11-5-42). For below normal years, Alternative 5 would result in occurrence of one inundation event ≥70 days, compared to zero such events for NAA; and one inundation event of 30–49 days, compared to zero such events for NAA in critical years. For dry and critical years, project-related increases are for 30–49 day duration events only as there are no events of longer duration for either scenario. These results indicate that overall project-related effects on occurrence of various duration inundation events would be beneficial for splittail spawning by creating better spawning habitat conditions.

Table 11-5-42. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February 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. A5_LLT	NAA vs. A5_LLT
30–49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	4	4
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

There would be increases in area of acreage of suitable splittail habitat in Yolo Bypass under A5_LLT ranging from 5 to 832 acres relative to NAA (Table 11-5-43). Areas under A5_LLT would be 49%, 56%, and 192% greater than areas under NAA in wet, above normal, and below normal water years, respectively. There would be increases in area under A5_LLT in dry and critical years relative to NAA, but they would be minimal (7 and 5 acres, respectively). These results indicate that increases in inundated acreage in each water year type would result in increased habitat and have a beneficial effect on splittail spawning.

Table 11-5-43. Change in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass under Alternative 5 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

	A5_LLT	
Water Year Type	vs. EXISTING CONDITIONS	vs. NAA
Wet	971 (63%)	832 (49%)
Above Normal	652 (57%)	644 (56%)
Below Normal	240 (183%)	244 (192%)
Dry	7 (NA)	7 (NA)
Critical	5 (NA)	5 (NA)

NA = could not be calculated because the denominator was 0.

A potential negative effect of Alternative 5 that is not included in the modeling is reduced inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. Potential effects on habitat and uncertainties in predicting the magnitude of such effects would be the same as described for Alternative 1A. These results indicate that Alternative 5 has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass inundation, but these effects have not been quantified.

Channel Margin and Side-Channel Habitat

Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel habitat upstream of the Delta. These habitats are likely to be especially important during dry years, when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are affected by changes in flow because greater flows cause more flooding, thereby increasing availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are expected to be most important to the splittail population because in years of high-flows, when most production comes from floodplain habitats, the upstream side-channel habitats contribute relatively little production.

Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the Sacramento River for the time-frame February through June. These are the most important months for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from the side-channel habitats during May and June if conditions become unfavorable.

Differences between model scenarios for monthly average flows during February through June by water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For the Sacramento River at Wilkins Slough, flows during February through March under A5_LLT would be similar to flows under NAA. During April flows would be similar to NAA except higher in critical years. May flows would be higher in critical, dry and above normal years and lower in below normal and wet water years. June flows would be higher in all water years than under NAA. Generally these flows result in a beneficial effect on rearing conditions. These results indicate that there would be some increases in flow (up to 15%) that would have beneficial effects on splittail rearing conditions in the Sacramento River.

Modeling indicated no differences in project-related effects on water temperature for Alternative 5 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be exceeded in the Sacramento River and would rarely be exceeded in the Feather River. Therefore, effects of Alternative 5 on water temperature would not affect spawning habitat conditions for Sacramento splittail.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 5 would be as described for Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

NEPA Effects: Collectively, these results indicate the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Alternative 5 would result in increased spawning habitat in Yolo Bypass, would have negligible effects (<5% difference), small effects that would not be biologically meaningful (-10% change in mean monthly flow), and small to moderate beneficial effects (increases in mean monthly flow to 15% in the Sacramento River and to 34% in the Feather River) on channel margin and side-channel rearing habitats, and would have negligible effects on spawning conditions based on stranding potential (flow reductions) and changes in water temperature.

CEQA Conclusion: In general, Alternative 5 would have beneficial effects on splittail spawning habitat relative to Existing Conditions due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo Bypass. There would also be beneficial effects on channel margin and side-channel spawning habitat due to small to moderate increases in mean monthly flow in the Sacramento River and the Feather River for a portion of the spawning period.

Floodplain Habitat

Alternative 5 would result in increased acreage of suitable spawning habitat compared to Existing Conditions in all water years (Table 11-5-43), with increases of between 5 and 971 acres of suitable spawning habitat depending on water year type. Increased areas for wet, above normal, and below normal water years are predicted to be 63%, 57%, and 183%, respectively, for Alternative 5. Comparisons for dry and critical water years indicate project-related increases of 7 and 5 acres of suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results indicate that Alternative 5 would have beneficial effects on splittail habitat through increasing spawning habitats by up to 183%.

Channel Margin and Side-Channel Habitat

Modeled flows were in the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for February through June splittail spawning and early life stage rearing (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate Alternative 5 would have negligible effects (<5%) during February through April, with the exception of a flow decrease (-6% during March in below normal years) and a flow increase (8% during April in critical years). Effects of Alternative 5 on flow during May and June consist primarily of increase in mean monthly flow (to 26%), except for decreases during May in below normal years (-7%), and in wet years (-17%). These results indicate that effects of Alternative 5 on flows would not have biologically meaningful effects on splittail spawning rearing conditions in the upper Sacramento River.

Flows in the Feather River at the confluence with the Sacramento River were evaluated during February through June. Flows during this period would show variable effects of Alternative 5 (A5_LLT compared to Existing Conditions) depending on month and water year type, with primarily negligible effects (<5%) or increases in flow (to 30%) that would have beneficial effects on rearing conditions. There would be (to -18%) decreases in mean monthly flow during February and March in below normal years, decreases to -28% during May in wet and above normal years when the effects of flow reductions on rearing conditions would be less critical, and decreases during June in wet (-17%) and critical years (-9%). Flow reductions in drier water years when they would be most critical for rearing conditions would be infrequent and of small magnitude. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on splittail rearing conditions in the Feather River. Modeling results indicate no differences in project-related effects on water temperature for Alternative 5 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be exceeded in the Sacramento River and rarely exceeded in the Sacramento and Feather Rivers. Therefore, impacts on spawning habitat for Sacramento splittail would not be biologically meaningful.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 5 would be as described for Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

Summary of CEQA Conclusion

Collectively, these results indicate the impact would be less than significant because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. No mitigation would be necessary. Alternative 5 would result in increased spawning habitat in Yolo Bypass, and would have negligible effects on spawning conditions based on stranding potential (flow reductions) and changes in water temperature. Effects of Alternative 5 on mean monthly flows would consist of negligible effects (<5% difference), beneficial effects based on increases in mean monthly flow to 30%, and infrequent small (-9%) to moderate (-28%) decreases in flow that would not have biologically meaningful effects (based on infrequent occurrence and/or on the timing in wetter years when effects of flow reductions on habitat conditions would be less critical) on channel margin and side-channel rearing habitats.

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

NEPA Effects: In general, Alternative 5 would have beneficial effects on splittail rearing habitat relative to NAA based on the beneficial effects on floodplain habitat in the Yolo Bypass and channel margin and side-channel habitats in the Sacramento River and the Feather River described in the previous impact discussion, AQUA-112.

Sacramento splittail rear in floodplain and main-channel environments; the analyses of splittail weighted habitat area and effects of flow conditions on channel margin and side-channel habitats provided in the previous impact, Impact AQUA-112, apply to rearing as well as spawning habitat for splittail. There would be increases in mean monthly flow for portions of the rearing period that would be beneficial for rearing conditions in channel margin and side-channel habitat in the Sacramento River (to 15%) and the Feather River (increases to 34%). Therefore, effects of Alternative 5 on flow would not have adverse effects on availability of channel margin and side-channel habitat for rearing in the Sacramento River and the Feather River at the confluence with the Sacramento River. Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create habitat in the Yolo Bypass.

CEQA Conclusion: In general, Alternative 5 would have beneficial effects on splittail rearing habitat relative to Existing Conditions, based on the beneficial effects on floodplain habitat in the Yolo Bypass and channel margin and side-channel habitats in the Sacramento River and the Feather River described in the previous impact discussion, AQUA-112.

Project effects on splittail rearing habitat are the same as described for spawning habitat in the previous impact discussion, Impact AQUA-112. Effects of Alternative 5 on flow would not negatively affect the availability of channel margin and side-channel habitat in the Sacramento River and the Feather River at the confluence with the Sacramento River. There would be increases in mean monthly flow for portions of the rearing period that would be beneficial for rearing conditions in channel margin and side-channel habitat in the Sacramento River (to 26%) and the Feather River (to 30%). Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create habitat in the Yolo Bypass. These results indicate that impact would be less than significant and no mitigation would be required.

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

Upstream of Delta

Effects of Alternative 5 on migration conditions for Sacramento splittail would be the same as described above for channel margin and side-channel environments (Impact AQUA-112). As concluded above, the effect would not be adverse. Effects of Alternative 5 on flow would not have meaningful negative effects on the availability of channel margin and main-channel habitat, and would have beneficial effects on migration conditions from increases in mean monthly flow for a portion of the migration period.

Through-Delta

Alternative 5 would reduce OMR reverse flows during the months of juvenile splittail migration through the Delta compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore the effect on juvenile migration survival would be beneficial, because of the improvement in OMR flow conditions under Alternative 5.

NEPA Effects: In general, effects of Alternative 5 on upstream splittail migration conditions would be beneficial relative to NAA, based on occurrence of increases in mean monthly flow in the Sacramento River and the Feather River for portions of the migration period, and reduced OMR flows compared to NAA.

CEQA Conclusion:

Upstream of Delta

Effects of Alternative 5 on migration conditions for Sacramento splittail would be the same as described above for channel margin and side-channel environments (Impact AQUA-112). As concluded above, the impact would be less than significant and no mitigation would be necessary. Effects of Alternative 5 on flow would not have meaningful negative effects on the availability of channel margin and main-channel habitat, and would have beneficial effects on migration conditions from increases in mean monthly flow for a portion of the migration period.

Through-Delta

Average OMR flows would be slightly reduced in May, particularly in below normal and dry water year types, but increased relative to Existing Conditions during the other months of the juvenile splittail migration through the Delta. Periods of increased reverse flows in May would remain within the NMFS and USFWS BiOp requirements, thus the changes are not expected to have a significant impact. Therefore the impact on splittail migration survival would be less than significant, because of the overall improvement in OMR flows under Alternative 5.

Summary of CEQA Conclusion

In general, effects of Alternative 5 on upstream splittail migration conditions would be beneficial relative to Existing Conditions, due to increased mean monthly flows in the Sacramento and Feather Rivers. Although average OMR flows would be slightly reduced relative to Existing Conditions in May, but increased during the other juvenile splittail migration months, through the Delta, the impact on splittail migration survival would be less than significant, and no mitigation is required.

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

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Alternative 1A, Impact AQUA-115). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-115, restoration construction activities are not expected to adversely affect Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-115 for Sacramento splittail, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-116). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-116, contaminants associated with restoration measures are not expected to adversely affect Sacramento splittail with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-116 for Sacramento splittail, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-117). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Impact AQUA-117 under Alternative 1A, restored tidal habitat is expected to be beneficial for Sacramento splittail although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to Sacramento splittail through increased habitat and improved food production especially those migrating to and from the San Joaquin River. Increased food production from all ROAs that is exported into the Delta will also benefit Sacramento splittail. The overall improved habitat connectivity will benefit all species including Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-117 for Sacramento splittail, the potential impact of restored habitat conditions on Sacramento splittail is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on Sacramento splittail are the same as those described under Alternative 1A (Impacts AQUA-118 through AQUA-126). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Green Sturgeon

Construction and Maintenance of CM1

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

NEPA Effects: The potential effects of construction of the water conveyance facilities on green sturgeon would be similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-127, the impact of the construction of water conveyance facilities on green sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-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 5 would be the same as those described for Alternative 1A (see Impact AQUA-128) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-128, the effect 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 would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

Alternative 5 is expected to reduce overall entrainment of juvenile green sturgeon at the south Delta export facilities, estimated as salvage density, by about 23–30% (34–49 fish) as compared to NAA (Table 11-5-44). Like Alternative 1A (Impact AQUA-129), entrainment reductions would be greater in wet and above normal years 25–31% decrease, 26–35 fish) than in below normal, dry, and critical years (20–29% decrease, 8–14 fish) compared to NAA. Alternative 5 would be beneficial for juvenile green sturgeon.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 5 and NAA (34 fish). The impact and conclusion for predation risk associated with NPB structures and the north Delta intake would be the same as described for Alternative 1A, Impact AQUA-129.

NEPA Effects: The effect on entrainment and predation losses under Alternative 5 would not be adverse.

CEQA Conclusion: As described above, annual entrainment losses of juvenile green sturgeon across all water year types would decrease 33% (54 fish) under Alternative 5 (A5_LLT) relative to Existing Conditions (Table 11-5-44). Impacts of water operations on entrainment of green sturgeon would be beneficial and no mitigation would be required.

Table 11-5-44. Juvenile Green Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type[b]	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet and Above Normal	-38 (-33%)	-26 (-25%)
Below Normal, Dry, and Critical	-16 (-33%)	-8 (-20%)
All Years	-54 (-33%)	-34 (-23%)
	Shading indicates entrainment increased by 10% or more.	

[a] Estimated annual number of fish lost, based on non-normalized data.
[b] Sacramento Valley water year-types.

The impact and conclusion for predation associated with entrainment would be the same as described above. Since few juvenile green sturgeon are entrained at the south Delta, reductions in entrainment (33% reduction compared to Existing Conditions, representing 54 fish) under Alternative 5 would have little effect in affecting entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 5.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 5 would not reduce spawning and egg incubation habitat for green sturgeon relative to NAA.

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under A5_LLT would almost always be similar to or greater than flows under NAA, except during dry years in March at Keswick (5% lower) although flows can be lower or higher in individual months of individual years. These results indicate that there would be very few reductions in flows in the Sacramento River under Alternative 5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. Flows under A5_LLT would be similar to or greater than flows under NAA at both Thermalito Afterbay and the confluence with the Sacramento River except in below normal years during March at Thermalito Afterbay (11% lower). These results indicate that there would be very few reductions in flows in the Feather River under Alternative 5 independent of climate change (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of Alternative 1A on temperatures during the period evaluated relative to NAA.

Flows in the San Joaquin River under Alternative 5 would be the same as those under NAA throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be limited effects of Alternative 5 on flows and water temperatures in the Sacramento and Feather rivers that would not affect spawning and egg incubation conditions for green sturgeon. Further, there would be no effects of Alternative 5 on flows in the San Joaquin River.

CEQA Conclusion: In general, Alternative 5 would not reduce spawning and egg incubation habitat for green sturgeon relative to Existing Conditions.

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows at Keswick under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal and dry years during March (18% and 7% lower, respectively), above normal years during April (6% lower), wet and below normal years during May (23% and 7% lower, respectively), and critical years during July (11% lower). Flows upstream of Red Bluff under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal water years during March in wet and below normal years during May, and in critical years during July. Also, flows can be lower or higher in individual months of individual years These results indicate that there would be few reductions in flows in the Sacramento River under Alternative 5 relative to Existing Conditions.

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. At Thermalito, flows under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in above normal and below normal years during February (8% and 46% lower, respectively), below normal years during March (48% lower) and in wet and above normal years during May (37% and 7% lower, respectively). (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)*.* At the confluence with the Sacramento River, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal years during February and March (12% and18% lower, respectively), in wet and above normal years during May (28% and 14% lower, respectively), and in wet and critical years during June (17% and 9% lower, respectively). These results indicate that there would be reductions in flows in the Feather River under Alternative 5 relative to Existing Conditions.

Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher in both rivers under Alternative 1A during the periods evaluated.

Flows in the San Joaquin River at Vernalis under Alternative 5 would be similar to those under Existing Conditions throughout the March through June spawning and egg incubation period for green sturgeon, except during June, in which there would be a 30% flow reduction under Alternative 5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis).*

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the NEPA conclusion set forth above. Flows in the Feather River at the confluence with the Sacramento River would be moderately lower under Alternative 5 relative to Existing Conditions. Further, water temperature-related impacts would be greater in the Sacramento and Feather Rivers, which could lead to reduced hatching success and egg mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

In general, Alternative 5 would not reduce the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to NAA.

Water temperature was used to determine the potential effects of Alternative 5 on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Water temperatures in the Sacramento River and Feather River for Alternative 5 are not different from those for Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not affect temperatures relative to NAA in either river. Water temperature modeling was not conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that this effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable rearing habitat relative to NAA.

CEQA Conclusion: In general, Alternative 5 would not reduce the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 5 on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Water temperatures in the Sacramento River and Feather River for Alternative 5 are not different from those for Alternative 1A, Impact AQUA-131, which indicates that there would be an increase in temperatures in both rivers under Alternative 1A relative to Existing Conditions.

Water temperature modeling was not conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. Temperatures under Alternative 5 would increase in both the Sacramento and Feather Rivers relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

In general, the effects of Alternative 5 on green sturgeon migration conditions relative to NAA are uncertain.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows under A5_LLT would generally be similar to or greater than flows under NAA in all months except September, during which flows would be up to 21% lower depending on location and water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved green sturgeon larval transport that results in improved year class strength. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be lower under Alternative 5.

Feather River flows under A5_LLT would generally be lower by up to 61% than those under NAA during August and September. Flows during other months under A5_LLT would generally be similar to or greater than flows under NAA with some exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

NEPA Effects: Upstream flows (above the north Delta intake) are similar between Alternative 5 and NAA. However, due to the removal of water at the north Delta intake, there are substantial differences in through-Delta flows between Alternative 5 and NAA (see Table 11-5-47 below). Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green sturgeon, found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of the north Delta intake, and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 5 would be deemed not adverse due to the similarities in upstream flow conditions between Alternative 5 and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 5 would be deemed adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 5 as compared to NAA.

CEQA Conclusion: In general, Alternative 5 would not affect green sturgeon migration conditions relative to Existing Conditions.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows between Keswick and Wilkins Slough under A5_LLT would generally be similar to or greater than flows under Existing Conditions in all months except February and November. In February and November, flows under A5_LLT would be up to 14% lower than under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

For Delta outflow, the percent of months exceeding flow thresholds under A5_LLT would be similar to or up to 50% lower (relative scale) than those under Existing Conditions depending on flow threshold, water year type, and month (Table 11-5-47).

Feather River flows between Thermalito and the confluence with the Sacramento River under A5_LLT would generally be similar to or greater than flows under Existing Conditions during all months except January and November. During January and November, flows under A5_LLT would be up to 45% lower than under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-132 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Although there are reductions in flows in the Sacramento and Feather rivers during summer and fall months under the Alternative 5 relative to the Existing Conditions, these reductions are not frequent enough (two of 12 months) to have substantial effects on green sturgeon migration. Exceedance of Delta outflow thresholds would be lower under Alternative 5 than under Existing Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows are co-variable with another unknown factor.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration conditions for green sturgeon. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-133). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-133, restoration construction activities are not expected to adversely affect green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-133 for green sturgeon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-134). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-134, contaminants associated with restoration measures are not expected to adversely affect green sturgeon with respect to copper, ammonia and pesticides. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-134 for green sturgeon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-135). These would include *CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration,* and *CM10 Nontidal Marsh Restoratio*n. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Alternative 1A, Impact AQUA-135 under Alternative 1A, restored tidal habitat is expected to be beneficial for delta smelt although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to green sturgeon in all ROAs except the south Delta. Sturgeon foraging on marsh mudflats will benefit from the increased transfer of increased production to mudflat fauna. Increased food production from all ROAs that is exported into the Delta will also benefit sturgeon. The overall improved habitat connectivity will benefit all species including sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-135 for green sturgeon, the potential impact of restored habitat conditions on green sturgeon is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on green sturgeon are the same as those described under Alternative 1A (Impacts AQUA-136 through AQUA-144). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

White Sturgeon

Construction and Maintenance of CM1

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of construction of the water conveyance facilities on white sturgeon would be similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-145, the impact of the construction of water conveyance facilities on white sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-146) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance of water conveyance facilities on white sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Water Exports

Alternative 5 is expected to reduce overall entrainment of juvenile white sturgeon at the south Delta export facilities, estimated as salvage density, by 23–30% (62–91 fish) across all water year types as compared to NAA (Table 11-5-45). As discussed for Alternative 1A (Impact AQUA-147), entrainment is highest in wet and above normal water years. Under Alternative 5, entrainment in wet and above normal water years would be reduced 24–31% (59–83 fish), compared to NAA. Therefore, Alternative 5 would have beneficial effects on juvenile white sturgeon.

Predation Associated with Entrainment

Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 5 and NAA (62 fish). The effect on predation loss under Alternative 5 would not be adverse.

CEQA Conclusion: As described above, operational activities associated with water exports from SWP/CVP south Delta facilities would decrease entrainment for juvenile white sturgeon by 35% (117 fish) under Alternative 5 (A5_LLT) relative to Existing Conditions (Table 11-5-45). Impacts of water operations on entrainment of white sturgeon would be beneficial and no mitigation would be required.

Table 11-5-45. Juvenile White Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between Model Scenarios for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type[b]	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet and Above Normal	-105 (-36%)	-59 (-24%)
Below Normal, Dry, and Critical	-12 (-28%)	-4 (-13%)
All Years	-117 (-35%)	-62 (-23%)

Shading indicates entrainment increase of 10% or more.

[a] Estimated annual number of fish lost, based on non-normalized data.
[b] Sacramento Valley water year-types.

The impact and conclusion for predation associated with entrainment would be the same as described immediately. Since few juvenile white sturgeon are entrained at the south Delta, reductions in entrainment (35% reduction compared to Existing Conditions, representing 117 fish) under Alternative 5 would have little effect in affecting entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 5.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 5 would not affect spawning and egg incubation habitat for white sturgeon relative to NAA.

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 A5_LLT from February to May would be similar to or greater than those under NAA, except at Verona in below normal years during February (7% lower), below normal and dry years in March (8% and 6% lower, respectively), and wet and above normal years during April (7% and 5% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be mostly small (<10%) reductions in flows in the Sacramento River under Alternative 5.

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito Afterbay under A5_LLT would be similar to or greater than flows under NAA during February to May, except in below normal years during March (11%). Flows under A5_LLT at the confluence with the Sacramento River would always be similar to or greater than flows under NAA. These results indicate that there would be few low magnitude reductions in flows in the Feather River during the white sturgeon spawning and egg incubation period under Alternative 5.

Flows in the San Joaquin River under Alternative 5 would not be different from those under Alternative 1A, Impact AQUA-148, which indicates that flows under Alternative 1A would not differ from those under NAA throughout the period evaluated.

Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-148, which indicates that flows under Alternative 1A would not differ from those under NAA throughout the period evaluated.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Reductions in flows under Alternative 5 are small and infrequent relative to NAA and, therefore, would not have a substantial effect on the species. There would be no increases in temperatures in the Sacramento or Feather rivers.

CEQA Conclusion: In general, Alternative 5 would not affect spawning and egg incubation habitat for white sturgeon relative to Existing Conditions.

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 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Wilkins Slough, flows under A5_LLT would be similar to or greater than those under Existing Conditions, except in below normal years during March (6% lower) and wet and below normal years during May (17% and 7% lower, respectively). At Verona, flows under A5_LLT from February to May would be generally similar to or up to 22% lower than Existing Conditions, depending on month and water year type. These results indicate that there would be mostly small (<12%) reductions in flows in the Sacramento River under Alternative 5 relative to Existing Conditions.

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito Afterbay from February to May under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in above normal and below normal years during February (8% and 46% lower, respectively), below normal years during March (48% lower), and wet and above normal years during May (37% to 7% lower, respectively). Flows at the confluence with the Sacramento River under A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal years during February and March (12% and 18% lower, respectively) and wet and above normal years during May (28% and 14% lower, respectively). These results indicate that there would be few reductions in flows in the Feather River under Alternative 5 relative to Existing Conditions.

Flows in the San Joaquin River under Alternative 5 would not be different from those under Alternative 1A, Impact AQUA-148, which indicates that flows would not differ between Existing Conditions and Alternative 1A.

Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of Alternative 1A on temperatures relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be less than significant and no mitigation is necessary because Alternative 5 does not have the potential to substantially reduce the amount of suitable habitat. Reductions in flows under Alternative 5 relative to Existing Conditions are small and infrequent and, therefore, would not have a substantial effect on the species. There would be no increases in temperatures in the Sacramento or Feather rivers.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

In general, Alternative 5 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to NAA.

Water temperature was used to determine the potential effects of Alternative 5 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Water temperatures in the Sacramento and Feather rivers under Alternative 5 would not be different from those under Alternative 1A, Impact AQUA-149, which indicates that there would be no effect of Alternative 1A on temperatures in either river relative to NAA.

Water temperatures were not modeled in the San Joaquin River.

NEPA Effects: These results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat.

CEQA Conclusion: In general, Alternative 5 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 5 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates. Water temperatures in the Sacramento and Feather rivers under Alternative 5 would not be different from those under Alternative 1A, which indicates that there would be no effect of Alternative 1A on temperatures in the Sacramento River relative to Existing Conditions, but temperatures would be higher under the majority of months under Alternative 1A in the Feather River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA conclusion set forth above. Water temperatures would be higher in the Feather River during the majority of the white sturgeon rearing period.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat of white sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, the effects of Alternative 5 on white sturgeon migration conditions relative to NAA are uncertain.

Analyses for white sturgeon focused on the Sacramento River (north Delta to RM 143—i.e., Wilkins Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-5-19). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A5_LLT were generally similar to those under NAA (Table 11-5-46). The number of months per year above 31,000 cfs at Verona would range from small increases to a reduction of 0.5 months (21% lower in wet years) relative to NAA. Overall, there is no consistent difference between Alternative 5 and the NAA. On an absolute scale, none of these values would be biologically meaningful (up to 0.2 months).

Table 11-5-46. Difference and Percent Difference in Number of Months in Which Flow Rates Exceed 17,700 and 5,300 Cubic Feet per Second (cfs) in the Sacramento River at Wilkins Slough, and 31,000 cfs at Verona

Water Year Types	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wilkins Slough, 17,700 cfs[a]		
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%)
Wilkins Slough, 5,300 cfs[b]		
Wet	-0.2 (-2%)	0 (1%)
Above Normal	-0.1 (-1%)	0.3 (4%)
Below Normal	0.2 (4%)	0.5 (10%)
Dry	0.6 (11%)	0.3 (5%)
Critical	0.3 (10%)	0.3 (7%)
Verona, 31,000 cfs[a]		
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.
[a] Months analyzed: February through May.
[b] Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percent of months exceeding flow thresholds under A5_LLT would generally be lower than those under NAA (up to 33% lower) (Table 11-5-47). These results indicate that, using the positive correlation between Delta outflow and year class strength, year class strength would be lower under Alternative 5.

Table 11-5-47. Difference and Percent Difference in the Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in April and in May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
April			
15,000 cfs	Wet	-4 (-4%)	-4 (-4%)
	Above Normal	-8 (-9%)	-8 (-9%)
20,000 cfs	Wet	-4 (-5%)	-4 (-5%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-12 (-13%)	-4 (-5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-27 (-32%)	-4 (-6%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-19 (-28%)	-8 (-13%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-8 (-9%)	-4 (-5%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	0 (0%)	0 (0%)

For juveniles, year-round migration flows at Verona would be up to 30% under A5_LLT relative to NAA throughout much of the year and under almost all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Although the differences would be generally small, they would occur throughout the year (in all but two months).

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-5-19). The average number of months exceeding 5,300 cfs under A5_LLT would always be similar to or up to 10% greater than the number of months under NAA.

NEPA Effects: Upstream flows (above the north Delta intake) are similar between Alternative 5 and NAA (Table 11-5-46). However, due to the removal of water at the north Delta intake, there are substantial differences in through-Delta flows between Alternative 5 and NAA (Table 11-5-47). Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of the north Delta intake, and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 5 would be deemed not adverse due to the similarities in upstream flow conditions between Alternative 5 and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 5 would be deemed adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 5 as compared to NAA.

CEQA Conclusion: In general, migration conditions for white sturgeon under Alternative 5 would be similar to those under the CEQA baseline.

The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough under A5_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal years (25% lower) (Table 11-5-19). The number of months per year above 31,000 cfs at Verona would be mostly lower than under Existing Conditions, except in critical water years (0% difference).

For Delta outflow, the percent of months exceeding flow thresholds under A5_LLT would be similar to or up to 50% lower (relative scale) than those under Existing Conditions depending on flow threshold, water year type, and month (Table 11-5-47).

For juveniles, year-round migration flows at Verona would be up to 34% under A5_LLT relative to Existing Conditions throughout much of the year under and almost all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Although the differences would be generally small, they would occur throughout the year (every month but October).

For adult migration, the average number of months exceeding 5,300 cfs under A5_LLT would generally be similar or up to 11% greater than the number of months under Existing Conditions (Table 11-5-46).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta outflow would be lower under Alternative 5 than under the CEQA Existing Conditions although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows co-vary with another unknown factor. Juvenile migration flows in the Sacramento River at Verona would be up to 34% lower during most months relative to Existing Conditions. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would not in itself result in a significant impact on migration habitat of white sturgeon. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-151). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-7, restoration construction activities are not expected to adversely affect white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-151 for white sturgeon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-152). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-152, contaminants associated with restoration measures are not expected to adversely affect white sturgeon with respect to copper, ammonia and pesticides. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-152 for white sturgeon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-153). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Impact AQUA-153 under Alternative 1A, restored tidal habitat is expected to be beneficial for white sturgeon although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to white sturgeon in all ROAs except the South Delta. Sturgeon foraging on marsh mudflats will benefit from the increased transfer of increased production to mudflat fauna. Increased food production from all ROAs that is exported into the Delta will also benefit sturgeon. The overall improved habitat connectivity will benefit all species including sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-153 for white sturgeon, the potential impact of restored habitat conditions on white sturgeon is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on white sturgeon are the same as those described under Alternative 1A (Impacts AQUA-154 through AQUA-162). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Pacific Lamprey

Construction and Maintenance of CM1

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: The potential effects of construction of the water conveyance facilities on Pacific lamprey would be similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Impact AQUA-163, the impact of the construction of water conveyance facilities on Pacific lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-164) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Water Exports

The potential entrainment impacts of Alternative 5 on Pacific lamprey would be the same as described above for Alternative 1A for operating new SWP/CVP north Delta intakes (Impacts AQUA-165), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-165), and decommissioning agricultural diversions in ROAs (Impacts AQUA-165). These actions would avoid or reduce potential entrainment and the effect would not be adverse.

The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta facilities is combined because the salvage facilities do not distinguish between the two lamprey species. Under Alternative 5, average annual entrainment of lamprey at the south Delta export facilities, as estimated by salvage density, would be reduced by about 10% (312 fish) (Table 11-5-48) across all water year types compared to NAA. Therefore, Alternative 5 would not have adverse effects on lamprey.

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 10% 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. The overall effect of predation loss on lamprey is considered not adverse.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be decreased by 12% (418 fish) under Alternative 5 (A5_LLT) relative to Existing Conditions. Impacts on Pacific lamprey are expected to be considered less than significant due to expected reductions in entrainment, and no mitigation would be required.

Table 11-5-48. Lamprey Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All Years	-418 (-12%)	-312 (-10%)
	Shading indicates entrainment increase of 10% or more.	
[a] Number of fish lost, based on non-normalized data, for all months.		

The impact and conclusion for predation associated with entrainment would be the same as described immediately above because the additional predation losses associated with the proposed north Delta intake would be partially offset by the reduction in predation loss at the south Delta. The relative impact of predation loss on the lamprey population is unknown since there is little available knowledge on their distribution and abundance in the Delta. The impact is considered to 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 5 would reduce the quantity and quality of Pacific lamprey spawning habitat relative to the NAA.

Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk and effects on 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 Thermalito Afterbay, and American River at Nimbus Dam and at the confluence with the Sacramento River. Pacific lamprey spawn in these rivers between January and August. 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%.

For evaluation of dewatering risk, comparisons for Alternative 5 to NAA indicate increases would occur in the Feather River (49% increase in dewatering risk) that would have negative effects on spawning success, and smaller increases would occur in the American River (to 7%) that would not have biologically meaningful effects (Table 11-5-49). Alternative 5 effects in all other locations analyzed consist of negligible effects (<5%) or decreases in dewatering risk (to -15% in the Sacramento River) that would constitute a beneficial effect.

Table 11-5-49. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Sacramento River at Keswick	Difference	12	-10
	Percent Difference	22%	-13%
Sacramento River at Red Bluff	Difference	7	-11
	Percent Difference	13%	-15%
Trinity River downstream of Lewiston	Difference	-1	-1
	Percent Difference	-1%	-1%
Feather River at Thermalito Afterbay	Difference	0	42
	Percent Difference	0%	39%
American River at Nimbus Dam	Difference	45	8
	Percent Difference	54%	7%
American River at Sacramento River confluence	Difference	46	6
	Percent Difference	48%	4%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 5 than under the baseline (Existing Conditions or NAA).

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on Pacific lamprey egg exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure would be similar to NAA at most locations, although egg exposure would substantially increase in the Feather River below Thermalito Afterbay.

NEPA Effects: Collectively, these results indicate that the 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 a 39% increase in the number of Pacific lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than 50% in the Feather River, which would affect lamprey spawning and egg incubation habitat in the Feather River. Also, there would be a 91% increase in the risk of egg exposure to temperatures greater than 71.6°F. 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 (Mitigation Measures AQUA-166a through Aqua-166c) would reduce the severity of effects, this would not necessarily result in a not adverse determination.

CEQA Conclusion: In general, Alternative 5 would reduce the quantity and quality of Pacific lamprey spawning habitat relative to Existing Conditions due to moderate to substantial increases in exposure to month-over-month flow reductions in the Sacramento River and the American River.

Rapid reductions in flow can dewater redds leading to mortality. Predicted effects of Alternative 5 in the Sacramento River and American River are for increases in the number of redd cohorts predicted to experience a month-over-month change in flow of greater than 50% relative to Existing Conditions (Table 11-5-49). Changes would be most substantial for the American River, with increased risk of dewatering exposure to 45 cohorts or 54% at Nimbus Dam, and 46 cohorts or 48% at the confluence. Effects of Alternative 5 would be negligible (<5%) for the Trinity River and Feather River.

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on egg exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure would be greater than under Existing Conditions at the Sacramento, Feather, and American Rivers.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 5 on flow would affect Pacific lamprey redd dewatering risk in Sacramento River (22% increase in exposure risk) and the American River (maximum of 54% increase in exposure risk), but would not have a biologically meaningful effect in the Feather River and Trinity River. Further, there would be an increase in egg exposure to elevated temperatures in the Sacramento, Feather, and American Rivers. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of Mitigation to Reduce Impacts to Spawning Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 5 would have significant and unavoidable adverse effects on spawning habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 5.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 5 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 5.

Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to spawning habitat under Alternative 5. 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).

Mitigation Measure AQUA-166c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on Pacific lamprey habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-166a.

If feasible means are identified to reduce impacts on spawning habitat consistent with the overall operational framework of Alternative 5 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on Pacific lamprey habitat is not feasible under Alternative 5 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on Pacific lamprey would remain significant and unavoidable.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, effects of Alternative 5 on Pacific lamprey rearing habitat would be negligible relative to NAA.

Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk 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.

Additionally, as described for operations-related effects of Alternative 5 on spawning habitat for Pacific lamprey above, it was determined that the effects of Alternative 5 on water temperatures for the Sacramento River, Trinity River, Feather River, and the American River were the same as those described in Impact AQUA-167 for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during Pacific lamprey ammocoete rearing are not adverse relative to NAA.

Effects of Alternative 5 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 11-5-50). Results indicate no effect (0%) or negligible effects (<5%) to ammocoete cohort exposures to all flow reduction categories. These results indicate that project-related effects of Alternative 5 on flow would not affect Pacific lamprey ammocoete stranding conditions in the Sacramento River at Keswick.

Table 11-5-50. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	-1	-1
-70%	-1	-1
-75%	-3	0
-80%	7	0
-85%	47	0
-90%	NA	NA

NA = all values were 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-5-51) indicate no change (0%) or negligible effects (<5%) on ammocoete cohort exposures to all flow reductions. These results indicate that Alternative 5 would not affect Pacific lamprey ammocoete stranding conditions in the Sacramento River at Red Bluff.

Table 11-5-51. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	3	-1
-60%	1	-1
-65%	-2	-3
-70%	9	-2
-75%	9	0
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the Trinity River indicate no effect (0%) or negligible changes (<5%) attributable to the project (Table 11-5-52). These results indicate that Alternative 5 would not affect Pacific lamprey ammocoete stranding conditions in the Trinity River.

Table 11-5-52. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the Feather River indicate no difference (0%) or negligible effects (<5%) for flow reductions up to 80%, and decreases in the percentage of cohorts exposed to 85% flow reductions (-10%) and 90% flow reductions (-56%) that would have a beneficial effect on spawning success (Table 11-5-53). These results indicate that Alternative 5 would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding conditions in the Feather River.

Table 11-5-53. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	2
-85%	18	-10
-90%	-22	-56

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the American River at Nimbus Dam (Table 11-5-54) indicate negligible effects (<5%) for most flow reduction categories, small increases (to 11%) in cohorts exposed to 75% and

80% flow reductions, and a moderate decrease (-25%) in cohorts exposed to 90% flow reductions which would have a beneficial effect on spawning success. These results indicate that Alternative 5 would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding conditions in the American River at Nimbus Dam.

Table 11-5-54. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	2	0
-70%	40	1
-75%	113	11
-80%	314	9
-85%	400	-1
-90%	125	-25

NA = could not be calculated because the denominator was 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the American River at the confluence with the Sacramento River (Table 11-5-55) indicate no effect (0% difference) on cohort exposure for all flow reduction categories with the exception of small (10%) to moderate (28%) increases in exposure to 80, 85, and 90% flow reductions. These results indicate that project-related effects of Alternative 5 would cause small to moderate increases in ammocoete cohort exposures to flow reductions but not of a magnitude that would contribute to biologically meaningful negative effects on spawning success in the American River at the confluence with the Sacramento River.

Table 11-5-55. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	8	0
-75%	37	0
-80%	279	28
-85%	300	14
-90%	364	10

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there would be small to moderate increases and decreases in exposure relative to NAA will balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality in any of the locations analyzed. While the effects of climate change would increase stranding risk during A5_LLT for some locations, project-related effects would primarily consist of no effect (0%), negligible effects (<5%), isolated categories of flow reductions that would experience a small increase in cohort exposure, or small decreases in stranding risk that would have beneficial effects on rearing success. There would also be small, beneficial effects in the Feather River and the American River at Nimbus Dam from decreased exposures to month-over-month flow reductions in the higher flow reduction categories. There would be small to moderate increases and decreases in ammocoete exposure to elevated temperatures that will balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of rearing habitat for Pacific lamprey would not be affected relative to the CEQA baseline.

Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of month-over-month flow reductions under Alternative 5 relative to Existing Conditions for the Sacramento River at Keswick indicate negligible changes (<5%) in occurrence of cohort exposure for all flow reduction categories with the exception of a small increase in exposure (7%) in the 80% flow reduction category and a more substantial increase in exposure (47%) to 85% flow reductions (Table 11-5-50). With primarily negligible to small effects and a moderate effect on a single flow reduction category, these results indicate that effects of Alternative 5 on flow would not result in biologically meaningful effects on Pacific lamprey ammocoete stranding risk in the Sacramento River at Keswick.

Comparisons of Alternative 5 to Existing Conditions for the Sacramento River at Red Bluff indicate negligible changes (<5%) in occurrence of cohort exposure for flow reduction categories from 50% to 65%, small increases (to 13%) in exposure to 70, 75, and 80% flow reductions, and a more substantial increase in exposure (56 to 112 cohorts or 100%) to 85% flow reductions (Table 11-5-51). These results indicate that effects of Alternative 5 on flow would cause increase risk of Pacific lamprey ammocoete stranding in the Sacramento River at Red Bluff but not to the extent that would be considered a biologically meaningful effect on rearing success.

Comparisons of Alternative 5 to Existing Conditions for the Trinity River indicate no effect (0% difference) in ammocoete cohort exposure for the lower flow reduction categories, and moderate increases in cohort exposure (to 41%) for flow reductions from 75% to 90% (Table 11-5-52). The effects of Alternative 5 on flow reduction exposures are consistent for the higher flow reduction categories which would contribute incrementally to increased stranding risk and therefore would have a negative effect on rearing conditions.

Comparisons of Alternative 5 to Existing Conditions for Feather River indicate no effect (0% difference) on ammocoete cohort exposures for the lower flow reduction categories, a moderate increase in cohort exposure (18%) to flow reductions of 85%, and a moderate decrease (22%) in exposures to flow reductions of 90% (Table 11-5-53). Based on the fact that moderate effects on cohort exposure would only occur for the two highest flow reduction categories, with one adverse and one beneficial in terms of stranding risk, these results indicate that effects of Alternative 5 on flow would not cause biologically meaningful effects on rearing success.

Comparisons for the American River at Nimbus Dam (Table 11-5-54) and at the confluence with the Sacramento River (Table 11-5-55) indicate negligible effects (<5%) on ammocoete cohort exposures under A5_LLT relative to Existing Conditions for 50% through 65% flow reduction events, and moderate (40%) to substantial increases (to 400%) in exposures for the larger flow reduction categories. These are substantial increases in cohort stranding exposure and would have negative effects on spawning success at both locations.

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there would be substantial increases in ammocoete exposure in all rivers evaluated relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 5 on flow would affect ammocoete stranding risk in the Trinity River and the American River at Nimbus Dam and at the confluence with the Sacramento River (based on substantial increases in the number of cohorts exposed to stranding risk in the larger flow reduction categories, to 41% in the Trinity River and between 40% and 400% in the American River), and would not have biologically meaningful effects in the Sacramento River and the Feather River. Also, there would be substantial increases in ammocoete exposure to elevated temperatures in all rivers evaluated.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

In general, effects of Alternative 5 on Pacific lamprey migration conditions would be negligible relative to NAA.

Macropthalmia

After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. Migration generally is associated with large flow pulses in winter months (December through March) (USFWS unpublished data) meaning alterations in flow have the potential to affect downstream migration conditions. The effects of Alternative 5 on seasonal migration flows for Pacific lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the migration pathways of Pacific lamprey during the likely migration period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, and the American River at the confluence with the Sacramento River.

Sacramento River

Analysis of Alternative 5 on mean monthly flow rates for the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate negligible effects (<5%) or small decreases in mean monthly flow (to -11%) for all months during the migration period. These results indicate that effects of Alternative 5 on flow would not cause biologically meaningful effects on macropthalmia migration conditions in the Sacramento River at Rio Vista.

For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), the difference in mean monthly flow rate for Alternative 5 indicates negligible effects on flow (<5%) or small increases or decreases (to 5%) that would not affect migration conditions, and increases in mean monthly flow (to 9%) for some water years during May which would have a beneficial effect on migration conditions. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Sacramento River at Red Bluff.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate negligible project-related effects (<5%) or increases in flow to 24% that would have beneficial effects on migration, with the exception of a single, small project-related decrease in flow during December in above normal years (-6%). These results indicate that effects project-related effects of Alternative 5 on flow would not have biologically meaningful effects on macropthalmia migration in the Feather River at the confluence.

American River

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate project-related effects consist primarily of negligible effects (<5%), with small to moderate increases in flow (to 18%) during some months/water years that would be beneficial for migration, and a small decrease in flow (-9%) during January in dry years that would be isolated and of small magnitude and therefore not have biologically meaningful negative effects. These results indicate that project-related effects of Alternative 5 on flow would not have biologically meaningful effects on macropthalmia migration in the American River.

Overall, effects of Alternative 5 on outmigrating macropthalmia for all locations analyzed consist of negligible effects on flow (<5% difference), small to moderate increases in flow that would have a beneficial effect on migration conditions, or infrequent and relatively small decreases in flow (to -11%) which would not have biologically meaningful effects on Pacific lamprey macropthalmia migration.

Adults

Sacramento River

For the Sacramento River at Red Bluff project-related effects consist primarily of negligible effects (<5%), with increases in mean monthly flow (to 9%) during May and June for some water years and a single occurrence of a small decrease in flow (-5%) during January in dry years. These results indicate that project-related effects of Alternative 5 on flow would not have biologically meaningful effects on adult migration in the Sacramento River.

Feather River

For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) project-related effects consist primarily of negligible changes (<5%) throughout the migration period, with occasional, small increases in flow (to 12%) for some months/water years and more substantial increases (to 34%) during June in all but critical water years. Increases in drier years during April and June would have a beneficial effect on migration conditions. These results indicate that project-related effects of Alternative 5 on flow would not affect adult migration conditions in the Feather River.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate predominantly negligible effects (<5%) or small increases in flow (to 12%) attributable to the project with more substantial increases for some water years during May (to 18%) and June (to 56%) that would have beneficial effects on migration conditions. These results indicate that effects of Alternative 5 on flow would not affect adult migration conditions in the American River.

Overall, project-related effects of Alternative 5 on flow for all locations analyzed consist of negligible effects on flow (<5% difference), small to substantial increases in flow (to 56%) that would have a beneficial effect on migration conditions, or infrequent, small decreases in flow (-5%) that would not have biologically meaningful effects on Pacific lamprey adult migration conditions.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Effects of Alternative 5 on mean monthly flows during the Pacific lamprey macropthalmia outmigration period and the adult migration period consist of negligible effects (<5%) or increases in flow (to 56%) that would have beneficial effects on migration conditions, with highly infrequent, small reductions in flow (to -11%) that would not have biologically meaningful effects on migration conditions.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of Pacific lamprey migration habitat would not be affected relative to the CEQA baseline.

Macropthalmia

Sacramento River

Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 5 relative to Existing Conditions indicate primarily negligible effects (<5%) with occasional small increases (to 10%) or decreases (to -12%) in mean monthly flow, with a moderate decrease (-17%) during March in below normal years and more substantial decreases (to -33%) during May in wetter water years. Effects in drier water year types when flow reductions would be most critical for migration conditions consist of negligible effects or small decreases (to -9%) in all months during the migration period with the exception of slightly greater reductions during March and May in below normal years (-17%). Flow reductions in drier water years would contribute incrementally to effects on migration but would not be of the frequency or magnitude to biologically meaningful effects on Pacific lamprey macropthalmia migration conditions.

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 5 relative to Existing Conditions indicate negligible (<5%) effects, or small decreases (to -9%) or increases in flow (to 13%) for all months and water years, which would have beneficial effects on migration conditions, with the exception of a moderate decrease in flow (-18%) during May in wet years when effects of flow reductions on migration conditions would be less critical. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on outmigrating macropthalmia at this location.

Feather River

Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate effects of Alternative 5 compared to Existing Conditions consist of negligible effects (<5%) or small increases (to 11%) or decreases in flow (-14%), with a few occurrences of larger increases in mean monthly flow (to 20%) that would have a beneficial effect on migration conditions, moderate decreases in flow predicted during January through March in below normal years (to -18%) and during May in wetter years (to -28%) when effects of flow reductions would be less critical for migration. Reductions for three months in below normal years would contribute to incremental effects on migration conditions; however, overall effects of Alternative 5 on flow for the entire migration period and all water years consists predominantly of negligible effects, increases in flow, and smaller decreases in flow. These results indicate that the effects of Alternative 5 on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable results depending on the specific month and water year, with negligible effects (<5%) or decreases in flow (to -23%) during December (including in drier water years), increases in wetter water years (to

27%) and decreases in drier water years (to -21%) during January through March, negligible effects (<5)% and small-scale increases (11%) or decreases (to -9%) during April, and reductions in flow (to -34%) during May in all but dry years (increase of 7%). Based on small to moderate reductions in flow in drier water years during most of the migration period (December through March and May), these results indicate that effects of Alternative 5 on flow would have negative effects on outmigrating macropthalmia in the American River at the confluence.

Overall, these results indicate that the effects of Alternative 5 on mean monthly flows during the Pacific lamprey macropthalmia migration period consist primarily of negligible effects (<5%), increases in flow that would be beneficial for migration conditions, and infrequent and/or small decreases in flow (to -17%), and occasional, more substantial decreases in wetter water years (to -33%) that would not affect migration conditions in the Sacramento River and the Feather River. Impacts would consist of more persistent and increased magnitude flow reductions throughout the migration period (flow reductions to -34% in December through March and May) in the American River.

Adults

Sacramento River

Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from January through June indicate primarily negligible effects (<5%), with small increases (to 11%) or decreases (to -10%) in flow that would not have biologically meaningful effects on migration conditions, and a moderate decrease in flow during May in wet years (-18%) when effects of flow reductions on migration conditions would be less critical. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on adult migration conditions in the Sacramento River.

Feather River

Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate effects of Alternative 5 consist primarily of negligible effects (<5%) or increases in flow (to 30%) that would have beneficial effects on migration, with the exception of small to moderate decreases (to -18%) during January, February, and March in below normal years that would not have biologically meaningful effects on migration conditions, moderate reductions during May in wet (-28%) and above normal (-14%) years when effects of flow reductions would be less critical for migration, and a reduction during June in wet years (-17%) and a small reduction in critical years (-9%) that would not have biologically meaningful effects. While flow reductions in drier water years would contribute incrementally to effects on migration, based on the prevalence of negligible effects and increases in flow, and isolated and/or small reductions in flow, effects would not be biologically meaningful for adult migration conditions in the Feather River.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate variable effects of Alternative 5 depending on the month and water year type, with negligible effects (<5%) or increases in flow (to 27%) in wetter water years and decreases (to -21%)

in drier water years for January through March, negligible effects or small decreases in flow (to -9%) during April, reductions in flow (to -34%) in all but dry years (increase of 7%) during May and decreases in wet (-32%) and critical years (-24%) in June with increases (to 19%) in below normal and dry years. The prevalence of moderate flow reductions in some of the drier water year types for January and May, with moderate decreases during February and June in critical years, would contribute incrementally to effects on migration conditions that would have negative effects on adult migration in the American River.

Overall, these results indicate that effects of Alternative 5 on flow during the January to June adult Pacific lamprey migration period in the Sacramento River and Feather River consist predominantly of negligible effects (<5% difference), increases in flow that would have beneficial effects, or small, isolated occurrences of decreases in flow (to -18%) for some water year types, or infrequent, more substantial decreases in wetter water years (to -28%) that would not have biologically meaningful effects. There would be greater prevalence of moderate flow reductions (to -34%) during some water year types from January through March, May, and June in the American River that would have negative effects on migration conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce migration conditions for Pacific lamprey, contrary to the NEPA conclusion set forth above. Effects of Alternative 5 on flow would affect Pacific lamprey macropthalmia and adult migration conditions in the American River (based on flow reductions to -34% for a substantial portion of the migration periods) and would not affect macropthalmia and adult migration in the Sacramento River and the Feather River (based on primarily negligible effects on flow, small increases that would have beneficial effects, and isolated occurrences of flow decreases to -18% in drier water years and to -33% in wetter water years that would not have biologically meaningful effects on migration conditions).

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

result in a significant impact on migration habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

NEPA Effects: The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-169). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-169, restoration construction activities are not expected to adversely affect Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-169 for Pacific lamprey, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-170). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-170, contaminants associated with restoration measures are not expected to adversely affect Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-170 for Pacific lamprey, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-171). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Impact AQUA-171 under Alternative 1A, restored tidal habitat is expected to be beneficial for Pacific lamprey although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to Pacific lamprey primarily through increased food production from all ROAs that is exported to the Delta. The overall improved habitat connectivity will benefit all species including Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-171 for Pacific lamprey, the potential impact of restored habitat conditions on Pacific lamprey is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on Pacific lamprey are the same as those described under Alternative 1A (Impacts AQUA-172 through AQUA-180). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

River Lamprey

Construction and Maintenance of CM1

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

NEPA Effects: The potential effects of construction of the water conveyance facilities on river lamprey would be similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-181, the impact of the construction of water conveyance facilities on river lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only one intake would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-182) except that only one intake would need to be maintained under Alternative 5 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Water Exports

The potential entrainment impacts of Alternative 5 on river lamprey would be the same as described above for Alternative 1A for operating new SWP/CVP north Delta intakes (Impacts AQUA-183), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-183), and decommissioning agricultural diversions in ROAs (Impacts AQUA-183). These actions would avoid or reduce potential entrainment and the effect would not be adverse.

The analysis of river lamprey entrainment at the SWP/CVP south Delta facilities is combined with the analysis of Pacific lamprey because the salvage facilities do not distinguish between the two lamprey species. Under Alternative 5, average annual entrainment of lamprey at the south Delta export facilities, as estimated by salvage density, would be reduced by about 10% (312 fish) (Table

11-5-56) across all water year types compared to NAA. Therefore, Alternative 5 would not have adverse effects on lamprey.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be decreased by 12% (418 fish) under Alternative 5 (A5_LLT) relative to Existing Conditions. Impacts of water operations on entrainment of river lamprey would be considered less than significant due to expected reductions in entrainment and no mitigation would be required.

Table 11-5-56. Lamprey Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities for Alternative 5

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All Years	-418 (-12%)	-312 (-10%)

Shading indicates entrainment increased by 10% or more.

[a] Number of fish lost, based on non-normalized data, for all months.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, effects of Alternative 5 on river lamprey spawning habitat would be negligible relative to NAA.

Flow-related effects on 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 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%. 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.

Results for the Sacramento River at Keswick indicate project-related increases would only occur in the Feather River, with a small increase of 12% that would not have biologically meaningful negative effects (Table 11-5-57). All other locations would experience negligible changes (<5%) attributable to the project or decreases in dewatering risk (to -12%) that would be beneficial for spawning success.

Table 11-5-57. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Sacramento River at Keswick	Difference	1	-2
	Percent Difference	3%	-6%
Sacramento River at Red Bluff	Difference	-2	-4
	Percent Difference	-5%	-10%
Trinity River downstream of Lewiston	Difference	-3	-1
	Percent Difference	-4%	-1%
Feather River at Thermalito Afterbay	Difference	-3	7
	Percent Difference	-4%	12%
American River at Nimbus Dam	Difference	10	1
	Percent Difference	18%	2%
American River at Sacramento River confluence	Difference	14	-3
	Percent Difference	24%	-4%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 5 than under the baseline (Existing Conditions or NAA).

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on river lamprey egg exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure would be similar to NAA at most locations, although egg exposure would moderately increase in the Feather River below Thermalito Afterbay.

NEPA Effects: These results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 5 on water temperature would be negligible, and effects on flow reductions that could negatively affect spawning and egg incubation conditions consists of negligible effects (<5%), a small increase in dewatering risk (12% for the Feather River) that would not have biologically meaningful effects, or decreases in dewatering risk (to -12%) that would be beneficial for spawning conditions. Egg exposure to elevated water temperatures under Alternative 5 would not increase in the majority of location evaluated.

CEQA Conclusion: In general, effects of Alternative 5 on river lamprey spawning habitat would be negligible relative to Existing Conditions based on primarily negligible effects on water temperatures and month-over-month flow reductions. Effects of Alternative 5 on flow reductions during the river lamprey spawning period from February to June in the Sacramento River, Trinity River, and Feather River consist of negligible (<5%) or small effects (-5%) on dewatering risk (Table 11-5-57). There would be increases in river lamprey redd cohort dewatering risk relative to Existing Conditions for the American River at Nimbus Dam (18%) and at the confluence (24%).

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on egg exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure would be greater than under Existing Conditions at the Sacramento, Feather, American, and Stanislaus Rivers.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. The risk of egg exposure to increased temperatures would be higher under Alternative 5 in multiple rivers. There would be negligible effects of Alternative 5 on redd dewatering risk.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

In general, effects of Alternative 5 on river lamprey rearing habitat would be negligible relative to NAA.

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, and effects of water temperatures. As described for river lamprey spawning effects above, water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under Alternative 5 in the upper Sacramento, Trinity, Feather, American, and Stanislaus Rivers for river lamprey ammocoete rearing. It was determined that the effects of Alternative 5 on water temperatures for all locations were the same as described for Alternative 1A in Impact AQUA-185. Conclusions for Alternative 1A are that effects of water temperature during river lamprey ammocoete rearing relative to NAA are not adverse.

For ammocoete stranding risk, the effects of Alternative 5 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 Alternative 5 to NAA for the Sacramento River at Keswick (Table 11-5-58) indicate either no effect (0%) or negligible effects (<5%) for all flow reduction categories attributable to the project. These results indicate that effects of Alternative 5 on flow would not affect ammocoete rearing success in the Sacramento River at Keswick.

Table 11-5-58. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	1	-1
-60%	4	1
-65%	-1	-2
-70%	-1	-1
-75%	-7	-1
-80%	11	0
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-5-59) indicate no change (0%) or negligible effects (<5%) attributable to the project for all flow reduction categories. These results indicate that effects of Alternative 5 on flow reductions would not affect river lamprey ammocoete stranding in the Sacramento River at Red Bluff.

Table 11-5-59. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	3	-1
-60%	6	-1
-65%	-2	-3
-70%	9	0
-75%	22	0
-80%	10	0
-85%	[25–50] 100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the Trinity River indicate negligible effects (<5%) for most flow reduction categories with a small reduction in ammocoete cohort exposures (-5%) to 75% flow reduction events and a small increase in exposure (6%) to 90% flow reduction events (Table 11-5-60). These results indicate Alternative 5 effects on flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the Trinity River.

Table 11-5-60. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-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%	62	6

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the Feather River no effect (0% difference) in exposures to flow events up to 75%, a small increase in exposure (7%) to 80% flow reductions, a more substantial increase (51%) for 90% flow reductions, and reduced exposure (-11%) to 85% flow reduction events (Table 11-5-61). With a substantial increase in ammocoete cohort exposure (51%) to a single flow reduction category (90%), and no effect, small effects, or a beneficial effect in the remaining categories, these results indicate that project-related effects of Alternative 5 on flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the Feather River.

Table 11-5-61. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	7
-85%	18	-11
-90%	-15	51

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Comparisons for the American River at Nimbus Dam (Table 11-5-62) and at the confluence with the Sacramento River (Table 11-5-63) indicate no effect (0%), negligible effects (<5%), small increases (to 12%) that would not have biologically meaningful effects on spawning success, or decreases (to -21%) that would have a beneficial effect, with the exception of moderate increases in exposure to 80% and 85% flow reduction events at the confluence (41% and 16%, respectively). Small increases in exposures to several larger flow reduction categories at Nimbus Dam would partially offset by a moderate reduction in exposure to 90% flow reduction events. Small to moderate increases in exposures to flow reductions, with a more substantial increase in exposure (31%) to a single flow reduction category (80%) would contribute incrementally to effects on rearing conditions at the confluence but not to the extent that would be considered an adverse effect. These results indicate that project-related effects of Alternative 5 on flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the American River.

Table 11-5-62. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0.0	0.0
-55%	0.0	0.0
-60%	0.0	0.0
-65%	0.0	0.8
-70%	5.6	0.0
-75%	2.8	12.4
-80%	60.0	10.1
-85%	31.2	3.6
-90%	544.0	-21.3

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Table 11-5-63. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	0
-70%	24	1
-75%	60	4
-80%	345	31
-85%	400	16
-90%	396	7

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there would be small to moderate increases and decreases in exposure will balance out within rivers such that there would be no overall effect on river lamprey ammocoetes relative to NAA.

NEPA Effects: Overall, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. Results indicate that effects of Alternative 5 on flow would not affect river lamprey ammocoete stranding in the Sacramento River at Keswick and Red Bluff, Trinity River, Feather River, and the American River at Nimbus Dam and the confluence. This is based on results indicating no change (0%), negligible effects (<5%), or only small effects (to 6%) in flow reduction events attributable to the project for all flow reduction categories in the Sacramento River and Trinity River. Results for the Feather River and the American River are more variable, with small to substantial (51%) increases in exposure to one or two flow reduction categories and small to moderate decreases in exposure (to -21%) to other flow reduction categories, with an overall result of no adverse effects on rearing success. There would be small to moderate increases and decreases in exposure will balance out within rivers such that there would be no overall effect on river lamprey ammocoetes

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of rearing habitat for river lamprey would not be reduced relative to the CEQA baseline.

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, and effects on water temperatures. As described for river lamprey spawning effects above, water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under Alternative 5 in the upper Sacramento, Trinity, Feather, and American Rivers for river lamprey ammocoete rearing. It was determined that the effects of Alternative 5 on water temperatures for all locations analyzed were the same as described for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during river lamprey ammocoete rearing would be less than significant relative to Existing Conditions.

Flow reductions were evaluated to determine the effects of Alternative 5 on ammocoete stranding risk. Comparisons of Alternative 5 to Existing Conditions for the Sacramento River at Keswick indicate negligible effects (<5%) or small-scale effects (to ±11%) on the number of ammocoete cohorts exposed to flow reductions for all flow reduction categories (Table 11-5-58) with the exception of a larger increase (44%) in exposure to month-over-month flow reductions of 85%. Comparisons for the Sacramento River at Red Bluff indicate slightly more variable results with negligible effects (<5%) for all flow reduction categories except for small increases (5% to 10%) in the 60%, 70%, and 80% flow reduction categories, and more substantial increases in exposure to 75% flow reduction events (20%) and 85% flow reduction events (25 to 50 cohorts or 100%) (Table 11-5-59). While there would be fairly substantial increases in the number of cohorts exposed to the 85% reduction category at both locations, effects would be negligible or small in all other flow reduction categories and therefore, results indicate that effects of Alternative 5 on flow reductions would not have biologically meaningful effects on river lamprey ammocoete stranding in the Sacramento River at Keswick and at Red Bluff.

Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50% to 70%, and increases ranging from 26% to 62% for the higher flow reduction categories (Table 11-5-60). These consistent and more substantial increases in ammocoete cohort exposures to larger flow reductions would affect ammocoete stranding risk and therefore rearing success in the Trinity River.

Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for all flow reduction categories with the exception of a moderate increase in cohort exposure (18%) to 85% flow reductions (Table 11-5-61). Decreased exposure (-15%) to 90% flow reduction events would have a beneficial effect. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the Feather River.

Comparisons for the American River at Nimbus Dam (Table 11-5-63) and at the confluence with the Sacramento River (Table 11-5-63) indicate small (5%) to substantial (480%) increased ammocoete cohort exposures to flow reductions between 70 and 90% for Alternative 5 compared to Existing Conditions; substantial increases are from 58 to 480% (increase in cohorts exposed from 25 to 145) for Nimbus Dam and from 24% to 400% (increase in cohorts exposed from 50 to 250) for the confluence. These consistent and substantial increases in ammocoete cohorts exposed to flow reductions would affect ammocoete stranding risk and therefore rearing success in the American River.

Because water temperatures under Alternative 5 would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there would be moderate to large increases in ammocoete exposure under Alternative 1A in all rivers evaluated that would substantially reduce rearing habitat conditions relative to Existing Conditions.

Summary of CEQA Conclusion

Overall, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 5 on flow reductions would affect ammocoete stranding risk in the Trinity River (based on increases to 62% for the larger flow reduction categories) and the American River (based on increases to 480% for the larger flow reduction categories), and would not affect rearing conditions in the Sacramento River and the Feather River (based on the occurrence of project-related increases in flow reductions with smaller magnitudes deemed to not contribute to biologically meaningful effects on rearing success). Further, there would be moderate to large increases in ammocoete exposure under Alternative 1A in all rivers evaluated that would substantially reduce rearing habitat conditions

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

result in a significant impact on rearing habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

In general, effects of Alternative 5 on river lamprey migration conditions would be negligible relative to NAA.

Macropthalmia

After 3 to 5 years river lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. River lamprey migration generally occurs September through November (USFWS unpublished data). The effects of water operations on seasonal migration flows for river lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of river lamprey during the likely migration period (September through November) were examined to predict how Alternative 5 may affect migration flows for outmigrating macropthalmia. Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, and the American River at the confluence with the Sacramento River.

Sacramento River

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November negligible effects (<5%) for some water years during September and October, with increases (to 20%) that would have a beneficial effect on migration and a small decrease (-14%) during September in below normal years. Project-related effects during November consist of small (-6 to -8%) to moderate (to -17%) decreases in all water years. Effects in drier water years for the migration period consist of negligible effects, increased flow, or relatively small decreases in mean monthly flow that would contribute incrementally to effects on migration conditions but would not be expected to have biologically meaningful effects on migration conditions. These results indicate that while flow reductions would occur, effects on outmigrating macropthalmia would not be biologically meaningful.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River indicates decreases in mean monthly flow during September in wetter years (to -47%) when effects on migration would be less critical, negligible effects in dry years, and a small increase (7%) in critical years. Project-related effects during October consist of increases in mean monthly flow (to 39%) which would benefit migration. Effects during November consist of negligible effects (<5%) in all water years except a small decrease (-6%) in above normal years. Fairly substantial reductions in flow during September in wetter water years would contribute incrementally to effects on migration conditions; however, this would be offset by increases during October. Based on this and negligible effects or positive effects in drier water years, these results indicate that effects of Alternative 5 on flow would not cause biologically meaningful negative effects for river lamprey macropthalmia migration in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November a prevalence of negligible (<5%) or small-scale effects on mean monthly flow, with decreases (to -16%) during September in wet and below normal years, during October in wet, above normal, and critical years, and during November in above and below normal years. These would be offset by small to moderate increases (to 24%) in some water years in each month. Effects in drier water years consist primarily of negligible effects, increases in flow, or small decreases. These results indicate that project-related effects of Alternative 5 on flows would not have biologically meaningful negative effects on river lamprey macropthalmia migration in the American River.

Overall, these results indicate that, despite some variation in results by location, month, and water year type, effects of Alternative 5 on flow would generally not have biologically meaningful effects on river lamprey macropthalmia migration in the Sacramento River, Feather River, and American River.

Adults

Effects of Alternative 5 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above. Results are the same; Alternative 5 would not have biologically meaningful negative effects on adult river lamprey migration in the Sacramento River, Feather River, and American River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Project-related effects consist primarily of negligible effects (<5%), increases in flow (to 24%) that would have a beneficial effect, infrequent small decreases (to -16%) in drier water years that would not have biologically meaningful effects, and more substantial decreases (to -47%) in wetter years when effects on migration would not be critical.

CEQA Conclusion: In general, under Alternative 5 water operations, the quantity and quality of migration habitat for river lamprey would not be reduced relative to the CEQA baseline.

Macropthalmia

Sacramento River

Comparisons for the Sacramento River at Red Bluff for September through November indicate variable effects of Alternative 5 during September, with increases in mean monthly flow (to 64%) in wetter years and decreases (to -24%) in drier years, primarily negligible effects (<5%) and increases in flow (to 22%) during October, and negligible effects or small decreases (to -10%) during November. Flow reductions during September (-24%) and November (-10%) in dry years, and smaller reductions during November in below normal (-13%) and critical years (-10%), would have incremental effects on migration conditions but would not be substantial enough to cause biologically meaningful negative effects on migration conditions.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for September through November indicate variable results by month and water year type, with primarily increases (to 72%) in wetter years and decreases (to -34%) in drier years during September, primarily increases in mean monthly flow during October (to 39%) with the exception of a small decrease (-7%) in wet years, and negligible effects (<5%) or small to moderate (to -21%) decreases during

November. There would be a substantial reduction in flow in below normal years during September (-30%) with negligible effects during October and a further decrease (-8%) during November that would contribute incrementally to effects on migration conditions in this water year type. The substantial reduction in flow during September in dry years (-34%) would be offset somewhat with an increase during October (11%). While decreases for some of the drier water years during September and November would contribute incrementally to migration conditions, overall effects of Alternative 5 on flows would not have biologically meaningful effects on river lamprey macropthalmia migration conditions in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November indicate reductions in flow during September through November in all water year types, ranging from -12 to -48%, with the exception of an increase during October in below normal years (29%) and negligible effects in critical years. The predominance of moderate to substantial decreases in mean monthly flows under Alternative 5 throughout the migration period would affect river lamprey macropthalmia migration conditions in the American River.

Overall, these results indicate that effects of Alternative 5 on flow from September through November would not have biologically meaningful negative effects on river lamprey macropthalmia migration in the Sacramento River and the Feather River (based on primarily negligible effects or increases in flow, to 72%, with isolated decreases in drier years to -34%), but would affect conditions in the American River (based on decreases in mean monthly flow from -12% to -48% in all water year types throughout the migration period with only a few isolated exceptions).

Adults

Effects of Alternative 5 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above. These results indicate that Alternative 5 would affect adult migration conditions in the American River, and would not have biologically meaningful negative effects in the Sacramento River and Feather River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 5 on flow would be biologically meaningful to river lamprey macropthalmia and adult migration conditions in the American River based on persistent and substantial decreases in mean monthly flow (from -12% to -48% in all water year types throughout the migration period with only a few isolated exceptions), and would not be biologically meaningful in the Sacramento River and Feather River (based on variable results with infrequent and/or small reductions in flow in drier years, to -34%, and otherwise primarily negligible effects, <5%, or increases in flow, to 72% that would have beneficial effects).

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 5 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

The potential effects of restoration construction activities under Alternative 5 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-187). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact AQUA-187, restoration construction activities are not expected to adversely affect river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-187 for river lamprey, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

NEPA Effects: The potential effects of contaminants associated with restoration measures under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-188). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-188, contaminants associated with restoration measures are not expected to adversely affect river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-188 for river lamprey, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat restoration (25,000 acres rather than 65,000 acres).

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

NEPA Effects: The potential effects of restored habitat conditions under Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-189). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As concluded in Alternative 1A, Impact AQUA-189 under Alternative 1A, restored tidal habitat is expected to be beneficial for river lamprey although the reduced acreage would reduce the benefit. The present discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

The restored tidal habitat will provide benefits to river lamprey primarily through increased food production from all ROAs that is exported to the Delta. The overall improved habitat connectivity will benefit all species including river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-189 for river lamprey, the potential impact of restored habitat conditions on river lamprey is considered to be beneficial although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on river lamprey are the same as those described under Alternative 1A (Impacts AQUA-190 through AQUA-198). The effects would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required.

Non-Covered Aquatic Species of Primary Management Concern

Construction and Maintenance of CM1

The effects of construction and maintenance of CM1 under Alternative 5 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-1) except that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require about 4.7 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. Additionally, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream. As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities on non-covered species of primary management concern would not be significant except potentially 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.

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-2) except that only one intake would be maintained rather than five intakes. California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream. Consequently, the effects would not be adverse.

CEQA Conclusion: As described above, these impacts would be less than significant.

Water Operations of CM1

The effects of water operations of CM1 under Alternative 5 include a detailed analysis of the following species:

- Striped Bass
- American Shad
- Threadfin Shad
- Largemouth Bass
- Sacramento tule perch
- Sacramento-San Joaquin roach – California species of special concern
- Hardhead – California species of special concern
- California bay shrimp

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Striped bass eggs and larvae would be vulnerable to entrainment at the proposed single north SWP/CVP Delta intake and the alternate NBA intake as these life stages are passively transported downstream to the north Delta. State of the art fish screens on the north Delta intake though would exclude juvenile and adult striped bass.

Entrainment losses under Alternative 5 to the SWP/CVP south Delta intakes would be expected to decrease moderately compared to NAA since exports from the south Delta facilities would be moderately reduced in the summer. Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs (approximately 4–12% of diversions) would not increase entrainment and may provide a minor benefit. Additionally, decommissioning of agricultural diversions may also reduce entrainment of striped bass. Also, restoration activities as part of the conservation measures should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that these habitat changes would result in at least a minor improvement in production of juvenile striped bass. Overall, the effect on striped bass entrainment would not be adverse.

Variations in striped bass survival rates during the first few months of life are moderated by a population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al. 2000). Therefore it would be expected that reductions in entrainment of juveniles and adults at the south Delta intakes would have a greater population impact than increases in entrainment of striped bass larvae and eggs at the proposed SWP/CVP north Delta intake and the NBA intake.

CEQA Conclusion: The impact of water operations on entrainment of striped bass would be the same as described immediately above. The changes in entrainment under Alternative 5 would not substantially reduce the striped bass population. The impact would be less than significant and no mitigation would be required.

American Shad

American shad eggs and larvae would be vulnerable to entrainment at the proposed single north SWP/CVP Delta intake and the alternate NBA intake as these life stages are passively transported downstream to the north Delta. State of the art fish screens on the north Delta intake though would exclude juvenile and adult American shad.

American shad entrainment losses under Alternative 5 would decrease compared to NAA due to moderately reduced south Delta exports in the summer. Reduced south Delta entrainment would also be expected to reduce predation loss associated with these facilities, especially within Clifton Court Forebay. Reduction or consolidation of agricultural diversions in ROAs would not increase entrainment. Overall, the effect on American shad would not be adverse, and would be slightly beneficial.

CEQA Conclusion: The impact of water operations on entrainment of American shad would be the same as described immediately above. The changes in entrainment under Alternative 5 would not substantially reduce the American shad population. The impact would be less than significant and no mitigation would be required.

Threadfin* S*had

The impact and conclusion would be the same as discussed for Alternative 1A (Impact AQUA-201). Entrainment at the south Delta would be reduced due to overall lower exports from south Delta facilities; there would also be a concomitant reduction in predation loss especially within Clifton Court Forebay. There would be entrainment of threadfin shad eggs and larvae at the north Delta intake. Decommissioning agricultural diversions in Delta ROAs would decrease or have no impact on threadfin shad entrainment. Overall, threadfin shad entrainment would be reduced because they are most abundant in the southwestern portion of the Delta and would benefit from reduced south Delta exports. The effect would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of threadfin shad would be the same as described immediately above. The changes in entrainment under Alternative 5 would not substantially reduce and may benefit the threadfin shad population. The impact would be less than significant and no mitigation would be required.

Largemouth Bass

Since largemouth bass are predominantly found in the south and central portions of the Delta, largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to the south Delta would be reduced because of reductions in south Delta exports in the summer. As discussed for Alternative 1A (Impact AQUA-201) few larval largemouth bass would be vulnerable to entrainment to north Delta and alternative NBA intake since they are not expected to readily occur there. Decommissioning agricultural diversions could reduce entrainment of largemouth bass since they hold in shallow water habitats where most agricultural diversions are sited. Overall entrainment would be reduced under Alternative 5 and there could be a small benefit to the species.

CEQA Conclusion: The impact of water operation on largemouth bass would be as described immediately above. The changes in entrainment under Alternative 5 could benefit the largemouth bass population. The impact would be less than significant and no mitigation would be required.

Sacramento Tule Perch

The effects and conclusion for this impact would be the same as Alternative 1A (Impact AQUA-201). Entrainment of Sacramento tule perch to the SWP/CVP south Delta facilities would decrease because south Delta exports would be less compared to NAA. Entrainment-related predation loss would also be reduced. Because Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively screened at the proposed north Delta facilities. Reduction or consolidation of these agricultural diversions under the Plan would decrease entrainment of Sacramento tule perch into these agricultural intakes. Overall the reduction in entrainment of Sacramento tule perch under Alternative 5 would not be adverse, and may provide a benefit for the species.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The changes in entrainment under Alternative 5 may provide a benefit to the Sacramento tule perch. The impact would be less than significant and no mitigation would be required.

Sacramento-San Joaquin Roach

The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento-San Joaquin roach would be the same as described immediately above. The impacts would be less than significant.

Hardhead

The effect of water operations on entrainment of hardhead under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of hardhead would be the same as described immediately above. The impacts would be less than significant.

California Bay Shrimp

The effect of water operations on entrainment of California bay shrimp under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. California bay shrimp do not occur in the vicinity of the intake and there would be effect.

CEQA Conclusion: The impact of water operations on entrainment of California bay shrimp would be the same as described immediately above. There would be no impact.

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 15% greater) than flows under NAA during April through June except in wet years during May relative to NAA (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under NAA during April through June except in above normal years in April relative to NAA (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 9% greater) than flows under NAA during April through June for each month and water year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 83% greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally greater (to 44%) than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the range would be similar to or lower (to 36% lower) than the percentage under NAA in all water year types (Table 11-5-64).

Table 11-5-64. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (0%)	-5 (-12%)
Above Normal	-6 (-13%)	-3 (-8%)
Below Normal	-10 (-22%)	-12 (-36%)
Dry	-4 (-8%)	0 (0%)
Critical	8 (21%)	-6 (-12%)
All	-2 (-5%)	-5 (-12%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 5 would generally be similar to or greater than flows under NAA. The percentage of months outside the 59°F to 68°F water temperature range would generally be lower under Alternative 5 than under NAA.

CEQA Conclusion: In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 13% greater) than flows under Existing Conditions during April through June, except in wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to 14% greater) than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or greater (to 86% greater) than flows under Existing Conditions during April through June, except in wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during April and June (to 19% greater), except in above normal and below normal years during April (7% and 5% lower, respectively) and wet and critical years during June (30% and 19% lower, respectively), but generally lower, by up to 31%, during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June would be similar to or lower (up to 22% lower) than the percentage under Existing Conditions in all water years except critical years (21% greater) (Table 11-5-64).

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under Alternative 5 would generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 5, although this effect would not be biologically meaningful to striped bass. The percentage of months outside the 59°F to 68°F water temperature range would generally be lower under Alternative 5 than under Existing Conditions.

American Shad

In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 15% greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to NAA during April through June except in above normal years in April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 9% greater) than flows under NAA during April through June for each month and water year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be substantially greater (to 83% greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 44%) than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the 60°F to 70°F water temperature range would generally be lower than the percentage under NAA in all water year types (from 7% to 15% lower) (Table 11-5-65).

Table 11-5-65. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-8 (-17%)	-3 (-7%)
Above Normal	3 (8%)	-6 (-15%)
Below Normal	2 (8%)	-5 (-14%)
Dry	2 (5%)	-4 (-9%)
Critical	3 (8%)	-3 (-7%)
All	-1 (-2%)	-4 (-10%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in American shad spawning or adult migration. Flows in all rivers examined during the April through June adult migration and spawning period under Alternative 5 would generally be similar to or greater than flows under NAA. The percentage of months outside the 60°F to 70°F water temperature range in the Feather River would generally be lower under Alternative 5 than under NAA. There would be no temperature related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 13% greater) than flows under Existing Conditions during April through June, except in wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to 14% greater) than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or greater (to 62% greater) than flows under Existing Conditions during April through June, except in wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during April and June (to 19% greater), except in above normal and below normal years during April (7% and 5% lower, respectively) and wet and critical years during June (30% and 19% lower, respectively), and generally lower, by up to 31%, during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of the 60°F to 70°F water temperature range would be greater than the percentage under Existing Conditions in all water years (5% to 8% greater) except wet years (17% lower) (Table 11-5-65). These are small increases that would not have biologically meaningful negative effects on migration and spawning success.

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in American shad adult migration and spawning habitat, and no mitigation is necessary. Flows in all rivers examined except the San Joaquin and Stanislaus rivers during the April through June adult migration and spawning period under Alternative 5 would generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 5, although this effect would not be biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water temperature range in the Feather River would generally be slightly greater under Alternative 5 than under Existing Conditions but would not have biologically meaningful effects on spawning and migration success. There would be no temperature related effects in any other rivers examined.

Threadfin Shad

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August threadfin shad spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, April through August flows under A5_LLT would generally be similar to or greater (up to 15% greater) than flows under NAA, and to 14% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under NAA, and a single flow reduction, 11% lower, compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would nearly always be similar to or greater (to 10% greater) than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater than flows under NAA from April through July (up to 42% greater), with two isolated exceptions (to 32% lower), and lower during August (up to 34% lower) except in above normal years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions in dry and critical years during July and August would have a localized effect late in the period.

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater than flows under NAA from April through July (up to 44% greater) except in above normal years during July (10% lower), and lower during August (to 35% lower) in all but above normal years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions in drier water years during August would be partially offset by increases in flow in adjoining months and would not have biologically meaningful effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT below 68°F would be greater than the percentage under NAA in wetter water year types (8% to 14% greater), and similar to or slightly lower (5% lower) in dry and critical years, respectively (Table 11-5-66). The increases would be of relatively small magnitude in terms of absolute percentages (5% to 7%) and would not have biologically meaningful effects on the shad population.

Table 11-5-66. Difference and Percent Difference in the Percentage of Months during April–August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F Water Temperature Threshold for Threadfin Shad Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-8 (-13%)	5 (8%)
Above Normal	-22 (-29%)	7 (13%)
Below Normal	-17 (-24%)	7 (14%)
Dry	-31 (-42%)	-1 (-3%)
Critical	-30 (-46%)	-2 (-5%)
All	-20 (-29%)	3 (7%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in spawning habitat. Flows in all rivers examined during the April through August spawning period under Alternative 5 would generally be similar to or greater than flows under NAA. There would be isolated, small-magnitude flow reductions in some month and water year types that would not have biologically meaningful effects. There would be moderate flow reductions in drier water years late in the period in the Feather River (during July and August) and the American River (during August) that would have localized effects but would not have biologically meaningful effects on the threadfin shad population. The percentage of months below the spawning temperature threshold in the Feather River would be moderately greater under Alternative 5 relative to NAA, but this increase is not expected to have a biologically meaningful effect on the threadfin shad population based on the relatively small magnitude of the absolute increases, and the fact that they would occur at a single location and not in all water year types. There would be no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT during April through August would generally be similar to or greater than flows under Existing Conditions (to 13% greater), except in wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions (to 28% greater) from April to August, except in critical years during May and August (6% and 25% lower, respectively) and in wet years during July (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would nearly always be similar to or greater than flows under Existing Conditions (to 14% greater) throughout the period, except in critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (up to 86% greater) than flows under Existing Conditions during April through August, except in wetter water years during May (to 37% lower), in drier water years during July (to 20% lower), and in drier water years during August (to 54% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions in drier water years during July and August would have a localized effect late in the period.

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater (to 20% greater) than flows under Existing Conditions in drier water years during April, in dry years during May, and in below normal and dry years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or lower than flows under Existing Conditions for the remainder of the period (to 52%). Flow reductions in drier water years, when effects on habitat conditions would be more critical, would be moderate but inconsistent month to month by water year type, with substantial flow reductions during August that would have a localized effect late in the period.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water temperature threshold for threadfin shad spawning under A5_LLT would be 13% to 46% lower than the percentage under Existing Conditions, depending on water year type (Table 11-5-66).

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers examined during the April through August spawning period under Alternative 5 would generally be similar to or greater than flows under Existing Conditions. There would be isolated, small-magnitude flow reductions in some month and water year types that would not have biologically meaningful effects. There would be moderate flow reductions in drier water years late in the period in the Feather River (during July and August) and the American River (during August) that would have localized effects but would not have biologically meaningful effects on the threadfin shad population. The percentage of months outside all temperature thresholds in the Feather River would generally be generally lower under Alternative 5 than under Existing Conditions, indicating that there would be a net temperature-related benefit of Alternative 5 to threadfin shad relative to Existing Conditions. There would be no temperature related effects in any other waterways examined.

Largemouth Bass

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 15% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under NAA during March through June except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under NAA during March through June for each month and water year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be substantially greater (to 83% greater) than flows under NAA during March through June.

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 44%) than flows under NAA regardless of water year type.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the 59°F to 75°F water temperature range would similar to or lower than the percentage under NAA in all water years except dry years (5% greater) (Table 11-5-67).

Table 11-5-67. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-14 (-27%)	0 (0%)
Below Normal	-13 (-28%)	-2 (-6%)
Dry	-17 (-35%)	1 (5%)
Critical	-17 (-38%)	-6 (-23%)
All	-13 (-26%)	-1 (-3%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

CEQA Conclusion: In general, Alternative 5 would not reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 13% greater) than flows under Existing Conditions during March through June, except in below normal years of March (10% lower), and wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under Existing Conditions during March through June, except in below normal years in March (6% lower) and in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to 29% greater) than flows under Existing Conditions during March through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or greater (to 86% greater) than flows under Existing Conditions during March through June, except in below normal years in March (48% lower), and in wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during March, April, and June (to 19% greater), except in above normal and below normal years during April (7% and 5% lower, respectively) and wet and critical years during June (30% and 19% lower, respectively), and generally lower, by up to 31%, during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of the 59°F to 75°F water temperature range for largemouth bass spawning would be lower (to 38%) than the percentage under Existing Conditions in all water years (Table 11-5-67).

Sacramento Tule Perch

The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The impacts would be less than significant.

Sacramento-San Joaquin Roach – California species of special concern

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 15% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under NAA during March through June except in above normal years in April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under NAA during March through June for each month and water year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be substantially greater (to 83% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 44%) than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A5_LLT would be similar to or lower (to 5% lower) than the percentage under NAA in all water year types (Table 11-5-68).

Table 11-5-68. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-4 (-7%)	2 (4%)
Dry	-13 (-23%)	-1 (-3%)
Critical	-17 (-30%)	-2 (-5%)
All	-11 (-19%)	-0.3 (-1%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 13% greater) than flows under Existing Conditions during March through June, except in below normal years of March (10% lower), and in wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 28% greater) than flows under Existing Conditions during March through June, except in below normal years in March (6% lower) and in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to 29% greater) than flows under Existing Conditions during March through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or greater (to 86% greater) than flows under Existing Conditions during March through June, except in below normal years in March (48% lower), and in wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions during March, April, and June (to 19% greater), except in above normal and below normal years during April (7% and 5% lower, respectively) and in wet and critical years during June (30% and 19% lower, respectively), but generally lower, by up to 31%, during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under

A5_LLT would be lower (to 30%) than the percentage under Existing Conditions in all water years (Table 11-5-68).

Hardhead – California species of special concern

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, April and May flows under A5_LLT would generally be similar to or greater (to 15% greater) than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, April and May flows under A5_LLT would generally be similar to or greater (to 17% greater) than flows under NAA throughout the (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, April and May flows under A5_LLT would always to be similar to flows under NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, April and May flows under A5_LLT would generally be substantially greater (up to 70% greater) than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would be similar to flows under NAA in April. During May, flows under A5_LLT would generally be greater than flows under NAA (up to 15% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the range would be similar to or lower (to 18%) than the percentage under NAA in all water year types (Table 11-5-69).

Table 11-5-69. Difference and Percent Difference in the Percentage of Months during April–May in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 64°F Water Temperature Range for Hardhead Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	2 (3%)	0 (0%)
Above Normal	-9 (-14%)	0 (0%)
Below Normal	18 (42%)	-4 (-6%)
Dry	-8 (-15%)	-3 (-6%)
Critical	-8 (-15%)	-8 (-18%)
All	-1 (-1%)	-2 (-4%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 13% greater) than flows under Existing Conditions throughout the period, except in wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 17% greater) than flows under Existing Conditions throughout the period, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to 10% greater) than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or greater (to 62% greater) than flows under Existing Conditions throughout the period, except in wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A5_LLT would be similar to or greater (to 12% greater) than flows under Existing Conditions during April, with some exceptions (up to 7% lower) and generally lower than flows under Existing Conditions (to 24%) during May, except in dry years (9% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower (to 15% lower) than the percentage under Existing Conditions in all water years except below normal years (42% greater) (Table 11-5-69). The isolated increase corresponds to a relatively moderate absolute increase of 18% and occurs in a single water year type, and would not have biologically meaningful effects on hardhead spawning success.

California Bay Shrimp

The effect of water operations on spawning habitat of California bay shrimp under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on spawning habitat of California bay shrimp would be the same as described immediately above. The impacts would be less than significant.

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

The discussion under Alternative 5, Impact AQUA-202 for striped bass also addressed the embryo incubation and initial rearing period. That analysis indicates that there is no adverse effect on striped bass rearing during that period. Other effects of water operations on rearing habitat for striped bass under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-5). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on striped bass rearing habitat would be less than significant.

American Shad

The effects of water operations on rearing habitat for American shad under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on American shad rearing habitat would be less than significant.

Threadfin Shad

The effects of water operations on rearing habitat for threadfin shad under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on threadfin shad rearing habitat would be less than significant.

Largemouth Bass

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 23%) than flows under NAA during all months but November with some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)*.* Flows under A5_LLT during November would be lower (up to 17% lower) depending on month, water year type, and time period.

In the Trinity River below Lewiston Reservoir, April through November flows under A5_LLT would generally be similar to or greater than flows under NAA during the April through November period with the exception of some small flow reductions (up to 11% lower).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 10% greater) than NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)*.*

In the Feather River at Thermalito Afterbay, April through November flows under A5_LLT would generally be similar to or greater (to 47% greater) than flows under NAA with infrequent exceptions (up to 32% lower) in every month but August and September. In August and September, flows under A5_LLT would generally be lower (to 61% lower) than flows under NAA, with small to substantial reductions in some of the drier water year types that would have a localized effect on habitat conditions during August and/or September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, April through November flows under A5_LLT would generally be greater (to 44% greater) than flows under NAA during all months but August, with infrequent exceptions of flow reductions of small magnitude (up to 14% lower). Flows during the month of August would generally be lower under A5_LLT relative to NAA (to 35% lower) with small to moderate reductions in each of the drier water year types that would have a localized effect during August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under NAA or A5_LLT (Table 11-5-70). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 5 and NAA.

Table 11-5-70. Difference and Percent Difference in the Percentage of Months during April–November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 23% greater) than flows under NAA during all months but November with relatively infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15% and 17% lower depending on month, water year type, and time period) (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). These are infrequent and small-magnitude flow reductions that would not have biologically meaningful effects.

In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally be similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 10% greater) than NAA throughout the year, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47% greater) than flows under NAA during all months except August and September, with infrequent exceptions (up to 32% lower). During August and September, flows under A5_LLT would generally be lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled with flow reductions in dry and critical years during July would have a localized effect on habitat conditions during the summer months in drier water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater (to 44% greater) than flows under NAA throughout the year, except for August and October, with some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under NA in all but above normal water years in August (to 35% lower), and in wet (8% lower) and below normal water years (14% lower) during September. These are relatively infrequent and small-magnitude flow reductions that would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A5_LLT (Table 11-5-71). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 5 and NAA.

Table 11-5-71. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 5 would generally be similar to or greater than flows under NAA in most months. Flows in July through September would generally be 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. The percentages of years outside all temperature thresholds examined in the Feather River under Alternative 5 would generally be similar to or lower than NAA. There would be no temperature-related effects in any other waterways examined.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions.

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 64%) than flows under Existing Conditions in all months of the period but November with infrequent exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During November, flows under A5_LLT would be similar to or lower than flows under Existing Conditions (to 10% lower) in all water years, with relatively small reductions in dry and critical years (to 10% lower).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT during April through July would generally be similar to or greater (to 28% greater) than flows under Existing Conditions throughout the year with infrequent exceptions (up to 14% lower), similar to flows under Existing Conditions during August and September except in critical years (to 34% lower), and similar to or lower than flows under Existing Conditions during October through November (to 29%) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The most consistent flow reductions would occur in critical years from August through November; the remaining flow reductions in drier water year types would be infrequent and/or of small magnitude.

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 14% greater) than flows under Existing Conditions throughout the April through November period, except in critical years during August through October (7% to 28% lower) and below normal years in October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 141% greater) than flows under Existing Conditions during April through October, with some exceptions (to 59% lower), and lower in all but above normal years during November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would be isolated and/or of small magnitude except for moderate to substantial reductions in dry and critical water years during July through September that would have a localized effect in those water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater (to 19% greater) than flows under Existing Conditions during April and June with some exceptions (up to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during May and July through November would generally be lower relative to Existing Conditions (to 52% lower). Flow reductions in drier water years, when effects would be more critical for habitat conditions, include moderate to substantial reductions for much of the period that would have a localized effect on rearing conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F water temperature threshold for year-round juvenile largemouth bass occurrence under Existing Conditions or A5_LLT (Table 11-5-70). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 5 and Existing Conditions.

Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 64% greater) than flows under Existing Conditions during all months but November with some exceptions (to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under Existing Conditions (to 10% lower).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 48% greater) than flows under Existing Conditions throughout most of the year with infrequent exceptions during January through July and December (to 17% lower), similar to flows under Existing Conditions during August and September except in critical years (25% and 34% lower, respectively), and lower than flows under Existing Conditions in most water year types during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be most persistent in critical years during July through January (small to moderate flow reductions), and would have a localized effect on rearing conditions for that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal years in October (6% lower) and critical years during August through November (7% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 141% greater) than those under Existing Conditions during all months of the year except January and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when effects on habitat conditions would be more critical, consist of moderate to substantial reductions in dry (to 60% lower) and in critical (to 47% lower) years during July through September that would have a localized effect on rearing conditions in those water year types. These reductions would be partially offset by increases in flow in the preceding months and October.

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27% greater) than flow under Existing Conditions from February through April, and June, with some exceptions (to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower (to 52% lower) than flows under Existing Conditions in January, May, and July through December, with some exceptions (to 27% greater). There would be persistent, moderate to substantial flow reductions in all water year types, including drier water years, during August (to 52% lower), September (to 42% lower), November (to 31% lower), December (to 21% lower), and January (drier years only, to 20% lower).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F water temperature range for year-round adult largemouth bass occurrence under Existing Conditions or A5_LLT (Table 11-5-71). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 5 and Existing Conditions.

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in largemouth bass habitat, and no mitigation is necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions in most locations, with the exception of infrequent, relatively small-magnitude flow reductions that would not have biologically meaningful effects on the largemouth bass population. Flows would be substantially lower during the majority of the year-round adult rearing period in the American River, but because of the migratory ability and widespread distribution of largemouth bass throughout the Central Valley, these reductions would not affect the largemouth bass population. Reduced flows in other rivers would not have biologically meaningful effects on largemouth bass. The percentages of years outside all temperature thresholds would generally be lower under Alternative 5 than under Existing Conditions in the Feather River. There are no temperature-related effects in any other waterways examined.

Sacramento Tule Perch

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 23% greater) than flows under NAA during all months but November with relatively infrequent exceptions (up to 14% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15% and 17% lower depending on month, water year type, and time period). These are infrequent and small-magnitude flow reductions that would not have biologically meaningful effects.

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 10% greater) than NAA throughout the year, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally greater (to 47% greater) than flows under NAA during all months except August and September, with infrequent exceptions (to 32% lower). During August and September, flows under A5_LLT would generally be lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled with flow reductions in dry and critical years during July would have a localized effect on habitat conditions during the summer months in drier water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows under NAA in all but above normal water years in August (to 35% lower), and in wet (8% lower) and below normal water years (14% lower) during September. These are relatively infrequent and small-magnitude flow reductions that would not have biologically meaningful negative effects (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT exceeding the 72°F threshold would be greater than the percentage under NAA by 13% to 67% depending on water year type. In both cases the relative differences would be large due to small values being compared, and the absolute differences in percent exceedance would be small (1% to 6%) and would not have biologically meaningful effects on Sacramento tule perch (Table 11-5-72).

The percentage of months under A5_LLT exceeding the 75°F threshold would be similar to or greater than the percentage under NAA (to 100% greater) (Table 11-5-72). The absolute differences in percent exceedance would be only 1% and would not have biologically meaningful effects on Sacramento tule perch.

Table 11-5-72. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F Water Temperature Thresholds for Sacramento Tule Perch Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
72°F Threshold		
Wet	1 (43%)	1 (40%)
Above Normal	2 (NA)	2 (67%)
Below Normal	4 (NA)	1 (17%)
Dry	11 (NA)	6 (52%)
Critical	13 (300%)	2 (13%)
All	5 (408%)	2 (33%)
75°F Threshold		
Wet	1 (NA)	1 (100%)
Above Normal	0 (NA)	0 (NA)
Below Normal	1 (NA)	1 (100%)
Dry	2 (NA)	1 (50%)
Critical	7 (1,000%)	1 (9%)
All	2 (1,800%)	1 (37%)

NA = could not be calculated because the denominator was 0.
[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in rearing habitat. Flows throughout the year in all rivers examined under Alternative 5 would generally be similar to or greater than flows under NAA in most months. Flows in July through September would generally be 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 Sacramento tule perch. The percentages of years outside both temperature thresholds under Alternative 5 would generally be similar to or slightly greater than the percentages under NAA. There would be no temperature related effects in any other waterways examined.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 64% greater) than flows under Existing Conditions during all months but November with some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

Analysis). Flows under A5_LLT during November would be lower than flows under Existing Conditions (up to 10% lower).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 48% greater) than flows under Existing Conditions throughout most of the year with infrequent exceptions during January through July and December (to 17% lower), similar to flows under Existing Conditions during August and September except in critical years (25% and 34% lower), respectively), and lower than flows under Existing Conditions in most water year types during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be most persistent in critical years during July through January (small to moderate flow reductions), and would have a localized effect on rearing conditions for that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal years in October (6% lower) and critical years during August through November (7% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 141% greater) than those under Existing Conditions during all months of the year except January and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when effects on habitat conditions would be more critical, consist of moderate to substantial reductions in dry (to 60% lower) and critical (to 47% lower) years during July through September that would have a localized effect on rearing conditions in those water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27% greater) from February through April, and June, with some exceptions (up to 30% lower) than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions during January, May, and July through December, with some exceptions. There would be persistent, moderate to substantial flow reductions in all water year types, including drier water years, during August through December (up to 52% lower), and January (drier years only, to 20% lower).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in Clear Creek or the San Joaquin River.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT exceeding 72°F relative to the percentage under Existing Conditions would be similar to or greater, to 300% (Table 11-5-72). Despite the high relative percentages from the comparisons, the absolute values for the increases would be small, ranging from 1% to 13%. The percentage of months under A5_LLT exceeding 75°F would be similar to the percentage under Existing Conditions in all water years except critical years (1,000% greater). Despite the high relative percentages from the comparisons, the absolute values for the increases would be small, ranging from 1% to 7%, and would not have biologically meaningful effects on Sacramento tule perch.

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in Sacramento tule perch habitat, and no mitigation is necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions in most locations, with the exception of infrequent, relatively small-magnitude flow reductions that would not have biologically meaningful effects on the Sacramento tule perch population. Flows would be substantially lower during the majority of the year-round adult rearing period in the American River, but based on the results for the other locations, these reductions would not affect the Sacramento tule perch population in the region. Reduced flows in other rivers including Trinity River and the San Joaquin and Stanislaus rivers would not have biologically meaningful effects on Sacramento tule perch. The percentages of years outside both temperature thresholds would generally be lower under Alternative 5 than under Existing Conditions. There would be no temperature related effects in any other waterways examined.

Sacramento-San Joaquin Roach

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to NAA.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 23% greater) than flows under NAA during all months but November with relatively infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15% and 17% lower depending on month, water year type, and time period). These are infrequent and small-magnitude flow reductions that would not have biologically meaningful effects.

In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 10% greater) than NAA throughout the year, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47% greater) than flows under NAA during all months except August and September, with infrequent exceptions (to 32% lower). During August and September, flows under A5_LLT would generally be lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled with flow reductions in dry and critical years during July would have a localized effect on habitat conditions during the summer months in drier water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows under NAA in all but above normal water years in August (to 35% lower), and in wet (8% lower) and below normal water years (14% lower) during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively infrequent and small-magnitude flow reductions that would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A5_LLT (Table 11-5-73). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 5 and NAA.

Table 11-5-73. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Range for Sacramento-San Joaquin Roach Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in spawning and juvenile and adult Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under Alternative 5 would generally be similar to or greater than flows under NAA in most months. Flows would generally be lower during August and September in the Feather River high-flow channel and during August in the American River below Nimbus Dam, although these reductions would not be biologically meaningful to the Sacramento-San Joaquin roach population. The percentages of years outside both temperature thresholds under Alternative 5 in the Feather River would be similar to or lower than the percentages under NAA. There would be no temperature related effects in any other waterways examined.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 64% greater) than flows under Existing Conditions during all months but November with some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under Existing Conditions (to 10% lower).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 48% greater) than flows under Existing Conditions throughout most of the year with infrequent exceptions during January through July and December (to 17% lower), similar to flows under Existing Conditions during August and September except in critical years (25% and 34% lower, respectively), and lower than flows under Existing Conditions in most water year types during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be most persistent in critical years during July through January (small to moderate flow reductions), and would have a localized effect on rearing conditions for that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal years in October (6% lower) and critical years during August through November (7% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 141% greater) than flows under Existing Conditions during all months of the year except January and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when effects on habitat conditions would be more critical, consist of moderate to substantial reductions in dry (to 60% lower) and critical (to 47% lower) years during July through September that would have a localized effect on rearing conditions in those water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27% greater) from February through April, and June, with some exceptions (up to 30% lower) than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions during January, May, and July through December, with some exceptions. There would be persistent, moderate to substantial flow reductions in all water year types, including drier water years, during August through December (up to 52% lower), and January (drier years only, to 20% lower).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or A5_LLT (Table 11-5-73). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 5 and Existing Conditions.

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in Sacramento-San Joaquin roach habitat, and no mitigation is necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions in many locations. Flows would be substantially lower during the majority of the year-round adult rearing period in the American River, but based on the results for the other locations, these reductions would not affect roach at a population level. Reduced flows in other rivers would not have biologically meaningful effects on the Sacramento-San Joaquin roach population. The percentages of years outside both temperature thresholds in the Feather River under Alternative 5 would be similar to or lower than the percentages under Existing Conditions. There would be no temperature related effects in any other waterways examined.

Hardhead

In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 23% greater) than flows under NAA during all months but November with relatively infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15% and 17% lower depending on month, water year type, and time period). These are infrequent and small-magnitude flow reductions that would not have biologically meaningful effects.

In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally be similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 10% greater) than NAA throughout the year, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47% greater) than flows under NAA during all months except August and September, with infrequent exceptions (up to 32% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During August and September, flows under A5_LLT would generally be lower (up to 34 and 61% lower, respectively) than those under NAA, including in drier water years. These flow reductions coupled with flow reductions in dry and critical years during July would have a localized effect on habitat conditions during the summer months in drier water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows under NAA in all but above normal water years in August (to 35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), and in wet (8% lower) and below normal water years

(14% lower) during September. These are relatively infrequent and small-magnitude flow reduction that would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the range would be similar to or lower than the percentage under NAA in all water year except in below normal years (7% greater) (Table 11-5-74).

Table 11-5-74. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-6 (-8%)	-3 (-4%)
Above Normal	-11 (-15%)	-6 (-10%)
Below Normal	-6 (-8%)	5 (7%)
Dry	-5 (-7%)	2 (4%)
Critical	-7 (-10%)	0 (0%)
All	-7 (-9%)	-0.4 (-1%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Collectively, these results indicate that the effect would not be adverse because Alternative 5 would not cause a substantial reduction in spawning and juvenile and adult hardhead rearing. Flows under Alternative 5 in all rivers examined during most months would generally be similar to or greater than flows under NAA. Flows in July through September would generally be 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 hardhead population. The percentages of years outside both temperature thresholds in the Feather River would generally be lower under Alternative 5 than under NAA. There would be no temperature related effects in any other waterways examined.

CEQA Conclusion: In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to Existing Conditions.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or greater (to 64% greater) than flows under Existing Conditions during all months but November with some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows under Existing Conditions (up to 10% lower).

In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or greater (to 48% greater) than flows under Existing Conditions throughout most of the year with infrequent exceptions during January through July and December (to 17% lower), similar to flows under Existing Conditions during August and September except in critical years (25% and 34% lower), respectively), and lower than flows under Existing Conditions in most water year types during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be most persistent in critical years during July through January (small to moderate flow reductions), and would have a localized effect on rearing conditions for that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal years in October (6% lower) and critical years during August through November (7% to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 141% greater) than those under Existing Conditions during all months of the year except January and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when effects on habitat conditions would be more critical, consist of moderate to substantial reductions in dry (to 60% lower) and critical (to 47% lower) years during July through September that would have a localized effect on rearing conditions in those water year types.

In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27% greater) from February through April, and June, with some exceptions (up to 30% lower) than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions during January, May, and July through December, with some exceptions. There would be persistent, moderate to substantial flow reductions in all water year types, including drier water years, during August through December (up to 52% lower), and January (drier years only, to 20% lower).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months in which year-round in-stream temperatures would be outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be lower (to 15% lower) than the percentage under Existing Conditions in all water years (Table 11-5-74).

Collectively, these results indicate that the impact would not be significant because Alternative 5 would not cause a substantial reduction in hardhead habitat, and no mitigation is necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions in many locations. Flows would be substantially lower during the majority of the year-round adult rearing period in the American River, but based on the results for the other locations, these reductions would not affect hardhead at a population level. Reduced flows in other rivers would not have biologically meaningful effects on hardhead. The percentages of years outside both temperature thresholds in the Feather River under Alternative 5 would be similar to or lower than the percentages under Existing Conditions. There would be no temperature related effects in any other waterways examined.

California Bay Shrimp

The effect of water operations on rearing habitat of California bay shrimp under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. These effects would not be adverse.

CEQA Conclusion: As described above the impacts on rearing habitat of California bay shrimp would be less than significant.

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Monthly flows in the Sacramento River downstream of the north Delta intake would decrease (2–11% for NAA) under Alternative 5 during the adult striped bass migration. Sacramento River flows are highly variable interannually, and striped bass are still able to migrate upstream the Sacramento River during lower flow years. The effect of reduced Sacramento flows under Alternative 5 would not be adverse.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (13–14% lower compared to Existing Conditions) would not interfere substantially with movement of pre-spawning striped bass through the Delta. No mitigation would be required.

American Shad

Flows in the Sacramento River below the north Delta intake facilities would be lower than NAA during March–May. Monthly flows on average would be 9–19% lower compared to NAA. Flows from the San Joaquin River at Vernalis would be unchanged. Sacramento River flows are highly variable interannually, and American shad are still able to migrate upstream the Sacramento River during lower flow years. Overall, the impact to American shad migration habitat conditions would not be adverse under Alternative 5.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (10–20% lower compared to Existing Conditions) would not interfere substantially with movement of American shad from the Delta to upstream spawning habitat. No mitigation would be required.

Threadfin Shad

Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats. Threadfin shad found in the Delta to not actively migrate upstream to spawn. Therefore there is no effect on migration habitat conditions.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because flow changes in the Delta under Alternative 5 would not alter movement patterns for threadfin shad. No mitigation would be required.

Largemouth Bass

Largemouth bass are non-migratory fish within the Delta. Therefore they do not use the Delta as migration habitat corridor. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes under Alternative 5 would not affect largemouth movements within the Delta. No mitigation would be required.

Sacramento Tule Perch

Similar with largemouth bass, Sacramento tule perch are a non-migratory species and do not use the Delta as a migration corridor as they are a resident Delta species. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes would not affect Sacramento tule perch movements within the Delta. No mitigation would be required.

Sacramento-San Joaquin Roach

For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 5, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

Hardhead

For hardhead the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 5, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for hardhead would not be significant and no mitigation is required.

California Bay Shrimp

The effect of water operations on migration conditions of California bay shrimp under Alternative 5 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on migration conditions of California bay shrimp would be less than significant.

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

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of construction of restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of restoration measures under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-7). However, the potential effects of restoration construction activities would be less than described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 65,000 acres for Alternative 1A). The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of the construction of restoration measures would be less than significant.

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-8 under delta smelt for a discussion of the effects of contaminants associated with restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of contaminants associated with restoration measures under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). However, the potential effects of contaminants associated with restoration measures would be less than described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 65,000 acres for Alternative 1A). These effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of contaminants associated with restoration measures would be less than significant.

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-9 under delta smelt for a discussion of the effects of restored habitat conditions on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. Although there are minor differences the effects are similar. The potential effects of restored habitat conditions under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). In addition, see Alternative 1A, Impact AQUA-207 for a discussion of the different effects on non-covered species of primary management concern. Also, the potential effects of restored habitat conditions would be less than described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 65,000 acres for Alternative 1A. The effects range from slightly beneficial to beneficial.

CEQA Conclusion: As described immediately above, the impacts of restored habitat conditions would range from slightly beneficial to beneficial.

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of methylmercury management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of methylmercury management under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-10). Also, the potential effects of methylmercury would be less than described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres for Alternative 5 rather than 65,000 acres for Alternative 1A. These effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of methylmercury management would be less than significant.

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic vegetation management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of invasive aquatic vegetation management under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. The effect on them will not be adverse. Control of invasive aquatic vegetation would not occur within California bay shrimp habitat and there would be no effect on them.

CEQA Conclusion: Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic vegetation management on non-covered species of primary management concern. There are minor differences and the effects are similar except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Control of invasive aquatic vegetation would not occur within California bay shrimp habitat and there would be no effect on them. Sacramento tule perch use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on them will not be significant and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

The effects of other conservation measures under Alternative 5 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species. The effects are also the same as those discussed for Alternative 1A.

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these nine impact mechanisms on the non-covered aquatic species of primary management concern are the same as those described under Alternative 1A for delta smelt (Impacts AQUA-10 through AQUA-18). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. As with delta smelt, the effects on these non-covered species would range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The impacts of the nine impact mechanisms listed above would range from no impact, to less than significant, to beneficial, and no mitigation is required (see discussion under Alternative 1A for delta smelt (Impacts AQUA-10 through AQUA-18).

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 5 would not be substantially reduced when compared to the No Action Alternative.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 5 would reduce the quantity of coldwater fish habitat in the CVP and SWP as shown in Table 102. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Like Alternative 1A, Alternative 6A would convey water from five fish-screened intakes (Intakes 1 through 5) in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through tunnels to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an isolated conveyance, no longer involving operation of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River. A map and schematic depicting the conveyance facilities associated with Alternative 6A are provided in Mapbook M3-1 and Figure 3-13; characteristics of this alternative are summarized in Table 11-7.

Alternative 6A would discontinue water diversions at the existing SWP/CVP south Delta facilities, and convey up to 15,000 cfs from the north Delta under Scenario D, which also includes criteria to meet Fall X2 objectives in accordance with the USFWS BiOp (U.S. Fish and Wildlife Service 2008a). Water conveyance operations under Scenario D are described in detail in Section 3.6.4.2 and water quality effects including salinity are discussed in Chapter 8 Water Quality under Alternative 6A.

Under Alternative 6A, physical and structural components would be similar to those under Alternative 1A. However, the existing hydraulic connections between the SWP/CVP south Delta points of diversions at Clifton Court Forebay and the Tracy Fish Facility on Old River would be closed. Although other portions of the south Delta export facility (i.e., pump stations and conveyance systems) would continue to operate, there would be no water diversions at the facility, and therefore no entrainment or other direct effects on aquatic species. An overview of the proposed water conveyance features and characteristics (i.e., lengths, volumes, etc. is presented in Table 11-7. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1.

Delta Smelt

Construction and Maintenance of CM1

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 designated critical habitat would be the same as described under Alternative 1A, Impact AQUA-1, because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping. As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or critical habitat.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-1, the impact of the construction of water conveyance facilities on delta smelt or critical habitat would be less than 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.

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-2). As concluded under Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt or designated critical habitat.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-2, the impact of the maintenance of water conveyance facilities on delta smelt or critical habitat would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Water Exports from SWP/CVP South Delta Facilities

Entrainment losses of delta smelt at the SWP/CVP south Delta facilities would be completely eliminated because there would be no south delta exports under Alternative 6A operations.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes, because potential entrainment, impingement, and predation risks at the proposed north Delta facilities would be limited since delta smelt rarely occur in the vicinity. In addition the intakes would be screened to exclude fish larger than 15 mm SL. Alternative 6A would have five north delta intakes, the same number planned under Alternative 1A. Therefore potential entrainment, impingement, and predation risks would be the same as compared to Alternative 1A (0–2% 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 models, was low, averaging 1.5% under Alternative 6A compared to 2.0% under NAA, or a 26% reduction in relative terms (Table 11-6A-1).

Table 11-6A-1. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 6A and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A6A_LLT	A6A_LLT vs. EXISTING CONDITIONS	A6A_LLT vs. NAA
2.1	2.0	1.5	-0.62 (-30%)	-0.52 (-26%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario

NEPA Effects: In conclusion, under Alternative 6A entrainment of delta smelt would be eliminated at the south Delta SWP/CVP facilities (due to lack of south Delta exports) and slightly reduced at the NBA and agricultural diversions. 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. Potential impacts at the north Delta intakes would be reduced further by monitoring and adaptive management by the Real-Time Response Team. The effect of Alternative 6A on delta smelt entrainment is considered to be beneficial.

CEQA Conclusion: As described above, under Alternative 6A delta smelt entrainment would be eliminated at south Delta facilities. Entrainment of larval delta smelt and impingement of juveniles and adults would potentially occur at the five proposed north Delta intakes, but the magnitude of this effect would be low because delta smelt occur infrequently in the vicinity. Potential entrainment of larvae would be slightly reduced (<1%) at the NBA compared to Existing Conditions (Table 11-6A-1).

Overall, the impact on delta smelt entrainment would be beneficial because of the elimination of entrainment and associated pre-screen predation loss at the south Delta facilities.

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

NEPA Effects: The effects of operations under Alternative 6A on abiotic spawning habitat would be the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning timing, would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect of Alternative 6A operations on spawning would not be adverse, because there would be little change in abiotic spawning conditions for delta smelt.

CEQA Conclusion: As described above, operations under Alternative 6A would not reduce abiotic spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

Juvenile and larval delta smelt generally rear throughout the west Delta, Suisun Bay, Suisun Marsh, and in Cache Slough. Other areas in the Delta may also be used for rearing. For purposes of this analysis, an abiotic habitat index (Feyrer et al. 2011) was applied that is based on correlations between turbidity and salinity, and detection of delta smelt in the Fall Midwater Trawl and generally increases with increased Delta outflows (Feyrer et al. 2011).This method applies only to the west Delta, Suisun Bay, and Suisun Marsh, and does not include any other potential rearing areas, including Cache Slough, where smelt are known to rear. The primary driver related to potential changes in rearing habitat from Alternative 6A based on flow alone, is fall outflow because of its assumed potential to shrink or expand the area of suitable habitat in the west Delta, Suisun Marsh, or Suisun Bay based on Feyrer et al. (2011).

The average abiotic habitat index under Alternative 6A without habitat restoration would increase by 845 hectares (17%) relative to NAA (Table 11-6A-2, Figure 11-6A-1). Alternative 6A would further benefit delta smelt with habitat restoration, particularly CM2 and CM4 in the Suisun Marsh, West Delta, and Cache Slough ROAs, which are closer to delta smelt's main range. Habitat restoration has the potential to increase spawning and rearing habitat and could supplement food production and export to rearing areas. However, the overall effects of habitat restoration and the mechanism of Fall X2 correlation are uncertain and current efforts (FlaSH studies) are underway to better understand the relationship between Fall X2 actions, suitable rearing habitat for delta smelt, and delta smelt abundance.

With habitat restoration, Alternative 6A would result in an increase in the abiotic habitat index by about 2,400 hectares (a 50% increase compared to NAA) averaged across all water years types and assuming 100% habitat occupancy. These effects are due to the inundation of new areas of the Delta resulting from habitat restoration implementation, which will open up additional habitat for delta smelt. It is unlikely though that all of the restored habitat would be fully utilized by delta smelt. When analyzing effects by water year types, the relative increase in abiotic habitat index would be greatest in dry years (79% compared to NAA) and below normal years (76% compared to NAA).

NEPA Effects: Despite the uncertainties discussed above, the effect of Alternative 6A on delta smelt would be beneficial because of the increase in abiotic habitat under Alternative 6A even without habitat restoration actions.

Table 11-6A-2. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 6A and Existing Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type

	Without Restoration		With Restoration	
Water Year	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All	1,730 (43%)	845 (17%)	3,302 (83%)	2,416 (50%)
Wet	2,565 (55%)	369 (5%)	4,581 (97%)	2,384 (35%)
Above Normal	2,244 (59%)	576 (10%)	3,894 (102%)	2,226 (41%)
Below Normal	1,368 (33%)	1,516 (38%)	2,884 (70%)	3,032 (76%)
Dry	1,322 (37%)	1,413 (41%)	2,667 (75%)	2,758 (79%)
Critical	484 (16%)	483 (16%)	1,428 (48%)	1,427 (48%)

Shading indicates a greater than 5% decrease in estimated abiotic habitat acres from baseline.

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

CEQA Conclusion: Without BDCP habitat restoration efforts, delta smelt fall abiotic habitat index under Alternative 6A would increase 43% relative to Existing Conditions. With the implementation of the BDCP habitat restoration actions (CMs 2, 4, 5, 6, and 7), the abiotic habitat index would increase by 83% when averaged across all water year types. The increase in abiotic habitat would be most substantial in wetter water year types (a 97–102% increase) compared to the CEQA Existing Conditions. The impact on delta smelt rearing habitat would be beneficial because of the increase in abiotic habitat, even without the benefit of habitat restoration actions. No mitigation would be required.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

The effects of operations under Alternative 6A on migration conditions would be the same as described for Alternative 1A (Impact AQUA-6). Alternative 6A would not affect the first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta water temperatures would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes under BDCP operations.

NEPA Effects: There would be no substantial change in the number of stressful or lethal condition days under Alternative 6A. Thus the effect on delta smelt migration conditions would not be adverse.

CEQA Conclusion**:** As described above, operations under Alternative 6A would not substantially alter the turbidity cues associated with winter flush events that may initiate migration, nor would there be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt migration conditions would be less than significant, and no mitigation would be required.

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

Alternative 6A has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through Impact AQUA-9) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on delta smelt are the same as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: All three of the impact mechanisms listed above would be beneficial or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 6A has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for delta smelt under Alternative 1A (Impact AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on delta smelt are the same as those described under Alternative 1A (Impact AQUA-10 through 18). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Longfin Smelt

Construction and Maintenance of CM1

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: The potential effects of construction of water conveyance facilities on longfin smelt would be the same as those described for Alternative 1A (see Impact AQUA-19), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping. As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for longfin smelt.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-19, the impact of the construction of water conveyance facilities on longfin smelt would be less than 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.

Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: The potential effects of maintenance of water conveyance facilities on longfin smelt would be the same as those described for Alternative 1A (see Impact AQUA-20), which concluded that the effect would not be adverse for longfin smelt.

CEQA Conclusion: As described under 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 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

Entrainment to the south delta facilities would be eliminated for all life stages of longfin smelt because there would be no south delta exports under Alternative 6A.

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed new north Delta intakes could increase entrainment potential in this area and locally attract piscivorous fish (i.e., predators), but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species is only expected to occur occasionally in very low numbers this far upstream.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Particle entrainment at the NBA, representing potential larval longfin smelt entrainment, was low for both starting distributions (wetter and drier). Particle entrainment averaged 0.12-15% under Alternative 6A, which was 0.04% greater than NAA, or 39-47% greater entrainment in relative terms (Table 11-6A-3).

Table 11-6A-3. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt Entrained by the North Bay Aqueduct under Alternative 6A and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Distribution	EXISTING CONDITIONS	NAA	A6A_LLT	A6A_LLT vs. EXISTING CONDITIONS	A6A_LLT vs. NAA
Wetter	0.20	0.08	0.12	-0.09 (-42.0%)	0.04 (47%)
Drier	0.25	0.11	0.15	-0.10 (-40.1%)	0.04 (39%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

Predation Associated with Entrainment

Pre-screen loss attributed to predation at the south Delta facilities would be eliminated because there would be no entrainment to those facilities under Alternative 6A. Predation loss at the proposed north Delta intakes and the alternate NBA intake would be limited because longfin smelt occur only rarely that far upstream. The effect under Alternative 6A would be beneficial because of the reduction of predation loss.

NEPA Effects: The effect under Alternative 6A would be beneficial to the species because of the elimination of entrainment and predation loss for both juveniles and adults at the south Delta facilities.

CEQA Conclusion: Entrainment loss of juvenile longfin smelt would be eliminated to the south Delta facilities because there would be no south Delta exports under Alternative 6A. Entrainment to the north Delta intakes would be low since longfin smelt would not occur in the vicinity of the intakes. Reductions in larval longfin smelt entrainment to agricultural diversions is also expected under Alternative 6A. Larval entrainment to the NBA would be reduced slightly compared to Existing Conditions; however, total entrainment to that facility would affect less than 1% of the population.

The impact statement and conclusion for predation associated with entrainment would be the same as described above. Predation loss of juveniles and adults at the south Delta facilities would be effectively eliminated because there would be no south Delta entrainment under Alternative 6A. Predation risk at the SWP/CVP north Delta intakes and the alternate NBA intake would be low because longfin smelt rarely occur in that vicinity. In conclusion, the impact under Alternative 6A would be beneficial because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

Longfin smelt spawn in late winter and early spring in the Sacramento River below Rio Vista and in the lower San Joaquin River (Moyle 2002; California Department of Fish and Game 2009b). Eggs are thought to be deposited on sand, gravel or hard substrate. Flows in this region are strongly influenced by tides. Averaged across all water years, flows in the Sacramento River at Rio Vista under Alternative 6A would be similar (<5% difference) to those under Alternative 1A during the longfin smelt spawning period. Therefore, effects under Alternative 6A would likely be similar to those under Alternative 1A, which was determined to be not adverse. Thus the effect on spawning habitat under Alternative 6A would also not be adverse. The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and Bay Midwater trawl indices have been correlated to outflow (expressed as the location of X2) in the preceding winter and spring months, when longfin smelt spawning and rearing occurs (January through June) (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer et al. 2009, reduced outflows in January through June under Alternative 6A compared to the NAA has the potential to reduce longfin smelt abundance. Longfin smelt abundance averaged across water years would be increased 15% (based on Fall Midwater Trawl indices) to 19% (based on Bay Otter Trawl indices) compared to NAA. Longfin smelt abundance would be increased approximately 29–43% under Alternative 6A compared to the NAA in dry and critical water year types (Table 11-6A-4).

Table 11-6A-4. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl[a]

	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
WY Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All	-915 (-18%)	561 (15%)	-2,986 (-21%)	1,770 (19%)
Wet	-5,548 (-31%)	816 (7%)	-22,928 (-35%)	3,221 (8%)
Above Normal	-2,893 (-34%)	-61 (-1%)	-10,251 (-39%)	-206 (-1%)
Below Normal	-857 (-20%)	442 (15%)	-2,686 (-24%)	1,334 (18%)
Dry	-28 (-1%)	465 (29%)	-77 (-2%)	1,260 (35%)
Critical	150 (16%)	284 (35%)	361 (19%)	675 (43%)
	Shading indicates 10% or greater decrease in abundance relative to baseline.			

[a] Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

Averaged across all water year types, Delta outflow under Alternative 6A would be similar (<10% change) to NAA during the January–June period. Other components of Alternative 6A have the potential to increase recruitment per unit of flow. These analyses do not take into account any potential changes in spawning or rearing conditions related to non-operational components of Alternative 6A, including habitat restoration.

Once larval smelt reach rearing habitat in the west Delta and Suisun Bay, they would likely benefit from habitat restoration actions (CM2 and CM4), which are intended to provide additional food production and export to longfin smelt rearing areas. This may provide potential benefits to longfin smelt, particularly from Suisun Marsh, West Delta, and Cache Slough ROAs.

NEPA Effects: Overall, the effect of Alternative 6A would not be adverse and may be beneficial because there would typically be an increase in longfin smelt abundances and restored spawning and rearing habitat. Investigations suggest that spring outflow is the primary driver for the observed relationship between outflow and longfin smelt recruitment (Thomson et al. 2010. However, despite the growing body of evidence that supports the positive correlation between longfin smelt abundance and spring outflow, the specific timing and amount of outflow needed to conserve longfin smelt, are generally unknown. Therefore, the overall benefits are not certain, especially in light of potential increases in food resources in the Plan Area and other benefits to spawning and rearing habitat.

CEQA Conclusion: Overall, the results of the Impact AQUA-22 CEQA analysis indicate that effects on spawning habitat under Alternative 6A would be less than significant, and no mitigation is required.

Flows at Rio Vista under Alternative 6A would be similar to Existing Conditions during the spawning period. When averaged across all water years, Sacramento River flows at Rio Vista under Alternative 6A would be similar to Existing Conditions in January and February (<10% difference) and reduced slightly in December and March (11% reduction). In addition, Sacramento River at Rio Vista flows under Alternative 6A would be similar to Alternative 1A (<5% difference) from December through March.

Despite the similarities in spawning habitat, the difference in rearing habitat between Existing Conditions and Alternative 6A could be significant because Alternative 6A could cause substantial reductions in modeled population indices of longfin smelt, contrary to the NEPA conclusion set forth above. In general, under Alternative 6A water operations, the quantity and quality of rearing habitat for longfin smelt would be reduced relative to Existing Conditions(Table 11-6A-4).

Relative longfin smelt abundance averaged across all water years would be reduced 18–21% compared to Existing Conditions (Table 11-6A-4). Relative abundance by water year type would be reduced under Alternative 6A in all water year types, with the largest differences occurring in wet, above normal, and below normal water years (20–39% lower abundance). Average Delta outflows under Alternative 6A would be increased 11% in January but reduced 11–21% from April to June relative to Existing Conditions. Delta outflows in February and March would be similar to Existing Conditions.

Collectively, the results of the Impact AQUA-22 CEQA analysis indicate that the difference in rearing habitat between the CEQA baseline and Alternative 6A could be significant because Delta outflows would be reduced in the spring, which would have the potential to contribute to substantial reductions in longfin smelt abundances.

The CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicate that differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, could be similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for longfin smelt.

Several habitat restoration conservation measures (CM2 and CM4) may also improve the quality of spawning and rearing habitat for longfin smelt, by increasing suitable habitat area and food production in the Delta. However, given the uncertainty of the outcome related to habitat restoration, the uncertainty regarding the actual mechanism for the outflow-abundance relationship from Kimmerer et al. (2009), and the modeled change in winter-spring outflow, the impact may still be significant, and mitigation would be required. With implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced larval entrainment would reduce this impact to less than significant, so no additional mitigation would be required.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Spawning and Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt

Discussion provided above, under Impact AQUA-22

Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt

Discussion provided above, under Impact AQUA-22

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for longfin smelt under Alternative 1A (Impacts AQUA-25 through Impact AQUA-36) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects to longfin smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Winter-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of construction of water conveyance facilities on Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-37), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for winter-run Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-37 for Chinook salmon, the impact of the construction of water conveyance facilities on Chinook salmon would be less than 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.

Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of maintenance of water conveyance facilities on Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-38), which concluded that the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Entrainment losses of juvenile winter-run Chinook salmon at the SWP/CVP south Delta export facilities would be eliminated under Alternative 6A because there would be no south Delta exports under this Alternative. Pre-screen loss of Chinook salmon at the south Delta facilities is attributed to predation and assumed to be proportional to entrainment loss.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 6A would eliminate south Delta entrainment for all races of Chinook salmon, which would be a beneficial effect.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta facilities would be eliminated under Alternative 6A for all salmon races and water year types compared to Existing Conditions. The reduction in entrainment would be a beneficial impact.

Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to the NEPA point of comparison.

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were examined during the May through September winter-run Chinook salmon 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 A6A_LLT during May through

July would nearly always be similar to or greater than flows under NAA. Flows under A6A_LLT during August through September would generally be lower than flows under NAA by up to 23% depending on location, month, and water year type.

Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the May through September winter-run Chinook salmon spawning and egg incubation period. May Shasta storage volume under A6A_LLT be similar to or greater than storage under NAA in all water year types (Table 11-6A-5).

Table 11-6A-5. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-59 (-1%)	-25 (-1%)
Above Normal	-111 (-2%)	-25 (-1%)
Below Normal	-218 (-5%)	-20 (-1%)
Dry	-372 (-10%)	72 (2%)
Critical	-474 (-19%)	110 (6%)

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be lower or similar to mortality under NAA except in below normal water years (96%) (Table 11-6A-6). The increase in the percent of winter-run Chinook salmon population subject to mortality would be 2% in below normal years. Therefore, the increase in mortality of 2% from NAA to A6A_LLT, although relatively large, would be negligible at an absolute scale to the winter-run Chinook salmon population. These results indicate that climate change would cause the majority of the increase in winter-run Chinook salmon egg mortality.

Table 11-6A-6. 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. A6A_LLT	NAA vs. A6A_LLT
Wet	1 (230%)	-0.2 (-13%)
Above Normal	2 (365%)	0.05 (2%)
Below Normal	3 (266%)	2 (96%)
Dry	6 (376%)	-0.1 (-1%)
Critical	40 (148%)	-4 (-6%)
All	8 (174%)	-0.4 (-3%)

SacEFT predicts that the percentage of years with good spawning habitat availability would be similar between NAA and A6A_LLT (Table 11-6A-7). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A6A_LLT would be identical to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A6A_LLT would be similar to that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A6A_LLT would be 7% lower than NAA. These results indicate that there would be small effects of Alternative 6A on redd dewatering risk.

Table 11-6A-7. 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. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-26 (-45%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-20 (-21%)	3 (4%)
Redd Dewatering Risk	2 (8%)	-2 (-7%)
Juvenile Rearing WUA	-19 (-38%)	6 (24%)
Juvenile Stranding Risk	5 (25%)	-6 (-19%)

WUA = Weighted Usable Area.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-40, which is that there would generally be no effects on water temperature in the Sacramento River.

NEPA Effects: Considering the range of results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would not be adverse because it does not have the potential to substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The reduction in flows of up to 23% in August and September would not translate into reductions in spawning habitat availability (Table 11-6A-7).

CEQA Conclusion: In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to the CEQA Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during May through July, except in wet and below normal years during May (10% to 19% lower). Flows under A6A_LLT would generally be lower by up to 23% during August through September. This indicates that there would be a small to moderate effect of Alternative 6A on flows during two of the five months of the winter-run Chinook salmon spawning and egg incubation period.

Shasta Reservoir storage volume at the end of May under A6A_LLT would be generally lower than Existing Conditions (up to 19% lower) (Table 11-6A-5). This indicates that there would be a small to moderate effect of Alternative 6A on flows during the spawning and egg incubation period.

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be 148% to 376% greater than mortality under Existing Conditions depending on water year type (Table 11-6A-6). These increases would have population-level effects only in dry and critical years, in which the absolute percent increase in mortality of the winter-run Chinook salmon population would be 6 and 40%, respectively. These results indicate that Alternative 6A would cause increased winter-run Chinook salmon mortality in the Sacramento River.

SacEFT predicts that there would be a 45% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-7). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A6A_LLT would be identical to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of years with good egg incubation conditions under A6A_LLT would be 21% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A6A_LLT would be 8% greater than the percentage of years under Existing Conditions. These results indicate that Alternative 6A would cause small to moderate reductions in spawning habitat WUA and egg incubation conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-40, which indicates there would be increased exceedances of NMFS temperature thresholds in the Sacramento River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 6A.

Instream flows under Alternative 6A during two of the five months of the winter-run Chinook salmon spawning and egg incubation period would be up to 23% lower than those under the CEQA Existing Conditions. Egg mortality under Alternative 6A in dry and critical years, during which winter-run Chinook salmon would already be stressed due to reduced flows and increased temperatures, would be 6% and 40% greater, than the CEQA Existing Conditions (Table 11-6A-6). Further, the extent of spawning habitat would be 45% lower due to Alternative 6A compared to the CEQA Existing Conditions (Table 11-6A-7), which represents a substantial reduction in spawning habitat and, therefore, in adult spawning and redd carrying capacity. This impact is a result of the specific reservoir operations and resulting flows associated with this alternative.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 6A would not affect the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to the NAA.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing habitat. Flows under A6A_LLT would generally be similar to or greater than flows under during October and December with some exceptions during October (up to 9% lower), but generally lower (up to 21% lower) than flows under NAA during August, September, and November.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A6A_LLT would be 24% greater than the percentage of years under NAA (Table 11-6A-6). The percentage of years with good (low) juvenile stranding risk under A6A_LLT is predicted to be 19% lower than under NAA. On an absolute scale, both rearing habitat availability and stranding risk would be small (6%) and would not have a biologically meaningful effect on winter-run Chinook salmon. This indicates that the quantity and quality of habitat in the Sacramento River would be lower under A6A_LLT relative to NAA.

SALMOD predicts that winter-run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be similar (3% reduction) to that under NAA.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-41, which indicates that there would be no effect on mean monthly temperatures during the winter-run juvenile rearing period.

NEPA Effects: Collectively, these results indicate that the effect of Alternative 6A is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat or substantially interfere with winter-run Chinook salmon rearing. Differences in flows are generally small and inconsistent among months and water year types.

CEQA Conclusion: In general, Alternative 6A would not affect the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to the CEQA Existing Conditions.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions in all months but September with some exceptions (up to 20% lower). Flows during September under A6A_LLT would generally be lower than flows under Existing Conditions (21% lower).

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A6A_LLT would be 38% lower than under Existing Conditions (Table 11-6A-7). However, the percentage of years with good (low) juvenile stranding risk under A6A_LLT is predicted to be 25% greater than under Existing Conditions. The 38% decrease in rearing habitat availability would correspond to a 19% absolute difference, which would be biologically meaningful, although the 25% increase in stranding risk would correspond to a 5% absolute increase, which would not be biologically meaningful.

SALMOD predicts that winter-run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be 11% higher than under Existing Conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-41, which indicates that there would be small temperature increases under Alternative 1A during some months in the Sacramento River relative to Existing Conditions.

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable juvenile rearing habitat, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 6A. Although differences in flows are small and inconsistent, both SacEFT and SALMOD predict a reduction in juvenile rearing habitat availability under Alternative 6A, which would increase competition for upstream food and space. Further, there would be small increases in water temperature under Alternative 6A during part of the rearing period.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

In general, Alternative 6A would reduce migration conditions for winter-run Chinook salmon relative to the NAA.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined for the July through November juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run Chinook salmon to migrate effectively down the Sacramento River. Flows under A6A_LLT would be up to 16% lower than under NAA during August, September, and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).Flows under A6A_LLT would be generally similar to or higher than flows under NAA during July and October with few exceptions.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. A reduction in flows may reduce the olfactory cues needed by adult winter-run Chinook salmon to return to natal spawning grounds in the upper Sacramento River. Flows under A6A_LLT would generally be similar to or greater than those under NAA, except during August, in which flows would be up to 10% lower under A6A_LLT.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-42, which indicates there would be no differences in water temperatures between NAA and Alternative 1A.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

During the juvenile winter-run Chinook salmon emigration period (November to early May), mean monthly flows under Alternative 6A averaged across years would be lower (15% to 28% lower) compared to NAA. Flows would be up to 34% lower in April of above normal years. As described in Impact AQUA-42 for Alternative 1, *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.

The north Delta facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The five NDD intakes would remove or modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be less than 2% compared to the annual production estimated for the Sacramento Valley (Table 11-1A-17). A conservative assumption of 5% loss per intake would yield a cumulative loss of 18.5% of juvenile winter-run Chinook that reach the north Delta (Appendix 5F, *Biological Stressors*). This assumption is uncertain and represents an upper bound estimate. This topic is further discussed in Alternative 1A, Impact AQUA-42.

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was modeled by the DPM. Average survival under Alternative 6A would be 33.5% across all years, 26.3% in drier years, and 45.7% in wetter years (Table 11-6A-8). Compared to NAA, juvenile survival would decrease less than 1% (a 1-3% relative decrease) for all years, drier years and wetter years scenarios.

Table 11-6A-8. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 6A

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wetter Years	46.3	46.1	45.7	-0.7 (-1%)	-0.4 (-1%)
Drier Years	28.0	27.1	26.3	-1.7 (-6%)	-0.9 (-3%)
All Years	34.9	34.2	33.5	-1.3 (-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).

Adults

Attraction flow was estimated by the percentage of Sacramento River-origin water at Collinsville (Table 11-6A-9). The proportion of Sacramento River water in the Delta during the adult winter-run migration period (December to June) would be slightly reduced 6% to 8% in January and February, and reduced 10% to 13% in March to May compared to NAA. The reductions in percentage are less than the 20% change in dilution reported to cause a significant change in migration by Fretwell (1989). Although Sacramento River attraction flows would be reduced during these months relative to NAA, the Sacramento River would still represent 55–69% of Delta flows.

Table 11-6A-9. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 6A

Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3
	Shading indicates 10% or greater decrease in abundance relative to baseline.				

NEPA Effects: Overall, the results indicate that the effect of Alternative 6A 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. Upstream of the Delta in the Sacramento River, there would be no effect of Alternative 6A relative to NAA on upstream flows or water temperatures during the juvenile and adult migration periods.

Adult attraction flows under Alternative 6A would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 6A NDD on winter-run Chinook salmon related to impingement and predation associated with five new intakes could result in substantial effects on juvenile migrating winter-run Chinook salmon, although there is high uncertainty regarding the potential effects. Estimates within the effects analysis range from very low levels of effects (2% mortality) to very significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the five new intake structures will be implemented as part of the final NDD screen design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for winter-run Chinook salmon. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 6A would be similar to survival rates estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative 6A on winter-run Chinook salmon through-Delta survival remains uncertain.

Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the presence and operation of the five intakes on winter-run Chinook salmon, this effect is adverse.

CEQA Conclusion: In general, Alternative 6A would affect migration conditions for winter-run Chinook salmon relative to CEQA Existing Conditions.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined during the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT for juvenile migrants would be generally similar to or greater than flows under Existing Conditions, except during September, in which flows would be up to 21% lower. Because these flow reductions occur in only one month during the five-month emigration period, they would not cause biologically meaningful effects.

Flows under A6A_LLT in the Sacramento River upstream of Red Bluff during the December through August adult winter-run Chinook salmon upstream migration period would generally be similar to or greater than flows under Existing Conditions with few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-42, which indicates that there would be small increase in water temperatures under Alternative during large portions of the juvenile and adult migration periods.

Through-Delta

As described above, through-Delta survival by emigrating juvenile winter-run Chinook salmon would decrease 1.3% (4% relative decrease) across all water years and decrease 1.7% (6% relative decrease) in drier years compared to Existing Conditions. Losses due to predation at the five north Delta intakes could hypothetically range from less than 2% up to 19.2% of juvenile winter-run Chinook that reach the north Delta.

Based on the proportion of Sacramento River flows, attraction flows and olfactory cues would be slightly reduced (up to 15% lower) compared to Existing Conditions during the adult winter-run adult Chinook salmon migration period (December to June) (Table 11-6A-9). Although Sacramento River attraction flows would be reduced during these months relative to Existing Conditions, the Sacramento River would still represent 55–67% of Delta flows.

Summary of CEQA Conclusion

In general, the impact is significant because Alternative 6A would reduce migration conditions for winter-run Chinook salmon and the movement of fish would be substantially altered. Although upstream flows would be similar between Existing Conditions and Alternative 6A, water temperatures would be elevated for much of the juvenile and adult migration periods, which could contribute to increased stress or mortality to migrating individuals. In the Delta, Alternative 6A would result in a decrease in through-Delta survival of juvenile winter-run Chinook salmon, increased predation at the five intakes, and loss of aquatic habitat associated with the five intake structures. Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions for the winter-run adult Chinook salmon migration.

With respect to the NDD intakes, implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce them to a level considered less than significant. Although implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be located near the intakes and therefore would not fully compensate for the lost habitat. Additionally, implementation of this measure would not fully address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness such that it is considered to have no demonstrable effect. Conservation measures that address habitat and predation losses, therefore, would potentially minimize impacts to some extent but not to a less than significant level.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel margin enhancement would be performed only along channels that provide rearing and outmigration habitat for juvenile salmonids. These include channels that are protected by federal project levees—including the Sacramento River between Freeport and Walnut Grove among several others.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem. Therefore, this conservation measure is not intended to entirely remove predators at any location, or substantially alter the abundance of predators at the scale of the Delta system. This conservation measure would also not remove piscivorous birds. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness. Effects would be temporary, as new individuals would be expected to occupy vacated areas; therefore, removal activities would need to be continuous during periods of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of the impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6A without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 6A operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this alternative, and the impact on winter-run Chinook salmon would remain significant and unavoidable.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-43 through Impact AQUA-54) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: These restoration and conservation impact mechanisms have been determined to range from no effect, not adverse, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-43 through 54). Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Spring-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of construction of water conveyance facilities on spring-run Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-55), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for spring-run Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than 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.

Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of maintenance of water conveyance facilities on Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-56), which concluded that the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-56, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Entrainment losses of juvenile spring-run Chinook salmon to the SWP/CVP south Delta facilities would be eliminated under Alternative 6A because there would be no south Delta exports under this Alternative.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 6A would eliminate south Delta entrainment for all races of Chinook salmon, which would be a beneficial effect.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta facilities would be eliminated under Alternative 6A for all salmon races and water year types compared to Existing Conditions. The reduction in entrainment would be a beneficial impact. Overall, water operations impacts on Chinook salmon would be less than significant and may be beneficial to the species because of the elimination of entrainment loss at the south Delta facilities. No mitigation would be required.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to the NEPA point of comparison.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would generally be no effects of Alternative 1A on water temperatures during the spring-run spawning and egg incubation period in the Sacramento River relative to NAA.

Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon spawning and incubation period (September through January) under A6A_LLT would generally be similar to or greater than those under NAA during October, December, and January, with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during September and November would generally be lower than those under NAA (up to 17% lower).

Shasta Reservoir storage volume at the end of September influences flows downstream of the dam during the spring-run Chinook salmon spawning and egg incubation period (September through January). Storage under A6A_LLT would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

Table 11-6A-10. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-530 (-16%)	-18 (-1%)
Above Normal	-454 (-14%)	161 (6%)
Below Normal	-271 (-9%)	83 (3%)
Dry	-373 (-15%)	138 (7%)
Critical	-314 (-26%)	68 (8%)

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be lower than or similar to mortality under NAA in all water year types except below normal years (19% greater) (Table 11-6A-11). The 19% increase in mortality in below normal years would be a small negative effect on the spring-run Chinook salmon population.

Table 11-6A-11. 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. A6A_LLT	NAA vs. A6A_LLT
Wet	16 (155%)	1 (4%)
Above Normal	18 (136%)	-4 (-11%)
Below Normal	37 (313%)	8 (19%)
Dry	50 (257%)	-6 (-8%)
Critical	22 (29%)	-1 (-1%)
All	28 (126%)	-0.4 (-1%)

SacEFT predicts that there would be a small difference (12% lower) in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to NAA (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to NAA. SacEFT predicts that there would be a 15% decrease in the percentage of years with good (lower) egg incubation conditions under A6A_LLT relative to NAA. SacEFT predicts that there would be a 35% increase in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative to NAA.

Table 11-6A-12. 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. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-15 (-21%)	6 (12%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-57 (-66%)	-5 (-15%)
Redd Dewatering Risk	-3 (-6%)	12 (35%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-4 (-21%)	1 (7%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A6A_LLT would generally be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A6A_LLT would be the same as that under NAA in all water year types (Table 11-6A-13).

Water temperatures were not modeled in Clear Creek.

Table 11-6A-13. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_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.

[a] 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.

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) where spring-run Chinook salmon primarily spawn during September through January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_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.

Oroville Reservoir storage volume at the end of September influence flows downstream of the dam during the spring-run Chinook salmon spawning and egg incubation period. Storage under A6A_LLT would be greater than storage under NAA in all water year types (Table 11-6A-14). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 6A.

Table 11-6A-14. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-754 (-26%)	260 (14%)
Above Normal	-576 (-24%)	215 (14%)
Below Normal	-497 (-25%)	112 (8%)
Dry	-13 (-1%)	340 (34%)
Critical	-23 (-2%)	165 (21%)

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month over the egg incubation period compared to the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel during October through January were identical among A6A_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on redd dewatering in the Feather River low-flow channel.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be no effect of Alternative 1A on water temperatures in the Feather River relative to NAA during the spring-run spawning and egg incubation period.

NEPA Effects: Based on these results, it is concluded that the effect would not be adverse because habitat would not be substantially reduced. Flows in the Sacramento River would be reduced by up to 17% in two months during the five–month spawning and egg incubation period, although flows in other rivers would not differ from the NEPA point of comparison. Storage volume in the Sacramento and Feather rivers would be greater under Alternative 6A. Biological modeling generally predicts that spawning and egg incubation conditions for spring-run Chinook salmon in the Sacramento River would improve. There would be no effects in Clear Creek.

CEQA Conclusion: In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to CEQA Existing Conditions.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the exceedances of NMFS temperature thresholds under alternative 6A relative to Existing Conditions.

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A6A_LLT during September would generally be lower than those under Existing Conditions (up to 21% lower). However, flows under A6A_LLT would be generally similar to or greater than those under Existing Conditions during October through January with some exceptions (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir Storage volume at the end of September would be 9% to 26% lower under A6A_LLT relative to Existing Conditions (Table 11-6A-10).

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be 29% to 313% greater than mortality under Existing Conditions depending on water year type (Table 11-6A-11).

SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions under A6A_LLT relative to Existing Conditions, respectively. SacEFT predicts that there would be a 6% decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A6A_LLT would generally be similar to or greater than flows under Existing Conditions except in critical years during September through November (6% to 28% lower) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows would be worse under A6A_LLT than reductions under Existing Conditions in above normal, dry, and critical water years (Table 11-6A-13).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River low-flow channel under A6A_LLT are not different from Existing Conditions during the spring-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

Oroville Reservoir storage volume at the end of September would be 24% to 26% lower under A6A_LLT relative to Existing Conditions during wet, above normal, and below normal water years and similar to storage under Existing Conditions during dry and critical water year types (Table 11-6A-14).

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the exceedances of NMFS temperature thresholds under Alternative 6A relative to Existing Conditions.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during October through January were identical between A6A_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on redd dewatering in the Feather River low-flow channel.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat and reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 6A. The quality and quantity of spawning and egg incubation habitat for spring-run Chinook salmon in the Sacramento River would be lower under Alternative 6A relative to the Existing Conditions, which would reduce the ability of spring-run Chinook salmon to spawn successfully. There would be no effects on spawning and egg incubation conditions in the Feather River and Clear Creek.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 6A would not affect the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to the NEPA point of comparison.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-59, which indicates that 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.

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November under A6A_LLT would generally be lower than those under NAA (up to 23% lower). Flows during the period would generally be similar to or greater than those under NAA with some exceptions.

As reported in Impact AQUA-40, May Shasta storage volume under A6A_LLT would be similar (within 2%) to NAA in most water years types, but greater by 6%in critical water years (Table 11-6A-5).

As reported in Impact AQUA-58, September Shasta storage volume would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A6A_LLT would be 14% greater than that under NAA (Table 11-6A-12). The percentage of years with good (lower) juvenile stranding risk conditions under A6A_LLT would be 7% greater than under NAA.

SALMOD predicts that spring-run Chinook salmon smolt equivalent habitat-related mortality would be greater under A6A_LLT than NAA.

Clear Creek

Flows in Clear Creek during the year November through March rearing period under A6A_LLT would nearly always be similar to or greater than flows under NAA, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A6A_LLT would not differ from those under NAA. In the high-flow channel, flows under A6A_LLT would be generally similar to or greater than flows under NAA during November and during January through June, with some exceptions (up to 31% lower). Flows under A6A_LLT would be generally lower than flows under NAA during December (up to 27% lower).

May Oroville storage under A6A_LLT would be similar to or greater than storage under NAA in all water years (Table 11-6A-15).

Table 11-6A-15. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-71 (-2%)	-25 (-1%)
Above Normal	-137 (-4%)	19 (1%)
Below Normal	-124 (-4%)	229 (8%)
Dry	-250 (-9%)	270 (12%)
Critical	-89 (-5%)	227 (15%)

As reported in Impact AQUA-58, September Oroville storage volume would always be greater than under NAA (Table 11-6A-14).

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-59, which indicates that mean monthly water temperatures would generally be similar between NAA and Alternative 1A during the period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because habitat would not be substantially reduced. There would be no consistent, high magnitude changes in flows in any of the waterways examined.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 6A (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either overstate the effects of Alternative 6A or suggest significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 6A.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-59, which indicates that there would be no differences in mean monthly water temperature between Existing Conditions and Alternative 1A.

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during December at Keswick and at Red Bluff under A6A_LLT would be generally lower than those under Existing Conditions (up to 12% and 11% lower, respectively), while flows during all other months would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

As reported Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A6A_LLT would be similar to Existing Conditions in wet and above normal water years, but lower by 5% to 19% in below normal, dry, and critical water years (Table 11-6A-5).

As reported in Impact AQUA-58, storage volume at the end of September under A6A_LLT would be 9% to 26% lower relative to Existing Conditions in all water years (Table 11-6A-10).

SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be a 6% decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative to Existing Conditions.

SALMOD predicts that spring-run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be 28% lower than under Existing Conditions.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A6A_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years during November in which flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not model in Clear Creek.

Feather River

Relatively constant flows in the low-flow channel throughout this period under A6A_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A6A_LLT would largely be lower during October through January and during July (up to 45% lower). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during the rest of the year, with some exceptions (up to 46% lower).

May Oroville storage volume under A6A_LLT would be lower than Existing Conditions by 9% and 5% in dry and critical water years, respectively, but would be similar to Existing Conditions in all other water year types (Table 11-6A-15).

As reported in Impact AQUA-156, September Oroville storage volume would be 24% to 26% lower under A6A_LLT relative to Existing Conditions in wet, above normal, and below normal water years, but similar to Existing Conditions in dry and critical water years (Table 11-6A-14).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat. Spring-run Chinook salmon fry and juveniles rear in both the high-flow and low-flow channels of the Feather River. Flows and water temperatures in the low-flow channel would be unchanged by Alternative 6A. However, flows in the high-flow channel would be mostly lower by up to 45% during the half of the fry and juvenile rearing period. This frequency, duration, and magnitude of flow reduction is expected to have a significant impact on rearing fry and juveniles.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

Upstream of the Delta

In general, Alternative 6A would reduce migration conditions for spring-run Chinook salmon relative to the NEPA point of comparison.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-60, which indicates that there would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period. Flows under A6A_LLT during the period would nearly always be similar to or greater than flows under NAA, except during January in critical years (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through July would always be similar to or greater than flows under NAA, but would be generally lower during August (6% to 10% lower).

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A6A_LLT would generally be similar to or greater than flows under NAA except in critical years during November through January (7% to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would nearly always be similar to or greater than flows under NAA except in below normal years during March (6% lower).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A6A_LLT would nearly always be similar to or greater than flows under NAA except in critical water years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under NAA during December (up to 18% lower), and similar to or greater than flows under NAA during the rest of the period with few exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through

June would be similar to or greater than flows under NAA with few exceptions (up to 31% lower), and flows during July and August would generally be lower than flows under NAA by up to 49%.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-60, which indicates that there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to baseline conditions. The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. As described for Alternative 1A (see details in Impact AQUA-42), the five NDD intakes would remove or modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be 2% compared to the annual production estimated for the Sacramento Valley (Table 11-1A-17). A conservative assumption of 5% loss per intake would yield a cumulative loss of 19.2% of juvenile spring-run Chinook that reach the north Delta (Appendix 5F, *Biological Stressors*). This assumption is uncertain and represents an upper bound estimate.

Through-Delta survival to Chipps Island by emigrating juvenile spring-run Chinook salmon was modeled by the DPM. Average survival under Alternative 6A would be 29.0% across all years, 23.5% in drier years, and 38.0% in wetter years (Table 11-6A-16). Juvenile survival would decrease slightly compared to NAA, ranging from 0.8% lower in drier years (3% relative decrease) up to 2.4% lower in wetter years (6% relative decrease). The effect on juvenile spring-run Chinook salmon migration survival through the Delta would be adverse.

Table 11-6A-16. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Alternative 6A

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Water Year Type	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wetter Years	42.1	40.4	38.0	-4.1 (-10%)	-2.4 (-6%)
Drier Years	24.8	24.3	23.5	-1.2 (-5%)	-0.8 (-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 WYs (6 years).
Drier = Below Normal, Dry and Critical WYs (10 years).

Adults

During the overall spring-run Chinook salmon upstream migration from March-June, the proportion of Sacramento River in the Delta would be similar in June (<10% difference), but reduced from

March–May (Table 11-6A-17). During the months from March–May, proportion of Sacramento River flows under Alternative 6A would be 10–13% less than baseline when climate change effects are factored in (NAA). While the proportion of Sacramento River flows would be reduced under Alternative 6A, the Sacramento River would still represent a substantial 55–64% of Delta outflows. Therefore, olfactory cues would still be strong for upstream migrating spring-run adult Chinook salmon. 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 in Alternative 1A.

Table 11-6A-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 6A

Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3
	Shading indicates 10% or greater decrease in abundance relative to baseline.				

NEPA Effects: Overall, the results indicate that the effect of Alternative 6A 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. Upstream of the Delta migration conditions for spring-run Chinook salmon under Alternative 6A would not be adverse because flow and temperature conditions would generally be similar to those under the NEPA baseline.

Adult attraction flows under Alternative 6A would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 6A NDD on spring-run Chinook salmon related to impingement and predation associated with five new intakes could result in substantial effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the potential effects. Estimates within the effects analysis range from very low levels of effects (~2% mortality) to very significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the five new intake structures will be implemented as part of the final NDD screen design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for spring-run Chinook salmon. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 6A would be similar to survival rates estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative 6A on spring-run Chinook salmon through-Delta survival remains uncertain.

Therefore, primarily due to unacceptable levels of uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the presence and operation of the five intakes on spring-run Chinook salmon, this effect is adverse. While implementation of the conservation and mitigation measures listed below would address these impacts, these are not anticipated to reduce the impacts to a level considered not adverse.

CEQA Conclusion: In general, spring-run Chinook salmon migration conditions would be reduced under Alternative 6A relative to Existing Conditions.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean monthly water temperature between NAA and Alternative 1A.

Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-run Chinook salmon migration period under A6A_LLT would generally be similar to or greater than flows under Existing Conditions except during December in below normal and dry years (7% and 6% lower, respectively), below normal years during March, April, and May (11%, 7%, 10% lower, respectively), and wet years during May (16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-run Chinook salmon upstream migration period under A6A_LLT would generally be similar to or greater than Existing Conditions, except in below normal years during April and May (7% and 10% lower, respectively), wet years during May (16% lower), and dry and critical years during August (6% and 20% lower, respectively).

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A6A_LLT would nearly always be similar to or greater than flows under Existing Conditions except in critical years during November (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A6A_LLT would nearly always be similar to or greater than flows under Existing Conditions with except during August in critical water years (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows were examined for the Feather River at the confluence with the Sacramento River during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November through January and during May under A6A_LLT would generally be lower than flows under Existing Conditions by up to 36%. Flows during February through April would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 15% lower).

Flows were examined for the Feather River at the confluence with the Sacramento River during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May through July under A6A_LLT would generally be lower by up to 53% than flows under Existing Conditions. Flows during April and August under A6A_LLT would generally be similar to or greater than flows under Existing Conditions except in critical water years during April and dry years in August (6% and 34% lower, respectively).

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean monthly water temperature between Existing Conditions and Alternative 1A.

Through-Delta

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to Existing Conditions. Through-Delta survival by emigrating juvenile spring-run Chinook salmon would decrease 2.3% (7% relative decrease) under Alternative 6A across all years compared to Existing Conditions (Table 11-6A-16). Losses due to predation at the five north Delta intakes could hypothetically range from less than 2% up to 19.2% of juvenile winter-run Chinook that reach the north Delta. Overall, the impact on juvenile Chinook salmon migration through the Delta would be significant.

Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, declined 14% to 15% under Alternative 6A during the adult spring-run Chinook salmon migration period (April-May) compared to Existing Conditions (Table 11-6A-17). Uncertainty remains with regard to adult salmon behavioral response to anticipated changes in lower Sacramento River flow percentages. For further discussion of the topic see the analysis for Impact AQUA-42 in Alternative 1A. Overall the impact on adult salmon upstream migration would be less than significant.

Summary of CEQA Conclusion

Collectively, these results indicate that the effect of Alternative 6A on spring-run Chinook salmon migration conditions would be significant because the alternative would substantially interfere with the movement of fish. Flows in the Feather River during a large portion of both the juvenile emigration and adult immigration period would be frequently lower by up to 53% Although there would be no effect of Alternative 6A in other upstream rivers. In the Delta, Alternative 6A would result in a decrease in through-Delta survival of juvenile winter-run Chinook salmon, increased predation at the five intakes, and loss of aquatic habitat associated with the five intake structures. Based on the proportion of Sacramento River flows, olfactory cues would be14% to 15% lower than those under Existing Conditions for winter-run adult Chinook salmon migration.

Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce them to a level considered less than significant. Although implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be located near the intakes and therefore would not fully compensate for the lost habitat. Additionally, implementation of this measure would not fully address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness such that it is considered to have no demonstrable effect. Conservation measures that address habitat and predation losses, therefore, would potentially minimize impacts to some extent but not to a less than significant level. Consequently, as a result of these changes in migration conditions, this impact is significant and unavoidable.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel margin enhancement would be performed only along channels that provide rearing and outmigration habitat for juvenile salmonids. These include channels that are protected by federal project levees—including the Sacramento River between Freeport and Walnut Grove among several others.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"). This conservation measure seeks to benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem. Therefore, this conservation measure is not intended to entirely remove predators at any location, or substantially alter the abundance of predators at the scale of the Delta system. This conservation measure would also not remove piscivorous birds. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness. Effects would be temporary, as new individuals would be expected to occupy vacated areas; therefore, removal activities would need to be continuous during periods of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

In addition to these conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact, although the effect would still likely remain significant and unavoidable. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have significant and unavoidable adverse effects on migration habitat, this conclusion was based on the best available scientific information at the time and may prove to have been over- or understated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 6A.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 6A operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 6A.

Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 6A. 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).

Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on spring-run Chinook salmon habitat, the BDCP proponents will consult with FWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-60a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6A without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under Alternative 6A operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on spring-run Chinook salmon would remain significant and unavoidable.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-61 through Impact AQUA-72) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: These impact mechanisms have been determined to range from no effect, not adverse, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-61 through 72). Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: The potential effects of construction of water conveyance facilities on fall-run/late fall-run Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-73), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping. As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for fall-run/late fall-run Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-73 for Chinook salmon, the impact of the construction of water conveyance facilities on Chinook salmon would be less than 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.

Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: The potential effects of maintenance of water conveyance facilities on Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-74), which concluded that the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-74, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

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

Entrainment losses of juvenile fall-run and late fall-run Chinook salmon to the SWP/CVP south Delta facilities would be eliminated under Alternative 6A because there would be no south Delta exports under this Alternative.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 6A would eliminate south Delta entrainment for fall-run Chinook salmon and late fall-run Chinook salmon, which would be a beneficial effect.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta facilities would be eliminated under Alternative 6A for all salmon races and water year types compared to Existing Conditions. The impact would be less than significant and may be beneficial. No mitigation would be required.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 6A would have negligible effects on spawning and egg incubation habitat for fall-/ late-fall run Chinook salmon relative to the NEPA point of comparison.

Sacramento River

Water temperatures in the Sacramento River for Alternative 6A are not different from those for Alternative 1A, Impact AQUA-76, which indicates that there would be no differences in mean monthly water temperature between NAA and Alternative 1A.

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 A6A_LLT would generally be greater than or similar to NAA during October, December, and January, except in critical years during October and January (7% and 11% lower) and above normal years during October (9% lower). During November, flows under A6A_LLT would generally be lower by up to 13% than under NAA.

Shasta Reservoir storage at the end of September would affect flows during the fall-run Chinook salmon spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be similar to mortality under NAA in all water year types (Table 11-6A-18).

Table 11-6A-18. 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. A6A_LLT	NAA vs. A6A_LLT
Wet	10 (105%)	1 (3%)
Above Normal	9 (86%)	-2 (-8%)
Below Normal	12 (109%)	0 (2%)
Dry	15 (102%)	-2 (-6%)
Critical	9 (30%)	-1 (-2%)
All	11 (80%)	-1 (-2%)

SacEFT predicts that there would be a 54% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to NAA (Table 11-6A-19). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to NAA. SacEFT predicts that there would be a 16% increase in good years relative to NAA. SacEFT predicts that there would be a 4% decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative to NAA.

Table 11-6A-19. 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. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	6 (13%)	19 (54%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-14 (-15%)	11 (16%)
Redd Dewatering Risk	-1 (-4%)	-1 (-4%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-11 (-35%)	0 (0%)

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 A6A_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 Chinook salmon spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be similar or slightly lower than mortality under NAA in all water years (Table 11-6A-20).

Table 11-6A-20. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	4 (175%)	-1 (-11%)
Above Normal	4 (152%)	-1 (-12%)
Below Normal	4 (301%)	0.4 (8%)
Dry	5 (185%)	0.1 (2%)
Critical	3 (144%)	0 (0%)
All	4 (185%)	-0.2 (-4%)

SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning availability for late fall–run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to NAA (Table 11-6A-21). SacEFT predicts that there would be no difference in redd scour risk, the percentage of years with good (lower) egg incubation conditions and redd dewatering risk between A6A_LLT and NAA.

Table 11-6A-21. 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. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-7 (-13%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-5 (-8%)	0 (0%)
Juvenile Rearing WUA	15 (33%)	-3 (-5%)
Juvenile Stranding Risk	-29 (-40%)	-3 (-7%)

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 A6A_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 A6A_LLT would be the same as the reduction under NAA for all water year types (Table 11-6A-22).

Table 11-6A-22. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_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.

[a] 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.

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-76, which indicates that temperatures conditions under Alternative 1A would be similar to or better than those under NAA.

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel under A6A_LLT would be identical to those under NAA. Flows in the high-flow channel under A6A_LLT would generally be similar to or greater than those under NAA, except during December (up to 27% lower) and some water year types during other months (up to 24% lower).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during November through January were identical between A6A_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A6A_LLT would be lower than mortality under NAA in all water years (Table 11-6A-23).

Table 11-6A-23. 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. A6A_LLT	NAA vs. A6A_LLT
Wet	10 (723%)	-9 (-44%)
Above Normal	6 (540%)	-6 (-46%)
Below Normal	9 (520%)	-4 (-26%)
Dry	13 (601%)	-6 (-26%)
Critical	18 (378%)	-5 (-17%)
All	11 (534%)	-6 (-32%)

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, AQUA-76, 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 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would nearly always be similar to or greater than flows under NAA, except in below normal water years during November (7% lower).

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 A6A_LLT would be 32% and 44% greater in magnitude than under NAA in below normal and critical water years, and would be similar to or lower magnitude than under NAA in other water year types (Table 11-6A-24).

Table 11-6A-24. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-8 (-37%)	17 (36%)
Above Normal	0.2 (1%)	10 (25%)
Below Normal	-42 (-219%)	-15 (-32%)
Dry	2 (5%)	0 (0%)
Critical	-6 (-11%)	-18 (-44%)

NA = could not be calculated because the denominator was 0.

[a] 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.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A6A_LLT would be similar to mortality under NAA in all water years (Table 11-6A-25).

Table 11-6A-25. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	24 (160%)	1 (1%)
Above Normal	23 (219%)	1 (2%)
Below Normal	23 (186%)	1 (2%)
Dry	17 (104%)	1 (2%)
Critical	10 (47%)	0 (0%)
All	20 (133%)	1 (2%)

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River 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 Alternative 6A would be similar to flows under NAA throughout the period.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 1A throughout the October through January period.

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 Alternative 6A would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 Alternative 6A would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect would not be adverse because habitat conditions are not substantially reduced. There are minimal reductions in flows or increases in temperatures under Alternative 6A in all locations examined that would not translate into adverse biological effects on fall-run Chinook salmon.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon would not be affected relative to the CEQA baseline.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large negative effects of Alternative 1A on temperatures in the Sacramento River.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A6A_LLT would generally be greater than or similar to Existing Conditions throughout the period, except in above normal and critical years during October (9% for both) and below normal and dry years during December (7% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta storage volume at the end of September would be 9% to 26% lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-10).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be 30% to 109% greater than mortality under Existing Conditions depending on water year type, which is a 9% to 15% increase on an absolute scale (Table 11-6A-18).

SacEFT predicts that there would be a 13% increase in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-19). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be a 15% decrease in the percentage of years with good (lower) egg incubation conditions under A6A_LLT relative to Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A6A_LLT are similar relative to Existing Conditions.

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A6A_LLT would generally be greater than or similar to flows under Existing Conditions, except in below normal years during March through May (7% to 11% lower) and wet yeas during May (16% lower).

Shasta storage volume at the end of September would be 9% to 26% lower under A6A_LLT relative to Existing Conditions (Table 11-6A-10).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be 144% to 301% greater than mortality under Existing Conditions (Table 11-6A-20). However, absolute differences in the percent of the late-fall population subject to mortality would be minimal in all but dry water years, in which there is a 5% increase.

SacEFT predicts that there would be a 13% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-21). SacEFT predicts that there would be a 7% decrease in the percentage of years with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be no difference in the percentage of years with good (lower) egg incubation conditions under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be an 8% decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative to Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir under A6A_LLT during the September through February fall-run Chinook salmon spawning and egg incubation period would generally be similar to or greater than flows under Existing Conditions, except in below normal and critical water years during October (6% lower for both) and critical years in November (6% lower).

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 occurred. The greatest monthly reduction in Clear Creek flows during October through February under A6A_LLT would be similar to or lower magnitude than those under Existing Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33%

greater (absolute, not relative, differences) under A6A_LLT in above normal, dry, and critical water years, respectively (Table 11-6A-22).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large effects of Alternative 1A on temperatures.

Fall-Run

Flows in the low-flow channel during October through January under A6A_LLT would be identical to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow channel under A6A_LLT would generally be lower by up to 43% than flows under Existing Conditions.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel were identical between A6A_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A6A_LLT would be 378% to 723% greater than mortality under Existing Conditions (Table 11-6A-23).

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be moderate to large effects of Alternative 1A on temperatures.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during 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 in the American River at the confluence with the Sacramento River under A6A_LLT would always be similar to or greater than flows under Existing Conditions during October, but generally lower by up to 34% than flows under Existing Conditions during November through January.

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 monthly reduction in American River flows during October through January under A6A_LLT would be up to 219% greater magnitude than those under Existing Conditions in all but above normal and dry water years, in which the greatest monthly reduction under A6A_LLT would be similar to or lower than that under Existing Conditions (Table 11-6A-24).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A6A_LLT would be 47% to 219% greater than mortality under Existing Conditions depending on water year type (Table 11-6A-25).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during 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 A6A_LLT would generally be lower than flows under Existing Conditions in all months and water year types by up to 16%.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, AQUA-76, which indicates that there be no effects of Alternative 1A on temperatures relative to Existing Conditions.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis 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 Alternative 6A would be similar to those under Existing Conditions during November and December, 5% lower under Alternative 6A during October, and 6% greater under Alternative 6A during January.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta 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 Alternative 6A would be up to 14% lower than flows under Existing Conditions during October and November, up to 15% greater than flows under Existing Conditions during December and January.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat of fish, contrary to the NEPA conclusion set forth above. There would be flow reductions in the Feather, American, and Stanislaus rivers that are substantially large and frequent to affect the fall-run Chinook salmon population. In addition, the Reclamation egg mortality model predicts moderate to substantial negative effects of Alternative 6A on fall-run Chinook salmon egg survival in the Sacramento River.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

Upstream of the Delta

In general, Alternative 6A would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to NAA.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on temperature.

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would always be greater than or similar to flows under NAA, except in critical years during January (11% lower).

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile Chinook salmon rearing period. As reported in Alternative 1A, Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to NAA (Table 11-6A-19). SacEFT predicts that there would be no change in the percentage of years with good (lower) juvenile stranding risk under A6A_LLT relative to NAA.

SALMOD predicts that fall-run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be similar to mortality under NAA.

Late Fall–Run

Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during this period under A6A_LLT would generally be similar to or greater than flows under NAA, with one exceptions (6% lower).

Shasta Reservoir storage at the end of September and May would affect flows during the late fall–run larval and juvenile Chinook salmon rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-6A-10).

As reported in Impact AQUA-40, Shasta storage at the end of May under A6A_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-6A-5).

SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to NAA (Table 11-6A-21). SacEFT predicts that there would be a 7% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A6A_LLT relative to NAA.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A6A_LLT would be similar to (<5% difference) mortality under NAA.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-run

Flows in Clear Creek below Whiskeytown Reservoir were examined in the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would almost always be similar to or greater than flows under NAA, except in below normal years during March (6% reduction).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on temperature.

Fall-run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A6A_LLT would not differ from those under NAA. In the high-flow channel, flows during December under A6A_LLT would be generally lower then under NAA (up to 27% lower). Flows during January through June would generally be similar to or greater than flows under NAA with some exceptions (up to 31% lower) under A6A_LLT.

As reported in Alternative 1A, Impact AQUA-59, May Oroville storage volume under A6A_LLT would always be similar to or greater than storage under NAA, indicating that the difference relative to NAA is primarily a result of climate change (Table 11-6A-15).

As reported in Alternative 1A, Impact AQUA-58, September Oroville storage volume would always be similar to or greater than NAA (Table 11-6A-14).

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on temperature.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under NAA except in critical years during March (23% lower) and dry and critical years during April (15% and 6% lower, respectively).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under NAA throughout the period, regardless of water year type.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be no effects of Alternative 1A on temperature.

San Joaquin River

Fall-Run

Flows in the San Joaquin River for Alternative 6A are not different from those for Alternative 1A, which indicates that there would be no differences in flows during the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River for Alternative 6A are not different from those for Alternative 1A, which indicates that there would be no differences in flows during the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Taken together, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat of fish. Despite small or intermittent flow reductions, there are no effects of Alternative 6A on fall-run or late-fall-run Chinook salmon in that would rise to the level of adverse.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of rearing habitat for fall-/late fall-run Chinook salmon would not be reduced relative to the CEQA baseline.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be no effects on temperatures during the evaluated period.

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be greater than or similar to flows under Existing Conditions, except in below normal years during March through May (7% to 11% lower) and wet years during May (16% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 9% to 26% lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-10).

SacEFT predicts that there would be an 15% increase in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-19). SacEFT predicts that there would be a 35% reduction in the percentage of years with “good” (lower) juvenile stranding risk under A6A_LLT relative to Existing Conditions.

SALMOD predicts that fall-run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be 7% lower than mortality under Existing Conditions.

Late Fall–Run

Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during the rest of the period under A6A_LLT would generally be similar to or greater than those under Existing Conditions, with some exceptions (up to 16% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 9% to 26% lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-10).

As reported in Impact AQUA-40, end of May Shasta storage under A6A_LLT would be similar to Existing Conditions in wet and above normal years, but lower by 5% to 19% in below normal, dry, and critical water years (Table 11-6A-5).

SacEFT predicts that there would be a 33% increase in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-21). SacEFT predicts that there would be a 40% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A6A_LLT relative to Existing Conditions.

SALMOD predicts that late fall–run Chinook salmon smolt equivalent habitat-related mortality under A6A_LLT would be 5% higher than mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would always be similar to or greater than flows under Existing Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher during substantial portions of the periods evaluated.

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under A6A_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A6A_LLT would be mostly lower (up to 43%) during December and January and mostly similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 46% lower under A6A_LLT).

As reported under Impact AQUA-59, May Oroville storage volume under A6A_LLT would be lower than Existing Conditions in dry and critical years (9% and 5% lower, respectively) and similar to flows under Existing Conditions (<5% difference) in all other water year types (Table 11-6A-15).

As reported in Impact AQUA-58, September Oroville storage volume would be 24% to 26% lower under A6A_LLT relative to Existing Conditions in wet, above normal, and below normal years and similar to flows under Existing Conditions in the other water year types (Table 11-6A-14).

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher in 3 months during the 5-month period evaluated.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be lower than flows under Existing Conditions during January, April, and May (up to 34% lower), and generally similar to or greater than flows under Existing Conditions during February and March, except in critical years (8% and 25% lower, respectively).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions by up to 36% throughout the period.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher throughout the period evaluated.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A6A_LLT would generally be similar to flows under Existing Conditions during February through May and 6% higher under A6A_LLT in January. Flows would generally be lower by up to 16% in drier water year types under Alternative 6A relative to Existing Conditions during February through May.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be up to 18% greater than those under Existing Conditions during January and February, similar to flows under Existing Conditions during March, and lower by up to 18% than flows under Existing Conditions during April and May.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable rearing habitat of fish, contrary to the NEPA conclusion set forth above. Changes in Sacramento River flows under Alternative 6A would substantially reduce the risk of stranding for late fall- and fall-run Chinook salmon. There would be small to moderate flow reductions in the American, Stanislaus, and San Joaquin rivers under Alternative 6A relative to Existing Conditions during large portions of the fall-run Chinook salmon rearing period. These flow reductions would cause reductions in habitat quantity and quality for rearing fall-run Chinook salmon.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

Upstream of the Delta

In general, Alternative 6A would reduce migration conditions for fall-/late fall–run Chinook salmon relative to NAA.

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on temperatures throughout the periods evaluated relative to NAA.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run Chinook salmon migrants during February through May under A6A_LLT would be similar to or greater than flows under NAA throughout the February through May juvenile fall-run Chinook salmon migration period in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A6A_LLT would generally be lower than those under NAA during September (up to 16% lower) and generally similar to or greater than flows under NAA during October, except in critical years under NAA (7% lower) and above normal years (9% lower).

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run Chinook salmon migrants (January through March) under A6A_LLT would nearly always be similar to or greater than flows under NAA, except in critical years during January (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A6A_LLT would nearly always be similar to or greater than those under NAA except in critical years during January (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run Chinook salmon migrants during February through May. Flows under A6A_LLT would nearly always be similar to or greater than those under NAA, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A6A_LLT would generally be similar to or greater than those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on temperatures throughout the periods evaluated relative to NAA.

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were reviewed for the fall-run juvenile Chinook salmon migration period (February through May). Flows under A6A_LLT would nearly always be greater than or similar to flows under NAA throughout the migration period, except in dry and critical years during May (14% and 9% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on temperatures throughout the periods evaluated relative to NAA.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally similar to or greater than flows under NAA, except in critical years during March (23% lower) and dry and critical years during April (15% and 6% lower, respectively).

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than those under NAA except during wet and above normal years during September (32% and 9% lower, respectively).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be nearly identical to flows under NAA throughout the period. This indicates that climate change would affect juvenile migration flows in the Stanislaus River, but Alternative 6A would not.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be nearly identical to flows under NAA throughout the period. This indicates that climate change would affect adult migration flows in the Stanislaus River, but Alternative 6A would not.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on temperatures throughout the period evaluated relative to NAA.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and water year types throughout the period.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized* *in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and water year types throughout the period. Flows under A6A_LLT would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42. Through-Delta conditions on the Sacramento River would substantially impact migration conditions relative to NAA.

Fall-Run

Juveniles

During the juvenile fall-run Chinook salmon emigration period (November to early May), mean monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged across years would be lower (15% to 26% lower) compared to NAA. Flows would be up to 34% lower in April of above normal years.

The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The predation effects of Alternative 6A would be the same as those described for Alternative 1A, since there are five intakes for both alternatives. Estimates of potential predation losses ranged from 1.8% (Table 11-1A-17) up to 20.3% (conservative assumption of 5% loss per intake) of fall-run annual production (Appendix 5F, *Biological Stressors*).

Through-Delta survival by juvenile fall-run Chinook salmon under Alternative 6A averaged across years would be 23.9% from the Sacramento River, similar to NAA, and 17.5% from the Mokelumne River, an increase relative to NAA (Table 11-6A-26). In wetter years, mean survival would be 2.1% lower from the Sacramento (7% relative decrease) and 2.7% greater (17% relative increase) from the Mokelumne.

Overall, Alternative 6A would have a negative effect on fall-run Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes.

Table 11-6A-26. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Alternative 6A

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Water Year Type	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
Wetter Years	34.5	31.1	29.0	-5.5 (-16%)	-2.1 (-7%)
Drier Years	20.6	20.8	20.8	0.2 (1%)	0.0 (0%)
All Years	25.8	24.7	23.9	-1.9 (-7%)	-0.8 (-3%)
Mokelumne River					
Wetter Years	17.2	15.7	18.4	1.3 (7%)	2.7 (17%)
Drier Years	15.6	15.9	17.0	1.3 (9%)	1.0 (6%)
All Years	16.2	15.9	17.5	1.3 (8%)	1.7 (10%)
San Joaquin River[a]					
Wetter Years	19.3	20.3	14.0	-5.3 (-27%)	-6.2 (-31%)
Drier Years	10.0	9.5	8.9	-1.1 (-11%)	-0.7 (-7%)
All Years	13.5	13.6	10.8	-2.7 (-20%)	-2.8 (-20%)

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).
[a] Results for San Joaquin River runs may be anomalous when applying DPM to operations scenarios with low or no south Delta exports.

Adults

The adult fall-run Chinook salmon migration through the Delta occurs from September-December. Attraction flow for fall-run adults, as estimated by the percentage of Sacramento River water at Collinsville, under Alternative 6A were 1% greater to 5% lower compared to NAA, which is fairly similar (Table 11-6A-28).

Late Fall–Run

Juveniles

During the juvenile late fall-run Chinook salmon emigration period (October to February), mean monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged across years would be lower (15% to 32% lower) compared to NAA. Flows would be up to 31% lower in November of above normal years.

Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be 4.9% of the annual production estimated for the Sacramento Valley (Table 11-1A-17). A conservative assumption of 5% loss per intake would yield a cumulative loss of 20.3% of juvenile late fall-run Chinook that reach the north Delta. This assumption is uncertain and represents an upper bound estimate (Appendix 5F, *Biological Stressors*).

Through-Delta survival to Chipps Island (DPM) by emigrating juvenile late fall-run Chinook salmon averaged 23.1% across all years, 20.6% in drier years, and 27.4% in wetter years (Table 11-6A-27). Compared to NAA, juvenile survival would decrease 0.1% to 0.4% (1% to 2% relative decrease).

Table 11-6A-27. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon under Alternative 6A

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Water Year Type	EXISTING CONDITIONS	NAA	A6A	EXISTING CONDITIONS vs. A6A	NAA vs. A6A
Wetter Years	28.8	27.3	27.4	-1.4 (-5%)	0.1 (<1%)
Drier Years	18.8	20.2	20.6	1.8 (10%)	0.4 (2%)
All Years	22.5	22.9	23.1	0.6 (3%)	0.3 (1%)

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).

Adults

The adult late fall–run Chinook salmon migration is from November through March, peaking in January through March. The proportion of Sacramento River water in the Delta would be similar to baseline (<10% difference) most months, and reduced 12% in March compared to NAA. Therefore the effect under Alternative 6A would also not be adverse. 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 in Alternative 1A.

San Joaquin River

Through-Delta conditions on the San Joaquin River would be positive relative to NAA.

Fall-Run

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There would be no flow changes associated with the Alternative 6A.

As modeled by DPM, average survival of juvenile San Joaquin River fall-run to Chipps Island would be slightly less (2.8% less survival, or 20% less in relative percentage) under Alternative 6A compared to NAA (Table 11-6A-26). The DPM results for wetter years suggest that migrating juveniles from the San Joaquin River would experience 6.2% lower survival in wetter years (31% less in relative percentage).

However, this result may be an anomaly of the Delta Passage Model. For certain Alternatives and operations scenarios with highly reduced south Delta exports (such as Alternative 6A), it can be problematic applying the DPM to San Joaquin River salmon. The DPM was run for 16 different water year conditions. As described in *BDCP Effects Analysis – Appendix 5.C Flow, Passage, Salinity and Turbidity*, in 1982 and 1983 there was considerably greater average south Delta export flows under baseline/Existing Conditions scenarios (~6,000–8,000 cfs) than under proposed alternative scenarios (40–2,000 cfs) which led to appreciably lower survival under Alternative 4 (Scenario H3) because, as noted in the DPM methods, the DPM assumes a positive relationship between south Delta exports and survival based on Newman's (2010) modeling. For these two wet years, nonoperation of the barrier at the Head of Old River was assumed under all scenarios. There is some uncertainty regarding the effects that the very low south Delta exports modeled for Alternative 6A scenarios in 1983 (i.e., 40–50 cfs) might have on San Joaquin River Chinook salmon smolt survival because this level of exports is considerably lower than the minimum exports during the periods modeled by Newman (2010; i.e., ~800 cfs).

A qualitative assessment is more appropriate given this modeling limitation. Under Alternative 6A, survival of juvenile fall-run Chinook salmon would be expected to be similar or greater compared to NAA, given that south Delta exports that could entrain juveniles into the central Delta would be eliminated.

Adults

Alternative 6A would increase the proportion of San Joaquin River water in the Delta in September through December by 5–10% (Table 11-6A-28). San Joaquin flows at Vernalis under Alternative 6A would not be changed relative to NAA. Therefore overall adult migration conditions under Alternative 6A would be improved relative to NAA. Alternative 6A would have a beneficial effect on San Joaquin River basin fall-run Chinook salmon adults.

NEPA Effects: Overall, the results indicate that the effect of Alternative 6A 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.

Upstream of the Delta, effects of Alternative 6A would not be adverse. Flows under Alternative 6A during September, one of the two months of the fall-run adult Chinook salmon migration period, in the Sacramento River would be up to 16% lower in most water year types. However, these reductions would not be large enough to reduce the ability of adult fall-run Chinook salmon to sense olfactory cues from their natal spawning grounds. There would be no biologically meaningful effects in any other upstream waterways.

Adult attraction flows in the Delta under Alternative 6A would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 6A NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated with five new intakes could result in substantial effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty regarding the potential effects. Estimates within the effects analysis range from very low levels of effects (<2% mortality) to very significant effects (~ 20% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the five new intake structures will be implemented as part of the final NDD screen design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for fall- and late fall-run Chinook salmon. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento

River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 6A would be similar to survival rates estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative 6A on fall- and late fall-run Chinook salmon through-Delta survival remains uncertain.

Therefore, primarily due to reduced flows along with unacceptable levels of uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the presence and operation of the five intakes on fall- and late fall-run Chinook salmon, this effect is adverse. While the implementation of the conservation and mitigation measures described below would address these impacts, these measures are not anticipated to reduce the impact to a level considered not adverse.

CEQA Conclusion: In general, Alternative 6A would reduce migration conditions for fall-/late fall–run Chinook salmon.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that temperatures would generally not change under Alternative 1A during the periods evaluated relative to Existing Conditions.

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run Chinook salmon migrants during February through May under A6A_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal water years during March through May (7% to 11%) and wet years during May (16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A6A_LLT would generally be lower than those under Existing Conditions during September (up to 21% lower) and similar to or greater than flows under Existing Conditions during October, except in above normal and critical years (9% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run Chinook salmon migrants (January through March) under A6A_LLT would nearly always be similar to or greater than flows under Existing Conditions, except in below normal water years during March (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A6A_LLT would nearly always be similar to or greater than those under Existing Conditions, except in below normal and dry years during December (7% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon upstream migration period (February through May) under A6A_LLT would be similar to or greater than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A6A_LLT would generally be similar to flows under Existing Conditions except in critical years (28% and 6% lower during September and October, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that there would be no differences in temperatures between Existing Conditions and Alternative 1A during the periods evaluated.

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile Chinook salmon migration period (February through May) under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during February through April with some exceptions (up to 15% lower), and generally lower than Existing Conditions during May (up to 25% lower depending on water year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A6A_LLT would always be greater than flows under Existing Conditions during September, and would generally be lower compared to Existing Conditions during October (up to 13% lower depending on water year type).

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher under Alternative 1A relative to Existing Conditions during substantial portions of the periods evaluated.

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during February and March would generally be similar to or greater than flows under Existing Conditions, except in critical years (8% and 25% lower, respectively). Flows under A6A_LLT during April and May would be generally be lower by up to 34% than flows under Existing Conditions depending on month and water year type.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during September would be 35% to 57% lower than flows under Existing Conditions. Flows under A6A_LLT during October would always be similar to or greater than those under Existing Conditions.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would predominantly be lower than flows under Existing Conditions by up to 36%.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher during substantial portions of the juvenile migration period evaluated.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during September would generally be similar to flows under Existing Conditions, except during wet and above normal years (17% and 6% lower, respectively). Flows under A6A_LLT during October would be 5% to 10% lower than flows under Existing Conditions.

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher under Alternative 1A relative to 1A during September, but not October.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A6A_LLT would be similar to Existing Conditions in all months, although flows would generally be lower under A6A_LLT relative to Existing Conditions in drier water years.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be lower than Existing Conditions by up to 11% during both months.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or up to 15% greater than those under Existing Conditions during February and March, but up to 18% lower than flows under Existing Conditions during April and May.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be up to 29% lower than those under Existing Conditions depending on the month and water year type.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

During the emigration periods for fall-run Chinook salmon and late fall-run Chinook salmon, mean monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged across years would be lower (15% to 32% lower) compared to Existing Conditions, and over 20% to 46% reduced in wetter years March to May. As discussed above, potential predation losses at the five north Delta intakes could increase, ranging hypothetically from 2% up to 20% of emigrating juveniles reaching the Delta.

Through-Delta survival of migrating fall-run Chinook salmon juveniles from the Sacramento would be reduced (5.5% lower, a 16% relative decrease) in wetter years under Alternative 6A compared to Existing Conditions, but slightly increased in the Mokelumne River (1.3% greater survival, or a 7% relative increase) (Table 11-6A-26). Overall, the impact on juvenile migration would be less than significant due to minor differences in survival across all water years and no mitigation would be required.

Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions for the fall-run adult Chinook salmon migration. The proportion of Sacramento River flows would be 11–15% less from February–May compared to Existing Conditions, which would overlap with the late fall–run adult Chinook salmon migrations. Although Sacramento River olfactory cues would be reduced during these months relative to Existing Conditions, the Sacramento River would still represent 55–64% of Delta flows from February–May.

Overall, olfactory cues would not affect the ability of Sacramento River Chinook salmon to successful migrate upstream.

San Joaquin River

Fall-Run

There is a beneficial effect of Alternative 6A to all San Joaquin River basin fish due to positive Old and Middle River flows during migratory months resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected to eliminate entrainment at South Delta facilities and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under Alternative 6A, entrainment and entrainment-related mortality at the South Delta Facilities would be eliminated.

Additionally, under Alternative 6A, the elimination of entrainment at the South Delta Facilities would alleviate one of the primary concerns related to potential Old and Middle River corridor habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat, food availability, and overall salmonid fitness and survival.

For San Joaquin basin fall-run adult Chinook salmon, the proportion of San Joaquin River flows in the Delta would increase 5–10%, improving olfactory attraction cues. The increase in the proportion of San Joaquin River flows at Collinsville would be due to a reduction in the contribution of flows from the Sacramento River and the elimination of south delta exports under Alternative 6A.

Summary of CEQA Conclusion

Overall, the results indicate that the effect of Alternative 6A 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.

Flows in the Feather, American, Stanislaus, and Mokelumne rivers in September and October would generally be lower than those under Existing Conditions, reducing olfactory cues for fall-run Chinook salmon adult migrants, potentially delaying or preventing them from reaching these spawning grounds. In addition, flows under Alternative 6A in the American River during two of the four months of the juvenile fall-run Chinook salmon migration period would be lower than Existing Conditions. Flows in the Stanislaus River throughout the fall-run juvenile Chinook salmon rearing period would be predominantly lower under A6A_LLT relative to Existing Conditions. These flow reductions would reduce the downstream migratory ability of juveniles, which could delay smoltification and reduce survival. Temperatures would increase in the American, and Stanislaus rivers, increasing stress and mortality of migrants.

In the Delta, the impact on emigrating juveniles would be significant due to the impacts associated with predation and habitat loss from the five intakes under this alternative (similar to the previous description under Impact AQUA-42). Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce them to a level considered less than significant. Although implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be located near the intakes and therefore would not fully compensate for the lost habitat. Additionally, implementation of this measure would not fully address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness such that it is considered to have no demonstrable effect. Conservation measures that address habitat and predation losses, therefore, would potentially minimize impacts to some extent but not to a less than significant level. Consequently, as a result of these changes in migration conditions, this impact is significant and unavoidable.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel margin enhancement would be performed only along channels that provide rearing and outmigration habitat for juvenile salmonids. These include channels that are protected by federal project levees—including the Sacramento River between Freeport and Walnut Grove among several others.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"). This conservation measure seeks to benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem. Therefore, this conservation measure is not intended to entirely remove predators at any location, or substantially alter the abundance of predators at the scale of the Delta system. This conservation measure would also not remove piscivorous birds. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness. Effects would be temporary, as new individuals would be expected to occupy vacated areas; therefore, removal activities would need to be continuous during periods of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

As discussed in detail for Alternative 1A, the effects of Alternative 6A operations on through-Delta migration conditions for fall-/late fall-run Chinook salmon would be significant/adverse and unavoidable, due to predation and habitat loss associated with the five intakes of the north Delta facilities, and flow changes in the Feather and American Rivers. However, as with the conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact though not necessarily to a not adverse or a less-than-significant level. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall–Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 6A would have significant and unavoidable adverse effects on migration habitat, this conclusion was based on the best available scientific information at the time and may prove to have been over- or understated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 6A.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 6A operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 6A.

Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 6A. 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).

Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on fall-run/late fall-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to either effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-78a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6A without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under Alternative 6A operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run Chinook salmon would remain significant and unavoidable.

In the Delta on the San Joaquin River, because of increased flows, increased olfactory attraction cues, elimination of entrainment and associated predation at the south Delta facilities, and alleviation of entrainment and predation concerns related to restoration potential on the Old and Middle River corridor, Alternative 6A would be beneficial for fall-run Chinook salmon and no mitigation is required.

Table 11-6A-28. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 6A

Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3
	Shading indicates 10% or greater decrease in abundance relative to baseline.				

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for fall- and late fall–run Chinook salmon under Alternative 1A (Impact AQUA-79 through Impact AQUA-90) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, not adverse, or beneficial effects on fall- and late fall-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-79 through 90). Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on fall- and late fall-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Steelhead

Construction and Maintenance of CM1

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

The potential effects of construction of water conveyance facilities on steelhead would be the same as those described for Alternative 1A (see Impact AQUA-91), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-91, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for steelhead.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-91, the impact of the construction of water conveyance facilities on steelhead would be less than 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.

Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

NEPA Effects: The potential impacts of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-92), which concluded that the impact would not be adverse for steelhead.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-92, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Water Exports from SWP/CVP South Delta Facilities

Entrainment losses at the SWP/CVP south Delta facilities would be completely eliminated under Alternative 6A because there would be no south Delta exports under this alternative.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 6A would eliminate south Delta entrainment for steelhead, which would be a beneficial effect.

CEQA Conclusion: Entrainment losses of steelhead at the south Delta facilities would be eliminated under Alternative 6A compared to Existing Conditions. The impact would be less than significant and may be beneficial. No mitigation would be required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, Alternative 6A would have negligible effects on steelhead spawning habitat conditions relative to the NEPA point of comparison.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under A6_LLT throughout the period would generally be similar to or greater than those under NAA (up to 22% higher) except in critical years during April (6% lower).

SacEFT predicts that under Alternative 6A compared to NAA (Table 11-6A-29), there would be a small negative effect (-6% difference) on the percentage of years with good spawning availability (measured as weighted usable area), a slightly greater improvement in redd dewatering risk (6%). These results indicate that there would be a low effect of Alternative 6A on spawning habitat quantity and an improved redd scour risk and no changes in temperature related egg incubation conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Alternative 1A and NAA would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

Overall in the Sacramento River, Alternative 6A would have negligible effects on water temperatures, negligible effects (<5%) on mean monthly flows with the exception of several, small, isolated increases and decreases (to 11%) that would not have biologically meaningful effects on spawning conditions, and negligible (<5%) to small effects (to 6%) on egg survival, redd scour, and redd dewatering habitat metrics computed using SacEFT, resulting in no biologically meaningful effects on steelhead spawning in the Sacramento River.

Table 11-6A-29. Difference and Percent Difference in Percentage of Years with "Good" Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	-3 (-4%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	7 (17%)	3 (7%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A6A_LLT would generally be similar to flows under NAA throughout the period, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between NAA and A6A_LLT for all water year types (Table 11-6A-30).

No water temperature modeling was conducted in Clear Creek.

Overall in Clear Creek, project-related effects of Alternative 6A would have negligible effects (<5%) on mean monthly flows, and flow reductions during the January to April steelhead spawning and egg incubation period.

Table 11-6A-30. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
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.

[a] 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.

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 A6A_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 A6A_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA (up to 40% higher), except in critical years during January and April (24% and 7% lower, respectively).

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 A6A_LLT would be greater than storage under NAA (up to 34%) depending on water year type (Table 11-6A-14). May Oroville storage under A6A_LLT would be similar to or greater than storage under NAA (up to 15%) (Table 11-6A-15).

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Alternative 1A and NAA would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

Overall in the Feather River low-flow channel, Alternative 6A would not have any effect on mean monthly flows and would have negligible effects on water temperatures. Overall in the Feather River above Thermalito Afterbay, Alternative 6A would result primarily in negligible effects (<5%) on mean monthly flow or increases in flow (to 40%) that would have a beneficial effect on spawning conditions, with two isolated occurrences of flow reductions (to -24%) that would not have biologically meaningful effects, and negligible effects on water temperatures.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to flows under NAA during the period except in critical years during March and April (23% and 6% lower, respectively) and dry years during April (15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94, which indicates that there would be no effects of Alternative 1A relative to NAA on temperatures during the periods evaluated.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under NAA throughout the period.

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94, which indicates that there would be no effects of Alternative 1A relative to NAA on temperatures during the periods evaluated.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the confluence were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be the same as flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 6A on mean monthly flow consist of negligible effects (<5%), small to moderate increases in flow (up to 40%) that would have beneficial effects on spawning conditions, and isolated occurrence of decreases in flow (up to -24%) that would not have biologically meaningful effects. Meaningful increases in flow that would have beneficial effects during the spawning period would occur in the Feather River below Thermalito Afterbay (increases up to 40%) although these increases would occur primarily in wetter water years when effects of flow alterations are not as critical for spawning conditions. Results of SacEFT and flow reduction analyses indicate no effect (0% change) or small effects (up to 6%) that would not have biologically meaningful effects on spawning and egg incubation habitat, redd dewatering risk, and redd scour risk. Alternative 6A would have negligible effects on water temperatures in all rivers evaluated during the spawning and egg incubation period.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of spawning and egg incubation habitat for steelhead would not be affected relative to the CEQA baseline.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows under A6A_LLT would generally be similar to or higher than Existing Conditions during January and February (up to 18% higher), similar to Existing Conditions in all water year except below normal (20% lower) during March, and lower than Existing Conditions during April (5% to 11% lower). Upstream of Red Bluff Diversion Dam, A6A_LLT flows would generally be similar to or higher than Existing Conditions throughout the period with lower flows in below normal years during March and April (11% and 7%, respectively).

SacEFT predicts no change (0% difference) in spawning habitat, egg incubation, and redd dewatering risk under Alternative 6A, and a small decrease (-7%) in percentage of years considered “good” for redd scour risk (Table 11-6A-29).

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under baseline conditions and Alternative 1A would be comparable.

Overall in the Sacramento River, Alternative 6A would have negligible effects (<5%) or cause small increases in mean monthly flow (to 13%), with only two isolated flow reductions (to -11%) that would not affect steelhead spawning conditions in a biologically meaningful way. SacEFT indicates that steelhead egg incubation and redd survival metrics would not be affected by Alternative 6A. Effects of Alternative 6A on water temperature would be negligible.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A6A_LLT would be similar to or greater than flows (up to 54% higher)under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between Existing Conditions and A6A_LLT for all water year types except wet, in which the reduction would be 38% lower (worse) under A6A_LLT than under Existing Conditions (Table 11-6A-30).

Overall in Clear Creek, Alternative 6A would have negligible effects (<5%) or contribute to increases in mean monthly flow (to 54%) that would be beneficial for steelhead spawning conditions.

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 A6A_LLT would not differ from Existing Conditions 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 A6A_LLT at Thermalito Afterbay would be similar Existing Conditions in April except in dry water years (18% higher) and critical water years (7% lower), lower than Existing Condition in all except wet water years during January (up to 43% lower), and mixed during February and March with February having lower flows in below normal and dry water years (up to 46% lower) and higher flows in wet and above normal water years (up to 29% higher) and March having lower flows in below normal and critical water years (up to 39% lower) and higher flows in wet and above normal water years (up to 40% higher).

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. Oroville Reservoir storage volume at the end of September would be 1% to 26% lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-14). May Oroville storage volume under A6A_LLT would be lower than Existing Conditions by 2% to 9% depending on water year type (Table 11-6A-15).

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be substantial increases in temperatures under Alternative 1A relative to Existing Conditions during the periods evaluated.

Overall in the Feather River, effects of Alternative 6A on mean monthly flow would be negligible (no difference) in the low-flow channel, and negligible (<5% difference) or beneficial in wetter water years (increases to 40%) at Thermalito Afterbay, with small (-8%) to substantial (to -46%) reductions in mean monthly flow in drier water year types for a substantial portion of the spawning period (January through March). Effects of Alternative 6A on water temperature would be negligible.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions in February and March (up to 27% higher), lower in most water years in April (up to 14% lower) and mixed in January with wet and above normal years having higher flows (27% higher) and below normal, dry and critical water years have lower flows (up to 29% lower). Overall, these results indicate that the effects of Alternative 6A on steelhead spawning and egg incubation habitat in the American River would be minor.

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be substantial increases in temperatures under Alternative 1A relative to Existing Conditions during the periods evaluated.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be lower than Existing Conditions in all water years, ranging from -6% to -36%. There would be two isolated increases in mean monthly flow, during January in above normal years (14%) and during March in wet years (7%).

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-94, which indicates that temperatures under Alternative 1A would be greater during the entire period evaluated relative to Existing Conditions.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or greater than Existing Conditions during January and February (up to 18% greater), similar to or lower during March (8% lower in dry water years) and g lower than Existing Conditions in all water years during April (up to 14% lower).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow consist of small to substantial decreases in mean monthly flow (up to -46%) in drier water years for a substantial portion of the spawning period (January through March) in the Feather River below Thermalito Afterbay, and persistent small to moderate (up to -36%) reductions in flow throughout the migration period in all water years in the Stanislaus River; in both locations the flow reductions would result in loss of spawning habitat and an increased potential for egg mortality. Effects of Alternative 6A on flow in the other locations analyzed include variable effects, with negligible effects or increases in flow (vto 54%) primarily in wetter water years that would have beneficial effects on spawning conditions, and small and/or moderate but isolated decreases in flow (up to -25%) that would not have biologically meaningful negative effects on spawning conditions. Results of SacEFT and flow reduction analyses indicate negligible effects (<5%), beneficial effects (reduction in month-over-month flow reductions), or small and/or infrequent effects (up to 38% change in wetter years when effects of flow reductions would be less critical for spawning success) that would not have biologically meaningful effects on redd dewatering risk for all locations analyzed. Water temperatures would increase during the evaluated periods in the Feather, American, and Stanislaus rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, Alternative 6A would not reduce the quantity and/or quality of steelhead rearing habitat relative to NAA.

Sacramento River

Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during January through July and December would be generally similar to NAA, flows in August through November would generally be lower than NAA in most water years (up to 16%) with greater flows in wet years during July (8% higher) and critical years during September (9% greater).

SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions under A6A_LLT would be 7% higher than that under NAA (Table 11-6A-29). Also, the percentage of years with good (lower) juvenile stranding risk conditions under A6A_LLT would be the same as under NAA. These results indicate that Alternative 6A would cause a small increase in rearing habitat conditions and no increase in juvenile mortality risk resulting from stranding in the Sacramento River.

Water temperatures in the Sacramento River under Alternative 6A 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 relative to NAA and Alternative 1A would be comparable.

Overall in the Sacramento River, Alternative 6A would have negligible effects on juvenile steelhead rearing conditions based on negligible effects (<5%) or small negative effects on minimum instream flows (-9% in critical years), and beneficial effects through a small increase (7%) in the number of years classified as "good" rearing habitat, no effect on juvenile stranding risk, and negligible effects on water temperature.

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 A6A_LLT would generally be similar to flows under NAA except for two total water years with higher flows (up to 15% higher) and two total water years with lower flows (up to 8% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 6A relative to NAA in all water year types except that it is higher (10%) in critical water year types (Table 11-6A-31).

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.

Overall, these results indicate that Alternative 6A would not affect juvenile rearing conditions in Clear Creek

Table 11-6A-31. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
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 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 A6A_LLT would not differ from those under NAA. In the high flow channel, flows under A6A_LLT compared to NAA would be mostly equal to or higher during January through June, August and September (up to 40% higher), equal to or lower during October and November (up to 13% lower), and lower in lower July (up to 43% lower).

May Oroville storage under A6A_LLT would be similar to or greater than (up to 15% higher) storage under NAA (Table 11-6A-15). September Oroville storage volume would be up to 34% greater than under NAA depending on water year type (Table 11-6A-14).

Water temperatures in the Feather River low-flow and high-flow channel under Alternative 6A 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.

Overall in the Feather River, Alternative 6A would have negligible effects in the low-flow channel and would not have biologically meaningful effects on juvenile rearing conditions at that location. Alternative 6A would have negligible effects on water temperature in the low-flow or the high-flow channel. In the high-flow channel, Alternative 6A would cause variable effects on mean monthly flow with small to substantial increases and decreases depending on specific month and water year type. There would be moderate to substantial (to -43%) decreases in mean monthly flows in drier water years, when effects of flow reductions would be more critical for rearing success, during six months of the year (December–January, April–July) that would have negative effects on juvenile steelhead rearing conditions. These would be offset by increases (to 279%) in drier water years during some months (February, March, June, September, October), such that net effects are not expected to have biologically meaningful negative effects on rearing success in the Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under NAA during May, August, October and December, equal to or lower than flows under NAA during March, April, June and November and lower than flows under NAA during July and September.

Water temperatures in the American River under Alternative 6A 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.

Overall in the American River, Alternative 6A would result in primarily negligible effects (<5%) on mean monthly flow during most of the year. The most critical effect of flow reductions on rearing conditions, reductions in flow below 1,500 cfs in the warmer months, would not occur due to project-related effects under Alternative 6A. Therefore, Alternative 6A would not cause flow reductions that would eliminate riffle habitat, or reductions in mean monthly flow that would increase the potential for loss of juvenile rearing habitat, degradation of habitat conditions, or stranding of juveniles.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under NAA for the entire year except for increases in dry and critical water years during June.

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that there would be no effect of Alternative 1A on temperatures during the period evaluated relative to NAA.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 6A were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) and the flows would not be different from those under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. Alternative 6A would not have project-related effects on water temperatures in any of the locations analyzed, and effects on flow would not be adverse for juvenile rearing conditions at any of the locations analyzed based on primarily negligible project-related effects on mean monthly flow (<5%) with small increases (to 23%) that would have beneficial effects or small (to -10%) and/or isolated decreases (to -32%) throughout the year that would not have biologically meaningful effects on rearing success, and negligible effects (<5%), small-scale negative effects (to -11%), or beneficial effects (10%) on SacEFT rearing conditions metrics and minimum instream flows that indicate stranding potential. The Feather River would experience more variable changes in mean monthly flow, with decreases to -43% and increases to 270% throughout the year depending on specific month and water year type. Flow reductions would not be persistent enough to cause biologically meaningful negative effects in the Feather River.

CEQA Conclusion: In general, Alternative 6A would not reduce the quantity or quality of steelhead rearing habitat relative to the Existing Conditions.

Sacramento River

Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during January, February, June and July under A6A_LLT would generally be similar to or greater than those under Existing Conditions. Flows during March and November would be similar to or lower than those under Existing Conditions. Flows during May, September and October would be mixed with some water years below and some water years above Existing Conditions. Flows during April, August and December would generally be lower under A6A_LLT than under Existing Conditions.

SacEFT predicts that there would be a 17% increase in the percentage of years with good rearing availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-29) and a substantial reduction (-41%) in the number of years with good (lower) juvenile stranding risk under A6A_LLT relative to Existing Conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would generally not be affected by Alternative 1A relative to Existing Conditions.

Overall in the Sacramento River, Alternative 6A would have negligible effects on water temperature, but would result in substantial increased risk of juvenile stranding (-41%) and moderate reductions in minimum flows in drier water years (to -27%) when effects of flow reductions have the greatest potential to affect rearing conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Flows in Clear Creek during the year-round rearing period under A6A_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years in August through November in which flows would be 6% to 28% lower and in below normal years in October when flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 11-6A-31. Results indicate that

Alternative 6A would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to Existing Conditions in all water years except for that they would be 8% lower in critical water years.

These results indicate that the effects of Alternative 6A on flows consist primarily of negligible or beneficial effects (increases in mean monthly flow to 54%) with only infrequent, small to moderate flow reductions (-6% to -28%) that would not have biologically meaningful effects on juvenile rearing habitat in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 6A relative to Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows under A6A_LLT would be mostly lower (up to 45% lower) during January, July, October, November and December, mostly similar to or higher (up to 161% higher) in August and September, and mixed with some water years higher and some lower in February, March, April, May and June.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-95, which indicate that temperatures would increase under Alternative 1A during the year-round period relative to Existing Conditions.

Overall in the Feather River, Alternative 6A would have negligible effects on juvenile rearing conditions in the low-flow channel based on results of effects on water temperatures and mean monthly flows. In the high-flow channel, Alternative 6A would have variable effects with occurrences of beneficial effects on rearing conditions through increases in flow in wetter water years during February and March, and drier years during May, and all water year types in August and September (to 161%). However, Alternative 6A would cause persistent, small to substantial decreases in mean monthly flow (to -45%) for nine out of twelve months of the year in drier water years when effects of flow reductions would be most critical for rearing conditions. Alternative 6A would increase water temperatures in the Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions (up to 45% lower) during April through September, November and December, generally higher flows in February and March (up to 27% higher), and mixed higher and lower flows depending on water year in January.

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under Alternative 1A during the year-round period relative to Existing Conditions.

Overall in the American River, Alternative 6A would cause substantial flow reductions (to -57%) for much of the year (depending on water year type), including various months throughout the year in drier water years and the warmer summer months in all water years. Increases in flow (to 27%) during January to March in wetter years and other isolated increases in some drier water years (to

32%) would have small beneficial effects but would not offset the prevalence of reductions in flow predicted for other months and water year types. It is also predicted that Alternative 6A would result in flows less than 1,500 cfs when flows would not be that low in Existing Conditions during June in critical years, August in dry years, and September in below normal and dry years, meaning that Alternative 6A would result in reduced availability of riffle habitat for these time-frames.

Stanislaus River

Flows in the Stanislaus River for Alternative 6A are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January, in wet years in March and June and in below normal years in December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under Alternative 1A relative to Existing Conditions during most of the year-round period.

San Joaquin River

Flows in the San Joaquin River for Alternative 6A are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January and in wet years in January and February (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 6A are generally lower than Existing Conditions in all months and all water years except that they are generally higher in January and February (up to 18% higher depending on water year) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-95 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of juvenile mortality contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow would affect juvenile steelhead rearing habitats in the Sacramento River, Feather River below Thermalito Afterbay, American River, and Stanislaus River through persistent reductions in mean monthly flow (to -57%) that would be prevalent for much of the rearing period and particularly during drier water year types and in the warmer summer and early fall months. Effects of Alternative 6A on flows in Clear Creek would not be as substantial. Alternative 6A would also have substantial effects on stranding risk based on SacEFT metrics (decrease in years classified as “good” in terms of stranding risk of -41%) and reduction of minimum instream flows in the Sacramento River. Increased potential for stranding would lead to increased potential for juvenile mortality through desiccation or predation. Effects of Alternative 6A on flow would reduce flows to less than 1,500 cfs in some months and water year types during the summer months in the

American River, reducing available riffle habitat and therefore decreasing suitable rearing habitat. Temperatures in the Feather, American, and Stanislaus River would increase under Alternative 6A relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

Upstream of the Delta

In general, Alternative 6A would reduce steelhead migration conditions relative to NAA.

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A6A_LLT would be higher than NAA in some water years in January, February and April (up to 22% higher), similar to NAA flows in March and May, and 6% to 16% lower than flows under NAA during October through December, and generally similar in March and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be higher than NAA in some water years in January, February and April (up to 22% higher), similar to NAA flows in March, and 6% to 17% lower than flows under NAA during September through December and generally similar in March (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during these two months would be minimally different between NAA and A6A_LLT with lower flows in critical years during April (5% lower) and higher flows in above normal (6%) in April.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period under A6A_LLT would be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A6A_LLT would be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A6A_LLT would be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in Clear Creek would not be affected by Alternative 6A.

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to flows under NAA during March and April, similar to or greater than flows under NAA during February (up to 16% higher), less than NAA during October and December (up to 18% lower), similar to or less than during May and November (up to 14% lower), and mixed lower and higher flows depending on water year during January and September.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under NAA during March, similar to or greater than NAA flows during February (up to 16% higher), similar to or lower than NAA lows during November (9% lower), and mixed lower and higher flows depending on water year during January and September.

Kelts

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA during March and April although 10% greater than NAA for above normal years in March.

Overall, these results indicate that there would be negligible effects of Alternative 6A on steelhead juvenile, adult, and kelt migration conditions. There would be some flow-based beneficial effects in some months

American River

Water temperatures in the American River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period. Flows under A6A_LLT would generally be similar to or greater than flows under NAA during October, December, January, February, and May (up to 17% higher), and similar to or lower than flows under NAA during November, March and April (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under NAA during October, December, January, February, and May (up to 17% higher), and similar to or lower than flows under NAA during September, November and March (up to 32% lower).

Kelts

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A6A_LLT would generally be similar to or lower than flows under NAA (up to23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in the American River, Alternative 6A would have negligible effects on water temperatures and effects on flow consist of negligible effects (<5%), increases in flow (to 17%) that would have a beneficial effect on migration conditions, or infrequent, small-magnitude and/or isolated decreases in flow (to -32%) that would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration in the American River.

Stanislaus River

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to NAA.

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May juvenile steelhead migration period. Flows under A6A_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April kelt migration period. Flows under A6A_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Juveniles

Flows in the San Joaquin River at Vernalis were evaluated during the October through May juvenile steelhead migration period. Flows under A6A_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the San Joaquin River at Vernalis were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the San Joaquin River at Vernalis were evaluated for the March and April kelt migration period. Flows under A6A_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mokelumne River

Water temperature modeling was not conducted in the Mokelumne River.

Juveniles

Flows in the Mokelumne River were evaluated during the October through May juvenile steelhead migration period. Flows under A6A_LLT would be similar to flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in the Mokelumne River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar flows under NAA during the entire period.

Kelts

Flows in the Mokelumne River were evaluated for the March and April kelt migration period. Flows under A6A_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Through-Delta

Sacramento River

Juveniles

During the juvenile steelhead emigration period (October to May), mean monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged across years would be lower (15% to 28% lower) compared to NAA. Flows would be up to 34% lower in April of above normal years. Juvenile steelhead and juvenile winter-run Chinook salmon migrate downstream during the same months and would be exposed to similar conditions. As discussed above in Impact AQUA-42, the five north Delta intakes structures of Alternative 1A would increase potential predation loss of migrating juvenile salmonids and would displace 22 acres of aquatic habitat. Losses of juvenile winter-run Chinook salmon were estimated ranging from 2% up to 18.5% of annual production (Impact AQUA_42). However, juvenile steelhead would be less vulnerable than winter-run Chinook salmon to predation associated with the intake facilities because of their greater size and strong swimming ability.

Adults

Little information apparently currently exists as to the importance of Plan Area flows on the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult San Joaquin River region steelhead adults as well.

The percentage of water at Collinsville that originated from the San Joaquin River during the steelhead migration period (September to March) is small, typically less than 3% under NAA conditions. Alternative 6A operations conditions would increase olfactory cues associated with the

San Joaquin River approximately 5% to 10%, which would benefit adult steelhead migrating to the San Joaquin River.

San Joaquin River

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There no flow changes associated with the Alternatives. Alternative 6A would have no effect on steelhead migration success through the Delta.

Adults

Alternative 6A would slightly increase the proportion of San Joaquin River water in the Delta in September through December by about 5–10% (compared to NAA) (Table 11-6A-28). The increase in the proportion of San Joaquin River water at Collinsville would be a result of a concomitant reduction in the proportion of Sacramento River flows in the Delta and the elimination of water exports from the south Delta. Therefore migration conditions under Alternative 6A would be similar or slightly improved relative to NAA. Alternative 6A would have no effect to a slight beneficial effect on the adult steelhead and kelt migration.

NEPA Effects: Overall, the results indicate that the effect of Alternative 6A 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.

Upstream of the Delta, flow and water temperature conditions under Alternative 6A would generally be similar to those under Existing Conditions in all rivers examined.

Adult attraction flows in the Delta under Alternative 6A would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 6A NDD on steelhead from the Sacramento River and tributaries related to impingement and predation associated with five new intakes could result in substantial effects on juvenile migrating steelhead, although there is high uncertainty regarding the potential effects. Estimates within the effects analysis range from very low levels of effects (~2% mortality) to very significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the five new intake structures will be implemented as part of the final NDD screen design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A predict improvements in smolt condition and survival associated with increased access to the Yolo

Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 6A would be similar to survival rates estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative 6A on steelhead through-Delta survival remains uncertain.

Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the presence and operation of the five intakes on steelhead, this effect is adverse.

While the implementation of the conservation and mitigation measures described below would address these impacts, these measures are not anticipated to reduce the impact to a level considered not adverse.

CEQA Conclusion: In general, Alternative 6A would have negligible effects on steelhead migration conditions relative to Existing Conditions, upstream of the Delta, through-Delta on the Sacramento River and through-Delta on the San Joaquin River.

Upstream of the Delta

Sacramento River

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to Existing Conditions.

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or lower than Existing Conditions during December, March, April and May (up to 7% lower), similar to or greater than Existing Conditions during October, January and February (up to 13% higher), and mixed in May with higher and lower flows.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or lower than Existing Conditions during December and March (up to 11% lower), similar to or greater than Existing Conditions during October, January, and February (up to 13% higher) and mixed in September with higher and lower flows.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or lower flows than under Existing Conditions in March and April (up to 11% lower).

Overall in the Sacramento River, these results indicate that there would be no biologically meaningful impacts of Alternative 6A on juvenile, adult, and kelt migration.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile steelhead migration period under A6A_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54% greater) during December through May and similar to or lower than Existing Conditions during October and November (up to 6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A6A_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54% greater) during December through March and similar to or lower than Existing Conditions during September through November (up to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A6A_LLT would be similar to or greater than flows under Existing Conditions (up to 29% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during the periods evaluated relative to Existing Conditions.

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions during October through January and May (up to 36% lower), similar or lower flows during April (up to 6% lower), and mixed flows during March with lower flows in below normal and critical water years (15% and 18%, respectively).

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be greater than flows under Existing Conditions during September (up to 63% higher), generally lower than flows under Existing Conditions during October through January (up to 36% lower), and mixed flows during March with lower flows in below normal and critical water years (15% and 18%, respectively).

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT compared to Existing Conditions would be mixed during March (up to 19% higher and 15% lower) and similar to lower during April (up to 6% lower).

Overall, these results indicate that migration conditions for steelhead in the Feather River would be degraded by Alternative 6A. Flows would be lower during a substantial portion of the juvenile and adult migration period, although there would be no other effects in the Feather River.

American River

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would higher under Alternative 1A during substantial portions of the juvenile and adult migration periods relative to Existing Conditions.

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions during October through December, April and May (up to 34% lower), similar to or greater than flows under Existing Conditions during October, February and March (up to 27% higher) except in critical years in February and March (8% and 25% lower, respectively).

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions during September through December (up to 57% lower), similar to or greater than flows under Existing Conditions during October, February and March (up to 27% higher) except in critical years in February and March (8% and 25% lower, respectively).

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or higher than Existing Conditions during March (up to 15% higher) except in critical years when they would be lower (25% lower) and less than Existing Conditions in April (up to 14% lower).

Overall, these results indicate that Alternative 6A would reduce juvenile and adult migration conditions during a portion of their respective migration periods, but not kelt migration.

Stanislaus River

Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under Alternative 1A, which indicates that temperatures would not be different under Alternative 1A during substantial portions of the periods evaluated relative to Existing Conditions.

Flows in the Stanislaus River for Alternative 6A are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 29% lower in critical water years during March).

San Joaquin River

Flows in the San Joaquin River for Alternative 6A are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 16% lower in below normal years during March and 38% lower in wet years during May) except for similar or slightly lower flow conditions during November and December and somewhat higher flow conditions in some water years during January (up to 11% higher).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 6A are substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 14% lower in dry water years during November) except for somewhat higher flow conditions in some water years during January and February (up to 18% higher) and generally higher flows for all water years in December (up to 15% higher).

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Juveniles

Juveniles migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to Existing Conditions. DPM results for Chinook salmon for Alternative 6A indicate juvenile salmonid survival would be reduced by less than 1%. Assuming similar results for steelhead juveniles, Alternative 6A would have a less-than-significant impact on steelhead outmigration through the Delta. No mitigation would be required.

Adults

For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-origin steelhead apparently have not been examined in detail, for this analysis of effects, it was assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to straying have low importance under Existing Conditions for adult Sacramento River region steelhead.

As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin water at Collinsville was always slightly lower under Alternative 6A than for Existing Conditions during the September-March steelhead upstream migration period. Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, under Alternative 6A range from an increase of 3% to a decline of 14% during the October to March migration period for steelhead adults (Table 11-6A-9). The reductions in percentage during two of the seven months (February and March) are modest in comparison with the magnitude of change in dilution reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not expected to substantially affect steelhead migration. While the proportion of Sacramento River flows would be reduced under Alternative 6A, the Sacramento River would still represent 63% to 69% of Delta flows and olfactory cues would still be strong for upstream migrating adults. However, uncertainty remains with regard to adult salmon behavioral response to anticipated changes in lower Sacramento River flow percentages. For further discussion of the topic see the analysis for Alternative 1A.

San Joaquin River

Juveniles

The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There no flow changes associated with the Alternatives. Alternative 6A would have no effect on steelhead migration success through the Delta.

Adults

Little information apparently currently exists as to the importance of Plan Area flows on the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult San Joaquin River region steelhead adults as well.

The percentage of water at Collinsville that originated from the San Joaquin River during the steelhead migration period (September to March) is small, typically less than 3% under Existing Conditions. Alternative 6A operations conditions would increase olfactory cues associated with the San Joaquin River approximately 5% to 10%, which would benefit adult steelhead migrating to the San Joaquin River.

Summary of CEQA Conclusion

The results of the Impact AQUA-96 analysis indicate generally similar impacts between Alternative 6A and Existing Conditions on locations upstream of the Delta, through-Delta conditions on the Sacramento River and through-Delta conditions on the San Joaquin River.

Through the Delta, Alternative 6A would result in some effects on flow conditions, during steelhead migration periods (juvenile, adult and kelt), although these effects would not be substantial in both the Sacramento River and San Joaquin River. Similarly, olfactory effects are not expected to be substantial in both locations. Consequently, the through Delta impacts of Alternative 6A in both the Sacramento River and the San Joaquin River would be less than significant and no mitigation is required.

Collectively, the analysis indicates that the difference between the CEQA baseline and Alternative 6A upstream of the Delta could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with steelhead migrations. Alternative 6A would negatively affect juvenile and adult migration conditions in the Feather River at Thermalito Afterbay (based on decreases in flow consisting of small to substantial effects, to -46%, including in drier water year types), the American River (based on decreases in flow for September through March, to -57%), and the Stanislaus River (based on persistent decreases in flow to -36%). Alternative 6A would also affect kelt migration in the Stanislaus River (based on persistent flow reductions to -30%), but would not have biologically meaningful effects on kelt migration conditions in the other rivers analyzed. Alternative 6A would not have biologically meaningful effects on juvenile, adult, or kelt migration in the Sacramento River, Clear Creek, or the Feather River at the confluence; despite some variability in effects of Alternative 6A on flow for these locations, flow reductions would not be consistent or of the magnitude expected to result in biologically meaningful negative effects on migration conditions. Temperatures would be higher under Alternative 6A relative to Existing Conditions during the majority of the year in the American and Stanislaus rivers.

With respect to the NDD intakes, implementation of CM6 and CM15 and Mitigation Measures AQUA-96a through AQUA-96c would address these impacts, but are not anticipated to reduce them to a level considered less than significant. Although implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be located near the intakes and therefore would not fully compensate for the lost habitat. Additionally, implementation of this measure would not fully address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness such that it is considered to have no demonstrable effect. Conservation measures that address habitat and predation losses, therefore, would potentially minimize impacts to some extent but not to a less than significant level. Consequently, as a result of these changes in migration conditions, this impact is significant and unavoidable.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

In addition to the conservation measures, the mitigation measures identified below would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures. However, this would not necessarily result in a less than significant determination.

Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 6A would have significant and unavoidable adverse effects on migration habitat, this conclusion was based on the best available scientific information at the time and may prove to have been over- or understated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 6A.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 6A operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 6A.

Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts on Steelhead Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 6A. 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).

Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on steelhead habitat, the BDCP proponents will consult with FWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-96a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6A without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 6A operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on steelhead would remain significant and unavoidable.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6A without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 6A operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this alternative, and the impact on steelhead would remain significant and unavoidable.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for steelhead under Alternative 1A (Impact AQUA-97 through Impact AQUA-108) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, not adverse, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-97 through 108). Specifically for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms listed above would range from no impact, to less than significant to beneficial, and no mitigation is required.

Sacramento Splittail

Construction and Maintenance of CM1

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

The potential effects of construction of water conveyance facilities on Sacramento splittail would be the same as those described for Alternative 1A (see Impact AQUA-109), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-109, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-109, the impact of the construction of water conveyance facilities on Sacramento splittail would be less than 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.

Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-110), which concluded that the impact would not be adverse for Sacramento splittail.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-110, the impact of the maintenance of water conveyance facilities on Sacramento splittail would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Water Exports from SWP/CVP South Delta Facilities

Entrainment of juvenile and adult splittail would be completely eliminated at the south Delta because there would be no water exports from the south Delta under Alternative 6A.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact from entrainment of splittail to the proposed SWP/CVP north Delta intakes is the same as described under Alternative 1A (Impact AQUA-111) because both Alternative 1A and 6A would have five north Delta intakes. The intakes would be screened to exclude splittail greater than 10 mm length.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effect of implementing dual conveyance for the NBA with an alternative Sacramento River intake would be the same as described under Alternative 1A (Impact AQUA-111). Reduced pumping from Barker Slough could reduce entrainment losses of larval splittail produced in the Yolo Bypass.

There would be potential for increased predation and impingement risk associated with the alternative intake, which would be screened to exclude splittail greater than 10 mm.

Predation Associated with Entrainment

Splittail predation loss at the south Delta facilities would be eliminated under Alternative 6A because there would be no south Delta entrainment. Predation at the north Delta would be increased due to the installation of the proposed water export facilities on the Sacramento River. The effects of potential predation associated with the five intake structures would be the same as described for Alternative 1A (Impact AQUA-111). These potential predation losses would be offset by the greatly reduced predation loss from eliminating south Delta diversions, and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement).

NEPA Effects: In conclusion, the effect of Alternative 6A on entrainment and predation loss is not adverse and may be beneficial.

CEQA Conclusion: As described above, entrainment of juvenile and adult splittail to the south Delta facilities would be eliminated because there would be no south Delta water exports under Alternative 6A. Entrainment would be reduced at the NBA. At the north Delta intakes, there would be a potential risk of larval entrainment and impingement. The impact and conclusion for predation associated with entrainment would be the same as described above.

In conclusion, the impact of entrainment and predation loss from Alternative 6A would be less than significant and may be beneficial due to the overall reduced entrainment and improved juvenile production from implementation of CM2. No mitigation would be required.

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning overwhelmingly dominates production in wet years. During low-flow years when floodplains are not inundated, spawning in side channels and channel margins is much more important.

In general, Alternative 6A would have beneficial effects on splittail spawning habitat relative to NAA by increasing the quantity and quality of spawning habitat in the Yolo Bypass.

Floodplain Habitat

Effects of Alternative 6A on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow velocity was generally very low throughout the modeled area for most conditions, with generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo Bypass inundation events compared to NAA, especially for dry and critical year types; the changes are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of the analyses provided here. For below normal, dry, and critical water years, Alternative 6A results in an increase in frequency of inundation events greater than 30 days compared to NAA (Figure 11-6A-2,Table 11-6A-32). For below normal years, Alternative 6A would result in the occurrence of five inundation events of 30-49 days, compared to one such event for NAA, and one inundation event ≥70 days, compared to no such events for NAA. For critical years, Alternative 6A would result in the occurrence of one inundation event lasting more than 30 days, compared to no such events for NAA. The changes are attributable to the influence of the Fremont Weir notch at lower flows. The overall project-related effects consist of an increase in occurrence of longer-duration inundation events that would be beneficial for splittail spawning by creating better spawning habitat conditions.

Table 11-6A-32. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February 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. A6A_LLT	NAA vs. A6A_LLT
30–49 Days		
Wet	-4	-2
Above Normal	0	0
Below Normal	4	4
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	0	0
Below Normal	0	0
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	2	2
Below Normal	1	1
Dry	0	0
Critical	0	0

There would be increases in area of suitable splittail habitat in Yolo Bypass under A6A_LLT ranging from 5 to 962 acres relative to NAA (Table 11-6A-33). Areas under A6A_LLT would be 57%, 64%, and 188% greater than areas under NAA in wet, above normal, and below normal water years, respectively. There would be increases in area under A6A_LLT in dry and critical years relative to NAA, but they would be minimal (6 and 5 acres, respectively). These results indicate that increases in inundated acreage in each water year type would result in increased habitat and have a beneficial effect on splittail spawning.

Table 11-6A-33. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass from Existing Conditions to Alternative 6A by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	1,101 (71%)	962 (57%)
Above Normal	752 (66%)	743 (64%)
Below Normal	234 (178%)	238 (188%)
Dry	6 (NA)	6 (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).

A potential adverse effect of Alternative 6A that is not included in the modeling is reduced inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the Yolo Bypass.

Channel Margin and Side-Channel Habitat

Splittail spawning and larval and juvenile rearing also occurs in channel margin and side-channel habitat upstream of the Delta. These habitats are likely to be especially important during dry years, when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are affected by changes in flow because greater flows cause more flooding, thereby increasing availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are expected to be most important to the splittail population because in years of high-flows, when most production comes from floodplain habitats, the upstream side-channel habitats contribute relatively little production.

Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the Sacramento River for the time-frame February through June. These are the most important months for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from the side-channel habitats during May and June if conditions become unfavorable.

Differences between model scenarios for monthly average flows during February through June by water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For the Sacramento River at Wilkins Slough, effects of Alternative 6A consist primarily of negligible changes in flow (<5%) during February through April, with the exception of a small increase in critical years during February (6%) and small decrease in critical years during April (-8%). Negligible changes (<5%) to small increases in flow are indicated for May and June (to 8%). These results indicate that the effects of Alternative 6A on flow would not have biologically meaningful effects on spawning conditions, and that small increases in flow (to 8%) would have small, beneficial effects on splittail spawning conditions in the Sacramento River.

For the Feather River at the confluence, effects consist primarily of negligible effects (<5%) or increases in flow (to 16%) that would have beneficial effects on spawning conditions during February through April, negligible effects (<5%) or decreases in flow (to -14%) in dry and critical years during May (to -14%) and June (to -31%). Project-related effects consist of increases in flow during June in wetter water years (to 14%) that would have beneficial effects. The occurrence of reductions in mean monthly flow in dry and critical years during May and June constitute small to moderate flow reductions that would be relatively infrequent and would occur late in the spawning period. Therefore, they are not considered to cause biologically meaningful negative effects on spawning success.

Modeling indicated no differences in project-related effects on water temperature for Alternative 6A relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be exceeded in the Sacramento River and would rarely be exceeded in the Feather River. Therefore, effects of water temperature on spawning habitat for Sacramento splittail under Alternative 6A are not biologically meaningful.

These results indicate that effects of Alternative 6A on flow consist of both negative and beneficial effects on Feather River splittail spawning conditions through both increases and decreases in flow for the February to June spawning period. The project-related reductions in flow (to -31%) would be infrequent and would occur late in the spawning period and would not contribute to biologically meaningful negative effects on spawning success.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, the following provides a narrative summary of potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture, which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al. 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds. Actions under Alternative 6A to increase the frequency of Yolo Bypass inundation would increase the frequency of potential stranding events. For splittail, an increase in inundation frequency would also increase the production of Sacramento splittail in the bypass. While total stranding losses may be greater under

Alternative 6A than under NAA, the total number of splittail would be expected to be greater under Alternative 6A.

In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the potential improvements in habitat capacity outweighed the potential stranding problems that may exist in some years.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The effects of Alternative 6A on splittail spawning habitat are largely beneficial. There would be substantial spawning habitat benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass. Effects of Alternative 6A on water temperature would be negligible, and effects on mean monthly flows would consist primarily of negligible effects (<5%), increases in flow (to 8% in the Sacramento River and to 16% in the Feather River) that would have beneficial effects on spawning conditions, and small and/or infrequent reductions in flow (to -31% in the Feather River) that would not have biologically meaningful effects on spawning conditions.

CEQA Conclusion: In general, Alternative 6A would have beneficial effects on splittail spawning habitat relative to Existing Conditions by increasing the quantity and quality of spawning habitat in the Yolo Bypass.

Floodplain Habitat

The proposed changes to the Fremont Weir under Alternative 6A would have minimal effects on the frequency and duration of Yolo Bypass inundation events compared to Existing Conditions, except in wet water year types (Table 11-6A-32). In wet water years, there would be 8 more inundation events of ≥70 days, compared to Existing Conditions, but up to 5 fewer inundation events of between 30 and 69 days, compared to Existing Conditions. However, comparisons of splittail weighted habitat area for Alternative 6A to Existing Conditions (Table 11-6A-33) indicate that Alternative 6A would result in increased acreage of suitable spawning habitat compared to Existing Conditions in all water year types, with increases of between 5 and 1,101 acres of suitable spawning habitat depending on water year type. Increased areas for wet, above normal, and below normal water years are predicted to be 71%, 66%, and 178%, respectively, for Alternative 6A. Comparisons for dry and critical water years indicate project-related increases of 6 and 5 acres of suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results indicate that Alternative 6A would have beneficial effects on splittail habitat through increasing spawning habitats in Yolo Bypass by up to 178%.

Channel Margin and Side-Channel Habitat

Modeled flows were in the Sacramento River at Wilkins Slough for the February through June splittail spawning and early life stage rearing (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate that Alternative 6A would have primarily negligible effects (<5%) during February through April, with the exception of two small decreases in mean monthly flow (-7%) in below normal years during the months of March and April. Effects of Alternative 6A in May and June consist of small increases in flow (to 17%) in some water years that would have beneficial effects on spawning conditions, with the exception of two small reductions in flow during May in wet years (-14%), when effects of flow reductions on rearing conditions would be less critical, and in below normal years (-13%). These results indicate that effects of Alternative 6A on flows consist primarily of negligible effects (<5%) or increases in flow, with small and/or isolated decreases in flow that would not have biologically meaningful effects on splittail spawning conditions in channel margins and side-channel habitats in the Sacramento River.

Results for the Feather River at the confluence show variable effects of Alternative 6A (A6A_LLT compared to Existing Conditions) depending on month and water type. Changes in flow for February and March under Alternative 6A consist of negligible effects (<5%), moderate increases in flow (to 20%) in wet and above normal water years, and small to moderate decreases in flow (to -15%) during February in below normal years (-15%), during March in below normal years (-15%) and critical years (-8%). Effects during April consist of negligible effects (<5%) with the exception of one small decrease in critical years (-6%). Effects of Alternative 6A during May and June consist of moderate to substantial decreases in flow for the majority of water year types, including drier years (to -40%). These are relatively prevalent decreases in flow attributable to Alternative 6A relative to Existing Conditions that would occur in drier water years for most of the spawning period and in most water years for the latter portion of the spawning period (May and June) that would have negative effects on spawning success in the Feather River.

Stranding Potential

As described in the NEPA effects section above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 6A would be as described for Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

Temperature Effects

Modeling results indicate no differences in project-related effects on water temperature for Alternative 6A relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be exceeded in the Sacramento River and rarely exceeded in the Feather River. Therefore, effects of Alternative 6A on water temperature would not have biologically meaningful effects on splittail spawning conditions.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would not be significant relative to Existing Conditions because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The effects of Alternative 6A on splittail spawning habitat are largely beneficial. There would be substantial spawning habitat benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass. Effects of Alternative 6A on water temperature would be negligible. Effects of Alternative 6A on mean monthly flows in the Sacramento River would consist primarily of negligible effects (<5%), increases in flow (to 17%) that would have beneficial effects, and small and/or isolated decreases in flow (to -14%) that would not have biologically meaningful effects on spawning conditions. Effects of Alternative 6A on flows in the Feather River would consist primarily of negative effects based on a prevalence of flow reductions (to -40%) for most of the spawning period, particularly in drier water years. However, because splittail spawning primarily occurs in Yolo Bypass, which would experience improvements in splittail spawning conditions under Alternative 6A, the negative effects of Alternative 6A based on reductions in mean monthly flow in the Feather River would not have biologically meaningful effects on splittail spawning success.

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

Floodplains are important rearing habitats for juvenile splittail during periods of high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion applies to splittail rearing conditions as well.

NEPA Effects: Based on the analyses above, the effect of Alternative 6A on splittail rearing habitat is not adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality.

CEQA Conclusion: As described above, upstream splittail rearing habitat under Alternative 6A is expected to be as described for side-channel and channel margin conditions and water temperature effects for spawning. Based on the analyses above, the impact of Alternative 6A on splittail rearing habitat would be less than significant because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality. No mitigation would be necessary.

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

Upstream of the Delta

In general, effects of Alternative 6A on splittail migration conditions would be negligible relative to NAA based on negligible effects in the Sacramento River, which provides the migration corridor to the most productive splittail spawning area, the Yolo bypass.

Effects of Alternative 6A on migration conditions for Sacramento splittail would be the same as described above for channel margin and side-channel environments (Impact AQUA-112). Effects of Alternative 6A on flow in the Sacramento River would consist primarily of negligible effects (<5%), increases in flow (to 17%) that would have beneficial effects, and small and/or isolated decreases in flow (to -14%) that would not have biologically meaningful effects on migration conditions. Effects of Alternative 6A on flows in the Feather River would consist primarily of negative effects based on a prevalence of flow reductions (to -40%) for most of the spawning period, particularly in drier water years. However, as concluded above (Impact AQUA-112), negative effects in the Feather River would be less detrimental based on the fact that the majority of splittail spawning occurs in the Yolo Bypass (accessed via migration in the Sacramento River). Therefore, the effect would not be adverse.

Through-Delta

Alternative 6A would substantially reduce OMR reverse flows during the months of juvenile splittail migration through the Delta compared to baseline conditions (NAA). The improved OMR flow conditions would be a result of the elimination of south Delta exports under Alternative 6A.

Therefore the effect on juvenile migration survival would be beneficial, because of the greatly improved OMR flow conditions.

NEPA Effects: Collectively, the effects of Alternative 6A would not be adverse to migrating adult Sacramento splittail in areas upstream of the Delta, although some negative and beneficial changes would occur. However, through-Delta migration conditions would generally be improved during the juvenile splittail migration period, as a result of improved OMR flow conditions. As a result, Alternative 6A would not be adverse.

CEQA Conclusion:

Upstream of the Delta

Project impacts on splittail rearing habitat are the same as described for spawning habitat in the previous impact discussion, AQUA-112. As concluded above, the impact would be less than significant and no mitigation would be necessary. Effects of Alternative 6A on flow would not have substantial effects on the availability of channel margin and main-channel habitat. Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat to some extent in the Sutter Bypass but would create habitat in the Yolo Bypass that would have a beneficial impact on rearing conditions.

Through-Delta

Average OMR flows would increase relative to Existing Conditions during the months of the juvenile splittail migration through the Delta, because of the elimination of south Delta exports. Therefore the impact on splittail migration survival would be beneficial because of the great improvement in OMR flows.

Collectively, the effects of Alternative 6A would be less than significant to migrating adult Sacramento splittail in areas upstream of the Delta, although some negative and beneficial changes would occur. However, through-Delta migration conditions would generally be improved during the juvenile splittail migration period, as a result of beneficial OMR flow conditions. As a result, Alternative 6A would be less than significant.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for Sacramento splittail under Alternative 1A (Impact AQUA-115 through Impact AQUA-126) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: As described in Alternative 1A (Impact AQUA-115 through 126), the effects of these restoration and conservation measure impact mechanisms would range from no effect, not adverse, to beneficial for Sacramento splittail. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms listed above would range from no impact, to less than significant to beneficial, and no mitigation is required.

Green Sturgeon

Construction and Maintenance of CM1

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

The potential effects of construction of water conveyance facilities on green sturgeon would be the same as those described for Alternative 1A (see Impact AQUA-127), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for green sturgeon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-127, the impact of the construction of water conveyance facilities on green sturgeon would be less than 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.

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 6A would be the same as those described for Alternative 1A (see Impact AQUA-128), which concluded that the impact would not be adverse for green sturgeon.

CEQA Conclusion: As described under 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 would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

Alternative 6A would eliminate entrainment of juvenile green sturgeon at the SWP/CVP south Delta facilities, because there would be no south Delta exports under this Alternative (Table 11-6A-34). Therefore Alternative 6A would have a beneficial effect on juvenile green sturgeon entrainment because overall entrainment losses would be reduced.

The potential entrainment effects in the north Delta under Alternative 6A would be the same as those under Alternative 1A. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Table 11-6A-34. Juvenile Green Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 6A

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet and Above Normal	-116 (-100%)	-104 (-100%)
Below Normal, Dry, and Critical	-50 (-100%)	-42 (-100%)
All Years	-166 (-100%)	-146 (-100%)
	Shading indicates entrainment increased 10% or more.	

[a] Estimated annual number of fish lost.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities would be eliminated because there would be no south Delta entrainment under Alternative 6A. 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.

NEPA Effects: The effect on entrainment and entrainment-related predation loss under Alternative 6A would be beneficial to the species, because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities.

CEQA Conclusion: The impact and conclusions regarding entrainment are the same as described immediately above. Delta-wide entrainment for green sturgeon would be eliminated at the SWP/CVP south Delta facilities and reduced through decommissioning agricultural diversions in ROAs. Overall, impacts of water operations on entrainment of green sturgeon would be beneficial and no mitigation would be required.

The impact and conclusion for predation associated with entrainment would be the same as described above. Overall, the impact would be less than significant and may provide a benefit to the species, particularly because of the elimination in entrainment-related predation loss at the south Delta intakes.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 6A would not affect spawning and egg incubation habitat for green sturgeon relative to NAA.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows can reduce the instream area available for spawning and egg incubation Flows under A6A_LLT would almost always be similar to or greater than flows under NAA, except in critical years during April (6% lower) at Keswick although flows can be lower or higher in individual months of individual years. These results indicate that there would be very few reductions in flows in the Sacramento River under Alternative 6A (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of Alternative 1A on temperatures during the period evaluated relative to NAA.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. Flows under A6A_LLT would generally be similar to or greater than flows under NAA at Thermalito Afterbay and the confluence with the Sacramento River, except in dry and critical years during May at both locations (9% to 24% lower), critical and dry years during April and June, respectively, at Thermalito (7% and 31% lower, respectively), and dry and critical years during June at the confluence (31% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be very few reductions in flows in the Feather River under Alternative 6A independent of climate change.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of Alternative 1A on temperatures during the period evaluated relative to NAA.

San Joaquin River

Flows were examined in the San Joaquin River at Vernalis during the March to July spawning and egg incubation period. Flows in the San Joaquin River under Alternative 6A would not differ from those under NAA throughout the period.

No water temperatures modeling was conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that this effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be limited project-related effects to flows and water temperatures in the Sacramento and Feather rivers that would not affect spawning and egg incubation conditions for green sturgeon. Further, there would be no effects of Alternative 6A on flows in the San Joaquin River.

CEQA Conclusion: In general, Alternative 6A would not affect spawning and egg incubation habitat for green sturgeon relative to Existing Conditions.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under A6A_LLT at Keswick during April would generally be lower than flows under Existing Conditions by up to 11%, and generally similar to or greater than flows under Existing Conditions during the rest of the period, except in below normal years during March (20% lower) and wet and below normal years during May (19% and 13% lower, respectively). Flows under A6A_LLT at Red Bluff would generally be similar to or greater than those under Existing Conditions, except in below normal years during March through May (7% to 11% lower) and wet years during (16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Also, flows can be lower or higher in individual months of individual years. These results indicate that there would be few reductions in flows in the Sacramento River under Alternative 6A relative to Existing Conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher under Alternative 1A during the period evaluated relative to Existing Conditions.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. At Thermalito, flows under A6A_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal and dry years during February (46% and 12% lower, respectively), in below normal and critical years during March (39% and 7% lower, respectively), critical years during April (6% lower), wet and above normal years during May (32% and 8% lower, respectively), and wet and dry years during June (11% and 27% lower, respectively)

(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence with the Sacramento River, flows under A6A_LLT would generally be up to 40% lower during May and June, and generally similar to or greater than flows under Existing Conditions during the rest of the period, except in below normal years during February and March (11% and 15% lower, respectively), and critical years during March and April (8% and 6% lower, respectively). These results indicate that there would be reductions in flows in the Feather River under Alternative 6A relative to Existing Conditions.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher under Alternative 1A during the period evaluated relative to Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 6A would be up to 38% lower than flows under Existing Conditions during the March through June spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the NEPA conclusion set forth above. Flows in the Sacramento and Feather rivers would generally be similar between Alternative 6A and the CEQA baseline, but flows would be lower under Alternative 6A in the San Joaquin River and temperatures would be greater in the Sacramento and Feather Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 1A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

In general, Alternative 6A would not reduce the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to the NAA.

Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Sacramento River

Water temperatures in the Sacramento River for Alternative 6A are not different from those for Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not affect temperatures relative to NAA in either river.

Feather River

Water temperatures in the Feather River for Alternative 6A are not different from those for Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not affect temperatures relative to NAA in either river.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that this effect would be not be adverse because it does not have the potential to substantially reduce the amount of suitable rearing habitat.

CEQA Conclusion: In general, Alternative 6A would not reduce the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Sacramento River

Water temperatures in the Sacramento River for Alternative 6A are not different from those for Alternative 1A, Impact AQUA-131, which indicates that that there would be increase in temperatures under Alternative 1A relative to Existing Conditions.

Feather River

Water temperatures in the Feather River for Alternative 6A are not different from those for Alternative 1A, Impact AQUA-131, which indicates that that there would be increase in temperatures under Alternative 1A relative to Existing Conditions.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. Temperatures under Alternative 6A would increase in both the Sacramento and Feather rivers relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

In general, effects of Alternative 6A on green sturgeon migration conditions relative to NAA are uncertain.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows under A6A_LLT would nearly always be similar to or greater than flows under NAA in all months, except during August, September, and November, in which flows would be up to 18% lower depending on location, month, and water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved green sturgeon larval transport that results in improved year class strength. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be lower under Alternative 6A than those under NAA (up to 67% lower).

Relative to NAA, flows in the Feather River at Thermalito under A6A_LLT would generally be similar in all but two months (July and December) (up to 43% lower). Flows at the confluence with the Sacramento River would generally be similar in all but three months (July, August, and December) (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

NEPA Effects: Upstream flows (above north Delta intakes) are similar between Alternative 6A and NAA. However, due to the removal of water at the North Delta intakes, there are substantial differences in through-Delta flows between Alternative 6A and NAA (see Table 11-6A-37 below). Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green sturgeon, found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 6A would be deemed Not Adverse due to the similarities in upstream flow conditions between Alternative 6A and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 6A would be deemed adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 6A as compared to NAA.

CEQA Conclusion: In general, Alternative 6A would not affect green sturgeon migration conditions relative to Existing Conditions.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)*.* Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows at Keswick under A6A_LLT would generally be similar to or greater than flows under Existing Conditions in all months with some exceptions (up to 20% lower), except April, August, September, and December, during which flows would be up to 23% lower than under

Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. Flows at Wilkins Slough under A6A_LLT would generally be similar to or greater than flows under Existing Conditions in all months, except August and September during which flows would be up to 24% lower than under Existing Conditions depending on month and water year type.

For Delta outflow, the percent of months exceeding flow thresholds under A6A_LLT would nearly always be lower than those under Existing Conditions for each flow threshold, water year type, and month (up to 75% lower) with few exceptions (see Table 11-6A-37 below).

Flows in the Feather River at Thermalito under A6A_LLT would generally be up to 45% lower than flows under Existing Conditions during July and October through January and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 46% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. Flows in the Feather River at the confluence under A6A_LLT would generally be up to 53% lower than flows under Existing Conditions during May through July and October through January, and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 34% lower).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce migration habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. The reduction in flows in the Sacramento and Feather rivers would reduce the migration periods of larval, juvenile, and adult migration, which would substantially slow or inhibit their downstream migration. Exceedance of Delta outflow thresholds would be lower under Alternative 6A than under Existing Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows are co-variable with another unknown factor.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for green sturgeon. This impact is found to be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-144) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144), and no mitigation is required.

White Sturgeon

Construction and Maintenance of CM1

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

The potential effects of construction of water conveyance facilities on white sturgeon would be the same as those described for Alternative 1A (see Impact AQUA-145), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-145, the impact of the construction of water conveyance facilities on white sturgeon would be less than 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.

Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-146), which concluded that the impact would not be adverse for white sturgeon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-146, the impact of the maintenance of water conveyance facilities on white sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Water Exports

Alternative 6A would eliminate entrainment of juvenile white sturgeon at the SWP/CVP south Delta facilities because there would be no south Delta exports under this Alternative (Table 11-6A-35). Thus Alternative 6A would have a beneficial effect on juvenile white sturgeon.

The potential entrainment effects under Alternative 6A would be the same as those under Alternative 1A. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Table 11-6A-35. Juvenile White Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between Model Scenarios for Alternative 6A

	Absolute Difference (Percent Difference)	
Water Year Types	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet and Above Normal	-289 (-100%)	-242 (-100%)
Below Normal, Dry, and Critical	-41 (-100%)	-33 (-100%)
All Years	-330 (-100%)	-275 (-100%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost.

Predation Associated with Entrainment

Juvenile white sturgeon predation loss at the south Delta facilities would be eliminated because there would be no south Delta entrainment under Alternative 6A. 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-147.

NEPA Effects: The effect on entrainment and entrainment-related predation under Alternative 6A would be beneficial to the species, because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities.

CEQA Conclusion: The impact and conclusion for entrainment are the same as described immediately above. Annual entrainment losses of juvenile white sturgeon would be eliminated at the south Delta diversions. Impacts would be beneficial, and no mitigation would be required.

The impact and conclusion for predation associated with entrainment would be the same as described above. Overall, the impact would be less than significant and may provide a benefit to the species, particularly because of the elimination in entrainment-related predation loss at the south Delta intakes under Alternative 6A.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 6A 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 A6A_LLT at Wilkins Slough from February to May would nearly always be similar to or greater than those under NAA, except in critical years during April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT at Verona would be lower by up to 7% during March and April and generally similar to or greater than flows under NAA during February and May, except during dry years (5% and 6% lower, respectively).

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be no effect or beneficial effects of Alternative 1A on temperatures relative to NAA.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in critical years during April and May (7% and 11% lower, respectively) and dry years during May (24% lower). Flows under A6A_LLT at the confluence would nearly always be similar to or greater than flows under NAA, except in dry and critical years during May (14% and 9% lower, respectively). These results indicate that there would be very few reductions in flows in the Feather River during the white sturgeon spawning and egg incubation period under Alternative 6A.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, which indicates that there would be no effect or beneficial effects of Alternative 1A on temperatures relative to NAA.

San Joaquin River

Flows in the San Joaquin River under Alternative 6A would not be different from those under Alternative 1A, which indicates that flows under Alternative 1A would not differ throughout the period evaluated.

Temperatures were not modeled for the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Reductions in flows under Alternative 6A are small and infrequent relative to NAA and, therefore, would not have a substantial effect on the species. There would be no increases in temperatures in the Sacramento or Feather rivers.

CEQA Conclusion: In general, Alternative 6A would not affect spawning and egg incubation habitat for white sturgeon relative to Existing Conditions.

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 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Wilkins Slough, flows under A6A_LLT would be similar to or greater than those under Existing Conditions, except in below normal years during March through May (7% to 13% lower) and wet years during May (14% lower). At Verona, flows under A6A_LLT would be generally up to 16% lower than Existing Conditions during March and April, and generally similar during February and May, except in below normal and dry years during February (8% and 7% lower, respectively) and wet and below normal years during May (19% and 8% lower, respectively). These results indicate that there would be small, yet frequent, reductions in flows in the Sacramento River under Alternative 6A relative to Existing Conditions.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of Alternative 1A on temperatures.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito Afterbay from February to May under A6A_LLT would generally be similar to or greater than those under Existing Conditions with some exceptions in which flows would be lower by 46%. Flows at the confluence with the Sacramento River under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during February through April with some exceptions (up to 15% lower), and generally lower during May (up to 25% lower). These results indicate that there would be few reductions in flows in the Feather River under Alternative 6A relative to Existing Conditions.

Water temperatures in the Feather River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of Alternative 1A on temperatures.

San Joaquin River

Flows in the San Joaquin River under Alternative 6A would not be different from those under Alternative 1, which indicates that flows would not differ between Existing Conditions and Alternative 1A.

Temperatures were not modeled for the San Joaquin River.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be less than significant because it does not have the potential to substantially reduce the amount of suitable habitat. No mitigation is necessary. Reductions in flows in all rivers evaluated under Alternative 6A would be small and infrequent relative to Existing Conditions and, therefore, would not have a substantial effect on the species. Further, there would be no effect of Alternative 6A on temperatures in the Sacramento and Feather rivers.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

In general, Alternative 6A would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to NAA.

Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Water temperatures in the Sacramento and Feather rivers under Alternative 6A would not be different from those under Alternative 1A, which indicates that there would be no effect of Alternative 1A on temperatures in either river.

Water temperatures were not modeled in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat relative to NAA.

CEQA Conclusion**:** In general, Alternative 6A would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Water temperatures in the Sacramento and Feather rivers under Alternative 6A would not be different from those under Alternative 1A, which indicates that there would be no effect of Alternative 1A on temperatures in the Sacramento River, but temperatures would be higher under the majority of months under Alternative 1A in the Feather River.

Water temperatures were not modeled in the San Joaquin River.

Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between the Existing Conditions and Alternative 6A could be significant because, under the Existing Conditions, the alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA conclusion set forth above. Water temperatures would be higher in the Feather River during the majority of the white sturgeon rearing period.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat of white sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, effects of Alternative 6A on white sturgeon migration conditions relative to NAA are uncertain.

Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-6A-36). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A6A_LLT were generally similar to those under NAA. The number of months per year above 31,000 cfs at Verona under A6A_LLT would be up to 6% higher and up to 50% lower than under NAA. On an absolute scale, all of these changes would be negligible (up to 0.2 months).

Table 11-6A-36. Difference and Percent Difference in Number of Months in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona

	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wilkins Slough, 17,700 cfs[a]		
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%)
Wilkins Slough, 5,300 cfs[b]		
Wet	-0.2 (-3%)	0 (0%)
Above Normal	-0.4 (-6%)	-0.1 (-1%)
Below Normal	-0.1 (-1%)	0.2 (4%)
Dry	0.3 (7%)	0.1 (1%)
Critical	0.1 (2%)	0 (0%)
Verona, 31,000 cfs[a]		
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.
[a] Months analyzed: February through May.
[b] Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percentage of months exceeding flow thresholds under A6A_LLT would generally be lower than those under NAA (up to 67% lower) with few exceptions (Table 11-6A-37). These results suggest that, using the positive correlation between Delta outflow and year class strength, year class strength would generally be lower under Alternative 6A.

Table 11-6A-37. Difference and Percent Difference in Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in April and May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-15 (-19%)	-12 (-15%)
	Above Normal	-25 (-43%)	-17 (-33%)
May			
15,000 cfs	Wet	-4 (-4%)	4 (5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-38 (-45%)	-15 (-25%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-25 (-75%)	-17 (-67%)
April/May Average			
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%)

For juveniles, year-round migration flows at Verona would be up to 21% lower under A6A_LLT relative to NAA in most water year types during January, March, April, July, August, November, and December, although differences would rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during other months would generally be similar to flows under NAA with some exceptions.

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-6A-36). The average number of months exceeding 5,300 cfs under A6A_LLT would always be similar to or greater than the number of months under NAA.

NEPA Effects: Upstream flows (above north Delta intakes) are similar between Alternative 6A and NAA (Table 11-6A-36). However, due to the removal of water at the North Delta intakes, there are substantial differences in through-Delta flows between Alternative 6A and NAA (Table 11-6A-37). Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 6A would be deemed Not Adverse due to the similarities in upstream flow conditions between Alternative 6A and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 6A would be deemed adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 6A as compared to NAA.

CEQA Conclusion: In general, Alternative 6A would not affect white sturgeon migration conditions relative to Existing Conditions.

The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough under A6A_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal years (25% lower) (Table11-6A-36). The number of months per year above 31,000 cfs at Verona under A6A_LLT would be up to 60% lower than the number under Existing Conditions in all water year types except critical.

For Delta outflow, the percent of months exceeding flow thresholds under A6A_LLT would nearly always be lower than those under Existing Conditions for each flow threshold, water year type, and month (up to 75% lower) with few exceptions (Table 11-6A-37).

For juveniles, year-round migration flows at Verona would be up to 21% lower under A6A_LLT relative to Existing Conditions in most water year types in six of 12 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)*.* Flows under A6A_LLT during other months are generally similar to or greater than flows under Existing Conditions.

For adult migration, the average number of months exceeding 5,300 cfs under A6A_LLT would generally be similar to or greater than the number of months under Existing Conditions, except in above normal water years (6% lower) (Table 11-6A-36).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta outflow would be lower under Alternative 6A than under the CEQA Existing Conditions. Juvenile migration flows in the Sacramento River at Verona would be up to 21% lower in six of 12 months relative to Existing Conditions. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would not in itself result in a significant impact on migration habitat of white sturgeon. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. This impact is found to be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-162) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: These restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is required.

Pacific Lamprey

Construction and Maintenance of CM1

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

The potential effects of construction of water conveyance facilities on Pacific lamprey would be the same as those described for Alternative 1A (see Impact AQUA-163), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-163, the impact of the construction of water conveyance facilities on Pacific lamprey would be less than 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.

Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-164), which concluded that the impact would not be adverse for Pacific lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-164, the impact of the maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Water Exports

Alternative 6A would eliminate entrainment of juvenile lamprey at the SWP/CVP south Delta export facilities, because there would be no south Delta exports under this Alternative (Table 11-6A-38); thus Alternative 6A would have a beneficial effect on juvenile lamprey.

The potential entrainment impacts of Alternative 6A on Pacific lamprey and would be the same as described above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impacts AQUA-165), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-165), and decommissioning agricultural diversions in ROAs (Impacts AQUA-165). These actions would avoid or reduce potential entrainment and the effect would not be adverse.

Table 11-6A-38. Lamprey Annual Entrainment Indexa at the SWP and CVP Salvage Facilities—for Alternative 6A

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All Years	-3,386 (-100%)	-3,280 (-100%)
	Shading indicates entrainment increased 10% or more.	
[a] Estimated annual number of fish lost, based on non-normalized data.		

Predation Associated with Entrainment

Lamprey predation loss at the south Delta facilities would be eliminated because there would be no entrainment loss to the south Delta under Alternative 6A. The impact and conclusion for predation risk associated with NPB would be the same as described for Alternative 1A. Predation at the north Delta would be increased due to the installation 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 Alternative 6A on entrainment and entrainment-related predation on lamprey would not be adverse.

CEQA Conclusion: As described above, annual entrainment losses of juvenile lamprey would be substantially reduced particularly because of the elimination of entrainment at the SWP/CVP south Delta facilities because there would be no south Delta export under this alternative. The impact and conclusion for predation associated with entrainment would be the same as described above because the additional predation losses associated with the proposed north Delta intakes would be offset by the elimination of entrainment-related predation loss at the south Delta export facilities. The relative impact of predation loss on the lamprey population is unknown since there is little available knowledge on their distribution and abundance in the Delta. Overall, impacts associated with Alternative 6A would be beneficial in the south Delta, because there would be no south Delta water exports; and less than significant at the north Delta intakes because monitoring and adaptive management protocols will be implemented to confirm that fish, including lamprey, are being excluded from entrainment and impingement in the manner that the design specifications suggest. Overall, impacts of water operations on entrainment to Pacific lamprey are expected to 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 6A would not affect the quantity and quality of spawning habitat for Pacific lamprey 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 on water temperature. Dewatering risk was analyzed for the Sacramento River at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. Pacific lamprey spawn in these rivers between January and August. 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%.

For evaluation of dewatering risk, comparisons for Alternative 6A to NAA indicate no effect in the Trinity River (0% difference) and decreases in dewatering risk in all other locations analyzed (to -29%), which would have beneficial effects on spawning conditions by increasing suitable spawning habitat area and reducing potential egg mortality (Table 11-6A-39).

Table 11-6A-39. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River at Keswick	Difference	16	-6
	Percent Difference	29%	-8%
Sacramento River at Red Bluff	Difference	13	-5
	Percent Difference	24%	-7%
Trinity River downstream of Lewiston	Difference	0	0
	Percent Difference	0%	0%
Feather River at Thermalito Afterbay	Difference	-73	-31
	Percent Difference	-49%	-29%
American River at Nimbus Dam	Difference	28	-9
	Percent Difference	33%	-7%
American River at Sacramento River confluence	Difference	34	-6
	Percent Difference	36%	-4%
Stanislaus River at San Joaquin confluence	Difference	0	-2
	Percent Difference	0%	-3%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 6A than under the baseline (EXISTING CONDITIONS or NAA).

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on Pacific lamprey egg exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure would be similar to NAA at most locations, although egg exposure would substantially increase in the Feather River below Thermalito Afterbay.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 6A on flow reductions would have no effect (Trinity River) or beneficial effects (all other locations analyzed) through small to moderate reductions (to -29%) in the number of cohorts predicted to experience month-over-month flow reductions of greater than 50%. Egg exposure to elevated water temperatures under Alternative 6A would not increase in the majority of locations evaluated.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of spawning habitat for Pacific lamprey would not be affected relative to the CEQA baseline.

Predicted effects of Alternative 6A in the Sacramento River and American River are for increases in the number of redd cohorts predicted to experience a month-over-month change in flow of greater than 50% relative to Existing Conditions (Table 11-6A-39). Changes would be most substantial for the American River, with increased risk of dewatering exposure to 28 cohorts or 33% at Nimbus Dam, and 34 cohorts or 36% at the confluence. Effects of Alternative 6A consist of no effect (0%

difference) for the Trinity River and Stanislaus River, and a substantial decrease in dewatering risk (-49%) in the Feather River.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on egg exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure would be greater than under Existing Conditions at the Sacramento, Feather, and American rivers.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 6A on flow would affect Pacific lamprey redd dewatering risk in Sacramento River (29% increase in exposure risk) and the American River (maximum of 36% increase in exposure risk), but would not have biologically meaningful effects on conditions in the Feather River, Trinity River, or Stanislaus River. Egg exposure to elevated water temperatures would substantially increase under Alternative 6A in multiple locations.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, Alternative 6A would have negligible effects on the quantity and quality of Pacific lamprey rearing habitat relative to NAA. There would be some small to moderate benefits in some locations from decreased stranding risk.

Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the

Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. 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 6A on Pacific lamprey ammocoete stranding were analyzed by calculating month-over-month flow reductions for the Sacramento River at Keswick (Table 11-6A-40). Results indicate no effect (0%) or negligible effects (<5%) to ammocoete cohort exposures to all flow reduction categories. These results indicate that project-related effects of Alternative 6A on flow would not affect Pacific lamprey ammocoete stranding conditions in the Sacramento River at Keswick.

Table 11-6A-40. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	-3
-65%	4	4
-70%	-2	-2
-75%	-2	0
-80%	7	0
-85%	47	0
-90%	NA	NA

NA = all values were 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-6A-41) no change (0%), negligible effects (<5%), and a single small decrease in exposure (-7%) of ammocoete cohorts to all flow reductions. These results indicate that Alternative 6A would not affect Pacific lamprey ammocoete stranding conditions in the Sacramento River at Red Bluff.

Table 11-6A-41. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	4	0
-60%	6	4
-65%	-2	-3
-70%	9	-2
-75%	10	0
-80%	5	-7
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Trinity River indicate no effect (0%) or negligible changes (<5%) attributable to the project in all flow reduction categories (Table 11-6A-42). These results indicate that Alternative 6A would not affect Pacific lamprey ammocoete stranding conditions in the Trinity River.

Table 11-6A-42. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	30	2
-85%	22	4
-90%	38	2

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Feather River indicate no effect (0% difference) for flow reductions up to 75%, and decreases in the percentage of cohorts exposed to the remaining flow reduction categories (to -28%) that would have beneficial effects on spawning success (Table 11-6A-43). These results indicate that Alternative 6A would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding conditions in the Feather River.

Table 11-6A-43. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-8	-6
-85%	-5	-27
-90%	-64	-28

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the American River at Nimbus Dam (Table 11-6A-44) indicate no effect (0% difference) for the lower flow reduction categories, and negligible (<5%) to moderate (to -33%) reductions in cohorts exposed to 65% through 90% flow reductions, which would have beneficial effects on spawning success. These results indicate that Alternative 6A would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding conditions in the American River at Nimbus Dam.

Comparisons for the American River at the confluence with the Sacramento River (Table 11-6A-45) indicate no effect (0% difference) on cohort exposure for the lower flow reduction categories and negligible (<5%) to moderate (to -35%) decreases in exposure to 70% through 90% flow reductions, which would have beneficial effects on cohort survival. These results indicate that project-related effects of Alternative 6A would not have biologically meaningful negative effects on spawning success in the American River at the confluence with the Sacramento River.

Table 11-6A-44. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	33	-5
-75%	69	-12
-80%	156	-32
-85%	336	-14
-90%	100	-33

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Table 11-6A-45. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	36	-1
-80%	129	-23
-85%	128	-35
-90%	248	-17

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-46) no effect (0% difference) or negligible effects (<5%) on cohort exposure for the lower flow reduction categories and moderate (-56 cohorts or -100%) decreases in exposure to 80% through 90% flow reductions, which would have beneficial effects on cohort survival. These results indicate that project-related effects of Alternative 6A would not have biologically meaningful negative effects on spawning success in the Stanislaus River at the confluence with the San Joaquin River.

Table 11-6A-46. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the San Joaquin River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	5	1
-75%	52	1
-80%	-100	-100
-85%	-100	-100
-90%	-100	-100

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there would be small to moderate increases and decreases in exposure under Alternative 1A relative to NAA that will balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality in any of the locations analyzed. While the effects of climate change would increase stranding risk during A6A_LLT for some locations, project-related effects would primarily consist of no effect (0%), negligible effects (<5%), or small to moderate decreases in stranding risk that would have beneficial effects on rearing success. There would be no overall effects to ammocoete exposure to elevated temperatures.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of rearing habitat for Pacific lamprey would not be affected relative to Existing Conditions.

Flow-related impacts on Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. As described for operations-related impacts of Alternative 6A on spawning habitat for Pacific lamprey above, it was determined that the impacts of Alternative 6A on water temperatures for all locations analyzed would be the same as described for Alternative 1A. Conclusions for Alternative 1A are that impacts of water temperature during Pacific lamprey ammocoete rearing would be less than significant relative to Existing Conditions.

Comparisons of month-over-month flow reductions under Alternative 6A relative to Existing Conditions for the Sacramento River at Keswick indicate negligible effects (<5%) or small changes (to 7%) in occurrence of cohort exposure for all flow reduction categories with the exception of a substantial increase in exposure (47%) to 85% flow reductions (Table 11-6A-40). With primarily negligible to small effects and a more substantial effect on a single flow reduction category, these results indicate that effects of Alternative 6A on flow would not result in biologically meaningful effects on Pacific lamprey ammocoete stranding risk in the Sacramento River at Keswick.

Comparisons of Alternative 6A to Existing Conditions for the Sacramento River at Red Bluff indicate negligible changes (<5%) to small increases (to 10%) in occurrence of cohort exposure for all flow reduction categories up to 80%, and an increases of 56 cohorts or 100% exposed to 85% flow reduction events (Table 11-6A-41). These results indicate that effects of Alternative 6A on flow would cause increase risk of Pacific lamprey ammocoete stranding in the Sacramento River at Red Bluff but not to the extent that would be considered a biologically meaningful effect on rearing success.

Comparisons of Alternative 6A to Existing Conditions for the Trinity River indicate no effect (0% difference) in ammocoete cohort exposure for the lower flow reduction categories, and moderate increases in cohort exposure (to 38%) for flow reductions from 75% to 90% (Table 11-6A-42). The effects of Alternative 6A on flow reduction exposures are consistent for the higher flow reduction categories which would contribute incrementally to increased stranding risk and therefore would have a negative effect on rearing conditions in the Trinity River.

Comparisons of Alternative 6A to Existing Conditions for Feather River indicate no effect (0% difference) on ammocoete cohort exposures for the lower flow reduction categories, and small (-5%) to substantial (-64%) decreases in exposures to flow reductions from 80% to 90% (Table 11-6A-43). The decreases in exposure to the highest flow reduction categories would have beneficial effects on lamprey rearing by reducing stranding risk. These results indicate that effects of Alternative 6A on flow would not cause biologically meaningful negative effects on rearing success in the Feather River.

Comparisons for the American River at Nimbus Dam (Table 11-6A-44) and at the confluence with the Sacramento River (Table 11-6A-45) indicate negligible effects (<5%) on ammocoete cohort exposures under A6A_LLT relative to Existing Conditions for 50% through 65% flow reduction events, and small (7%), moderate (33%) and substantial increases (increase of 188 cohorts or 336% at Nimbus Dam, 139 cohorts or 248% at the confluence) in exposures for the larger flow reduction categories. These are substantial increases in cohort stranding exposure and would have negative effects on spawning success at both locations.

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-46) indicate negligible effects (<5%) and small increases 5%) and decreases (-8%) in ammocoete cohort exposures under A6A_LLT relative to Existing Conditions for 50% through 70% flow reduction events, a moderate increase (52%) for 75% flow reductions, and substantial decreases (56 cohorts or 100%) in exposures for the larger flow reduction categories. These substantial decreases in cohort stranding exposure for higher flow reduction events would have beneficial effects on spawning success and would outweigh the negative effects of the increase (52%) in 75% flow reductions.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there would be substantial increases in ammocoete exposure in all rivers relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow would affect ammocoete stranding risk in the Trinity River and the American River at Nimbus Dam and at the confluence with the Sacramento River based on substantial increases in the number of cohorts exposed to stranding risk in the larger flow reduction categories (to 38% in the Trinity River and to 336% in the American River). Alternative 6A would not have biologically meaningful effects on stranding risk in the Sacramento River, Feather River, and Stanislaus River, where it would increase stranding risk for some flow reduction categories but not to the extent that would be expected to substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. There would be substantial increases in ammocoete exposure to increased temperatures in all rivers evaluated.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

Upstream of the Delta

In general, Alternative 6A would not affect the quantity or quality of migration habitat for Pacific lamprey relative to NAA based on primarily negligible effects on mean monthly flow or a mix of relatively small increases (beneficial effect) and decreases (negative effect) in mean monthly flow throughout the migration period with a net result of negligible effects for the locations analyzed.

Macropthalmia

After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. Migration generally is associated with large flow pulses in winter months (December through March) (USFWS unpublished data) meaning alterations in flow have the potential to affect downstream migration conditions. The effects of Alternative 6A on seasonal migration flows for Pacific lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the migration pathways of Pacific lamprey during the likely migration period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, the American River at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

Sacramento River

Effects of Alternative 6A on mean monthly flow rates for the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May compared to NAA indicate reductions in mean monthly flow (to -31%) for all water year types and only the occasional occurrence of negligible effects (<5%). Based on the persistent small to substantial reductions in mean monthly flow during all months of the migration period in all water year types, effects of Alternative 6A on flow would affect macropthalmia migration conditions in the Sacramento River at Rio Vista.

For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*]), the difference in mean monthly flow rate for Alternative 6A compared to indicates primarily negligible project-related effects on flow (<5%) with infrequent, small increases (to 10%) and a single decrease (-11%) that would not have biologically meaningful effects on migration conditions. These results indicate that effects of Alternative 6A on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Sacramento River at Red Bluff.

Feather River

For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 6A compared to NAA indicates primarily negligible project-related effects (<5%), with small (5% to 10%) to moderate (18%) increases in flow that would have beneficial effects on migration, and moderate project-related decreases in flow during December in all but wet years (to -18%), a small decrease during January in critical years (-10%), and small decreases during May in dry (-14%) and critical years (-9%). The persistent, moderate decreases in mean monthly flow during December would occur early in the migration period, and the small decreases during May in drier years would occur infrequently at the very end of the migration period. Based on negligible effects or small increases in flow for the remainder of the migration period, these effects of Alternative 6A on flow reductions are not expected to have biologically meaningful negative effects on macropthalmia migration in the Feather River at the confluence.

American River

For the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December through May, comparisons of Alternative 6A to indicates project-related effects consist primarily of negligible effects (<5%), with infrequent, small increases in flow (to 12%) during some months/water years that would be beneficial for migration, a single, moderate decrease in flow (-23%) during March in critical years, and decreases during April in dry (-15%) and critical years (-6%), which would be offset somewhat by increases in drier water years (to 11%) during May. Project-related decreases in flow are isolated and/or of relatively small magnitude and therefore effects of Alternative 6A on flow would not have biologically meaningful negative effects on migration conditions in the American River.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December through May indicates project-related effects consist entirely of negligible effects (<5%) throughout the migration period. These results indicate that project-related effects of Alternative 6A on flow would not have biologically meaningful effects on macropthalmia migration in the Stanislaus River.

Overall, project-related effects of Alternative 6A on outmigrating macropthalmia for all locations analyzed, except Rio Vista, consist of negligible effects on flow (<5% difference), small to moderate increases in flow (to 18%) that would have a beneficial effect on migration conditions, or infrequent (to -23%) and/or relatively small decreases in flow (to -15%) which would not have biologically meaningful effects on Pacific lamprey macropthalmia migration. Effects of Alternative 6A for the Sacramento River at Rio Vista consist of persistent small to moderate reductions in mean monthly flow (to -31%) that would affect macropthalmia migration conditions in the Sacramento River at Rio Vista.

Adults

Sacramento River

For the Sacramento River at Red Bluff for the time-frame January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), effects of Alternative 6A on mean monthly flow consist primarily of negligible effects (<5%) for the entire migration period, with infrequent, small increases in mean monthly flow (to 10%) and a single occurrence of a small decrease in flow (-11%) during January in critical years. These results indicate that project-related effects of Alternative 6A on flow would not have biologically meaningful effects on adult migration in the Sacramento River.

Feather River

For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) during January to June, mean monthly flows under Alternative 6A consist primarily of negligible changes (<5%) throughout the migration period, with occasional increases in flow (to 16%) for some months/water years that would have beneficial effects on migration conditions, and infrequent/isolated decreases in flow during January in critical years (-10%), during May in dry (-14%) and critical years (-9%), and during June in dry (-31%) and critical years (-10%). The small to moderate decreases in flow during May and June in dry and critical years consist primarily of small flow reductions that would occur late in the migration period and are therefore not expected to have biologically meaningful negative effects on migration conditions. These results indicate that project-related effects of Alternative 6A on flow would not affect adult migration conditions in the Feather River.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) predominantly negligible effects (<5%) throughout the migration period, with occasional, small increases in flow (to 12%) that would have beneficial effects on migration conditions, and isolated decreases in flow during March in critical years (-23%), during April in dry (-15%) and critical years (-6%), and during June in dry years (-8%). The project-related decreases in flow are infrequent and/or of small magnitude and would not have biologically meaningful negative effects on migration conditions. These results indicate that effects of Alternative 6A on flow would not affect adult migration conditions in the American River.

Stanislaus River

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate effects of Alternative 6A compared to NAA consist predominantly of negligible effects (<5%) throughout the migration period with the exception of moderate increases in flow during June in dry (19%) and critical years (16%) that would have beneficial effects on migration conditions. These results indicate that effects of Alternative 6A on flow would not affect adult migration conditions in the Stanislaus River.

Overall, project-related effects of Alternative 6A on flow for all locations analyzed consist of negligible effects on flow (<5% difference), small to substantial increases in flow (to 19%) that would have a beneficial effect on migration conditions, or infrequent (to -31%) and/or small decreases in flow (to -15%) that would not have biologically meaningful effects on Pacific lamprey adult migration conditions.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Project-related effects of Alternative 6A on mean monthly flows during the Pacific lamprey macropthalmia outmigration period and the adult migration period consist of negligible effects (<5%) or increases in flow (to 19%) that would have beneficial effects on migration conditions, with highly infrequent small (to -15%) to moderate (to -31%) reductions in flow that would not have biologically meaningful effects on migration conditions. Effects of Alternative 6A on flow in the Sacramento River at Rio Vista would have localized effects on macropthalmia migration conditions through persistent small to moderate reductions in mean monthly flow (to -31%), but based on the limited geographic extent of these persistent flow reductions, as well as the moderate magnitude, they are not expected to have biologically meaningful effects on regional migration conditions.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of Pacific lamprey macropthalmia and adult migration habitat would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 6A (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing

Conditions) may therefore either overstate the effects of Alternative 6A or suggest significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 6A.

Macropthalmia

Sacramento River

Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 6A relative to Existing Conditions indicate primarily decreases in mean monthly flow (to -60%) throughout the migration period and in all water year types. Effects in drier water year types when flow reductions would be most critical for migration conditions would be considered moderate, to -16% in dry years and to -19% in critical years. The larger magnitude reductions would occur in wetter years when effects of flow reductions would be less critical for migration conditions. Based on the prevalence of moderate to substantial reductions in mean monthly flow during all months and most water year types for the migration period, including moderate reductions in drier water years, effects of Alternative 6A on flow would affect macropthalmia migration in the Sacramento River at Rio Vista.

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 6A relative to Existing Conditions indicate primarily negligible (<5%) effects, with occasional small decreases (to -16%) or increases in flow (to 13%) for all months and water years. Increases would have beneficial effects on migration conditions, and the decreases in flow would be infrequent and of greatest magnitude in wetter years when effects of flow reductions would be less critical. Flow reductions in drier water years would not be greater than -11%. These results indicate that effects of Alternative 6A on flow would not have biologically meaningful negative effects on outmigrating macropthalmia at this location.

Feather River

Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate effects of Alternative 6A compared to Existing Conditions are somewhat variable depending on month and water year. Effects for December through April consist primarily of negligible effects (<5%), small to moderate increases (to 20%) or decreases in flow (-15%), with a more substantial decrease in flow predicted during December in critical years (-36%). Effects during May consist of decreases in flow for most water year types, to -25%. These reductions for most water years would occur during the last month of the 6 month migration period, with small reductions in drier years during May (to -12%). These would contribute to incremental effects on migration conditions; however, overall effects of Alternative 6A on flow for the entire migration period and all water years consists predominantly of negligible effects, increases in flow, and smaller decreases in flow. These results indicate that the effects of Alternative 6A on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable results depending on the specific month and water year, with negligible effects (<5%) or decreases in flow (to -22%) during December (including in drier water years), increases in wetter water years (to 27%) and decreases in drier water years (to -29%) during January through March, negligible effects

(<5)% and small-scale decreases (to -14%) during April, and reductions in flow (to -34%) during May in all but dry years (<5% difference). Based on small to moderate reductions in flow in drier water years during most of the migration period (December through March and May), these results indicate that effects of Alternative 6A on flow would have negative effects on outmigrating macropthalmia in the American River at the confluence.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate primarily decreases in flow (to -30%) for all months of the migration period and most water year types, with only infrequent occurrence of negligible effects (<5% difference) or small increases in flow (to 14%). Based on persistent, small to moderate reductions in flow, including in drier water years, throughout the migration period, these results indicate that effects of Alternative 6A on flow would have negative effects on outmigrating macropthalmia in the Stanislaus River at the confluence.

Overall, these results indicate that the effects of Alternative 6A on mean monthly flows would affect outmigrating macropthalmia in the Sacramento River at Rio Vista, and the American River and the Stanislaus River, based on a prevalence of flow reductions throughout the migration period (to -60%, -34% and -30% for these locations, respectively), and particularly in drier water years. Effects of Alternative 6A on flow would not have biologically meaningful negative effects on migration conditions in the Sacramento River at Red Bluff and in the Feather River, based on a prevalence of negligible effects (<5%), increases in flow that would be beneficial for migration conditions (to 20%), and infrequent, small decreases in flow (to -15%), and occasional, more substantial decreases in wetter water years (to -34%) that would not affect migration conditions.

Adults

Sacramento River

Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from January through June indicate primarily negligible effects (<5%), with small increases (to 13%) in flow that would have beneficial effects on migration conditions, and infrequent, isolated decreases (to -16%) in flow that would not have biologically meaningful effects on migration conditions. These results indicate that effects of Alternative 6A on flow would not have biologically meaningful negative effects on adult migration conditions in the Sacramento River.

Feather River

Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate variable effects of Alternative 6A by month and water year type. Effects during January through March consist primarily of increases in flow (to 20%) in wetter years, and decreases (to -15%) in drier years. Effects during April consist primarily of negligible effects (<5%), with the exception of small decrease (-6%) in critical years. Effects during May and June consist primarily of reductions in flow (to -40%) that include small (-11%) to substantial (-40%) reductions in drier water years. Flow reductions in drier water years would contribute incrementally to effects on migration, and would occur in January and March through June, which would affect migration conditions in the Feather River.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate variable effects of Alternative 6A depending on the month and water year type, with negligible effects (<5%) or increases in flow (to 27%) in wetter water years and decreases (to -29%) in drier water years for January through March, negligible effects or small decreases in flow (to -14%) during April, and reductions in flow (to -52%) in all but dry years (<5% difference) during May and in all but below normal years (<5% difference) in June. The prevalence of moderate to substantial flow reductions in some of the drier water years for most months in the migration period would have negative effects on adult migration in the American River.

Stanislaus River

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate primarily decreases (to -21%) in mean monthly flow for all months and most water year types, with only occasional occurrences of negligible effects (<5%) or increases in flow (to 14%). Reductions in flow range up to -36% and include substantial reductions (to -36%0) in drier water years. The persistent moderate to substantial flow reductions would have negative effects on adult migration in the Stanislaus River.

Overall, these results indicate that effects of Alternative 6A on flow during the January to June adult Pacific lamprey migration period in the Sacramento River consist predominantly of negligible effects (<5% difference), increases in flow that would have beneficial effects, or small, isolated occurrences of decreases in flow (to -18%) for some water year types, or infrequent, more substantial decreases in wetter water years (to -28%) that would not have biologically meaningful effects. There would be greater prevalence of moderate to substantial flow reductions during some water year types and most or all months of the adult migration period in the Feather River (to -40%), American River (to -52%), and the Stanislaus River (-36%) that would have negative effects on migration conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow would affect Pacific lamprey macropthalmia migration in the Sacramento River at Rio Vista (based on prevalent flow reductions of up to -60%), both macropthalmia and adult migration conditions in the American River (based on flow reductions to -34% for macropthalmia migration and to -52% for adults) and the Stanislaus River (based on prevalent flow reductions to -30% for macropthalmia migration and -36% for adults), and adult migration conditions only in the Feather River (based on prevalent flow reductions to -40%).

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on Pacific lamprey macropthalmia and adult migration habitat. This impact is found to be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-180) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-169 through 180).

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A (Impact AQUA-169 through 180), and no mitigation is required.

River Lamprey

Construction and Maintenance of CM1

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

The potential effects of construction of water conveyance facilities on river lamprey would be the same as those described for Alternative 1A (see Impact AQUA-181), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-181, the impact of the construction of water conveyance facilities on river lamprey would be less than 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.

Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-182), which concluded that the impact would not be adverse for river lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-182, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

NEPA Effects: The impact discussion is the same as discussed under Pacific lamprey. Please see Impact AQUA-165 above.

CEQA Conclusion: The conclusion is the same as discussed under Pacific lamprey. Please see Impact AQUA-165 above.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, Alternative 6A would have negligible effects on river lamprey spawning habitat relative to NAA.

Flow-related effects on 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 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%. 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.

Results indicate negligible effects (<5%) under Alternative 6A relative to NAA for most locations, including the Sacramento River at Red Bluff, Trinity River, Feather River, and American River at Nimbus Dam (Table 11-6A-47). Project-related effects consist of no change (0% difference) in the Sacramento River, Trinity River, and the Feather River, with negligible (<5%) to small decreases in dewatering risk (to -8%) in the American River and Stanislaus River. Decreases in dewatering risk would be beneficial for spawning success.

Table 11-6A-47. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River at Keswick	Difference	3	0
	Percent Difference	9%	0%
Sacramento River at Red Bluff	Difference	2	0
	Percent Difference	5%	0%
Trinity River downstream of Lewiston	Difference	-2	0
	Percent Difference	-3%	0%
Feather River at Thermalito Afterbay	Difference	-10	0
	Percent Difference	-15%	0%
American River at Nimbus Dam	Difference	4	-5
	Percent Difference	7%	-8%
American River at Sacramento River confluence	Difference	13	-4
	Percent Difference	22%	-5%
Stanislaus River at San Joaquin River confluence	Difference	-9	-4
	Percent Difference	-16%	-8%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 6A than under the baseline (EXISTING CONDITIONS or NAA).

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on river lamprey egg exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure would be similar to NAA at most locations, although egg exposure would moderately increase in the Feather River below Thermalito Afterbay. Because this is isolated to a single location in the Feather River, it is not expected to cause a population level effect on river lamprey.

NEPA Effects: These results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 6A on water temperature would be negligible, and project-related effects on flow reductions that could negatively affect spawning and egg incubation conditions consist of no effect (0% difference) or small decreases in dewatering risk (to -8%) that would be beneficial for spawning conditions. Egg exposure to elevated water temperatures under Alternative 6A would not increase in the majority of location evaluated.

CEQA Conclusion: In general, Alternative 6A would not reduce the quantity and quality of river lamprey spawning conditions relative to Existing Conditions.

Effects of Alternative 6A on flow reductions during the river lamprey spawning period from February to June consist of negligible (<5%) to small (5%) effects on dewatering risk in the Sacramento River at Red Bluff and the Trinity River (Table 11-6A-47). There would be increases in river lamprey redd cohort dewatering risk relative to Existing Conditions for the Sacramento River at Keswick (9%), and the American River at Nimbus Dam (7%) and at the confluence (22%). There would be decreased dewatering risk in the Feather River (-15%) and the Stanislaus River (-16%). Decreases in dewatering risk would have a beneficial effect on spawning success.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on egg exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure would be greater than under Existing Conditions at the Sacramento, Feather, American, and Stanislaus rivers.

Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. The risk of egg exposure to increased temperatures would be higher under Alternative 6A in multiple rivers. There would be negligible effects of Alternative 6A on redd dewatering risk.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

In general, Alternative 6A would have negligible effects on river lamprey rearing habitat relative to NAA. In most locations, there would be small to substantial decreases in exposure to the higher flow reduction categories that would have beneficial effects on rearing success.

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, and effects of water temperatures. As described for river lamprey spawning effects above, water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under Alternative 6A in the upper Sacramento, Trinity, Feather, American, and Stanislaus rivers for river lamprey ammocoete rearing. It was determined that the effects of Alternative 6A on water temperatures for all locations were the same as described for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during river lamprey ammocoete rearing are not adverse relative to NAA.

For ammocoete stranding risk, the effects of Alternative 6A 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 Alternative 6A to NAA for the Sacramento River at Keswick (Table 11-6A-48) indicated no effect (0%), negligible effects (<5%), and small increases (up to 5%) for all flow reduction categories attributable to the project. These results indicate that effects of Alternative 6A on flow would not affect ammocoete rearing success in the Sacramento River at Keswick.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-6A-49) indicate negligible effects (<5%) attributable to the project for all flow reduction categories. These results indicate that effects of Alternative 6A on flow reductions would not affect river lamprey ammocoete stranding in the Sacramento River at Red Bluff.

Table 11-6A-48. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	2	0
-60%	1	-3
-65%	4	4
-70%	-3	-3
-75%	-2	4
-80%	17	5
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Table 11-6A-49. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	6	3
-60%	11	4
-65%	-3	-4
-70%	10	1
-75%	26	3
-80%	6	-4
-85%	[25–50] 100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Trinity River indicate no effect (0% difference) or negligible effects (<5%) for all flow reduction categories (Table 11-6A-50). These results indicate that project-related effects of Alternative 6A on flow would not affect river lamprey ammocoete stranding in the Trinity River.

Table 11-6A-50. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	32	0
-80%	40	1
-85%	32	1
-90%	52	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Feather River indicate no effect (0% difference) in ammocoete cohort to flow events up to 70%, and small to moderate (to -33%) decreases in exposure to all higher flow reduction events that would have beneficial effects on rearing success (Table 11-6A-51). These results indicate that project-related effects of Alternative 6A on flow would not have negative effects on river lamprey ammocoete stranding in the Feather River.

Table 11-6A-51. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	-4	-4
-80%	-14	-8
-85%	-12	-33
-90%	-62	-32

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the American River at Nimbus Dam (Table 11-6A-52) and at the confluence with the Sacramento River (Table 11-6A-53) indicate negligible effects (<5%) or decreases (to -40%) in cohort exposure to all flow reduction categories that would have beneficial effects on rearing success for both locations. These results indicate that project-related effects of Alternative 6A on flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the American River.

Table 11-6A-52. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	3	-4
-70%	39	-12
-75%	88	-17
-80%	[50–150] 200	-37
-85%	[25–115] 360	-18
-90%	[25–50] 100	-33

NA = could not be calculated because the denominator was 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Table 11-6A-53. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	4	-1
-70%	17	-5
-75%	40	-9
-80%	[71–176] 148	-27
-85%	[50–129] 158	-40
-90%	[25–91] 264	-22

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-54) indicate no effect (0%) or negligible effects (<5%) for exposure to 50% through 75% flow reduction events, and decreases from 25 cohorts to 0 cohorts (-100%) for the higher flow reduction categories which would have beneficial effects on rearing success. These results indicate that project-related effects of Alternative 6A on flow would not have negative effects on river lamprey ammocoete stranding in the Stanislaus River.

Table 11-6A-54. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the San Joaquin River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	-3	0
-65%	-9	-2
-70%	3	3
-75%	67	0
-80%	[25–0] -100	[25–0] -100
-85%	[25–0] -100	[25–0] -100
-90%	[25–0] -100	[25–0] -100

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there would be small to moderate increases and decreases in exposure relative to NAA that will balance out within rivers such that there would be no overall effect on river lamprey ammocoetes.

NEPA Effects: Overall, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. Results indicate that project-related effects of Alternative 6A on flow would not affect river lamprey ammocoete stranding at any of the locations analyzed based on results indicating no change (0%), negligible effects (<5%), or small-scale effects (to 6%) in ammocoete cohort exposure to flow reduction events. In most locations, there would be small to substantial decreases in exposure to the higher flow reduction categories that would have beneficial effects on rearing success. There would be small to moderate increases and decreases in ammocoete exposure to elevated temperatures will balance out within rivers such that there would be no overall effect.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of rearing habitat for river lamprey would not be affected relative to the CEQA baseline.

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, and effects on water temperatures. As described for river lamprey spawning effects above, water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under Alternative 6A in the upper Sacramento, Trinity, Feather, American, and Stanislaus rivers for river lamprey ammocoete rearing. It was determined that the effects of Alternative 6A on water temperatures for all locations analyzed were the same as described for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during river lamprey ammocoete rearing would be less than significant relative to Existing Conditions.

Flow reductions were evaluated to determine the effects of Alternative 6A on ammocoete stranding risk. Comparisons of Alternative 6A to Existing Conditions for the Sacramento River at Keswick indicate negligible effects (<5%) on the number of ammocoete cohorts exposed to flow reductions flow reduction categories from 50% to 75%, with a moderate increase (17%) in exposure to 80% flow reductions and a more substantial increase (44%) in exposure to 85% flow reductions (Table 11-6A-48). All values for 90% flow reduction events are zero. Comparisons for the Sacramento River at Red Bluff indicate slightly more variable results with negligible effects (<5%) or small-scale increases (to 11%) for all flow reduction categories except for a moderate increase (26%) to 75% flow reductions, and a more substantial increase in exposure to 85% flow reduction events (increase from 25 to 50 cohorts or 100%) (Table 11-6A-49). While there would be fairly substantial increases in the number of cohorts exposed to the 85% reduction category at both locations, effects would be negligible or small in all other flow reduction categories and therefore, results indicate that effects of Alternative 6A on flow reductions would not have biologically meaningful effects on river lamprey ammocoete stranding in the Sacramento River at Keswick and at Red Bluff.

Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50% to 70%, and increases ranging from 32% to 52% for the higher flow reduction categories (Table 11-6A-50). These consistent and more substantial increases in ammocoete cohort exposures to larger flow reductions would affect ammocoete stranding risk and therefore rearing success in the Trinity River.

Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for all flow reduction categories, with reductions ranging from -4% to -62% in the higher flow reduction categories (Table 11-6A-51). Decreased exposure to flow reduction events would have beneficial effects on rearing success. These results indicate that effects of Alternative 6A on flow would not have negative effects on river lamprey ammocoete stranding in the Feather River.

Comparisons for the American River at Nimbus Dam (Table 11-6A-52) and at the confluence with the Sacramento River (Table 11-6A-53) indicate small (5%) to substantial (360%) increased ammocoete cohort exposures to flow reductions between 70 and 90% for Alternative 6A compared to Existing Conditions; substantial increases are from 39 to 360% (increase in cohorts exposed from 25 to 115) for Nimbus Dam and from 40% to 264% (increase in cohorts exposed from 25 to 91) for the confluence. These consistent and substantial increases in ammocoete cohorts exposed to flow reductions would affect ammocoete stranding risk and therefore rearing success in the American River.

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-54) indicate negligible effects (<5%) and small reductions in exposure (to -9%) for flow reduction events between 50% and 70%, a substantial increase (67%) in ammocoete cohort exposure to 75% flow reductions, and decreases in exposure risk (from 25 to 0 cohorts or -100%) for the higher flow reduction categories. These consistent and substantial decreases in ammocoete cohorts exposed to the higher flow reduction events would have beneficial effects on rearing success.

Because water temperatures under Alternative 6A would be similar to those under Alternative 1A, results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there would be moderate to large increases in ammocoete exposure under Alternative 1A relative to Existing Conditions in all rivers evaluated that would substantially reduce rearing habitat conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow reductions would affect ammocoete stranding risk in the Trinity River (based on increases to 52% for the larger flow reduction categories) and the American River (based on increases to 360% for the larger flow reduction categories), and would not have biologically meaningful effects in the Sacramento River, the Feather River, and the Stanislaus River (based on negligible effects, reductions in stranding risk, or small and/or inconsistent increases in stranding risk). Further, there would be moderate to large increases in ammocoete exposure under Alternative 6A in all rivers evaluated that would substantially reduce rearing habitat conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in

the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

Macropthalmia

In general, Alternative 6A would have negligible effects on river lamprey migration conditions compared to NAA for all locations analyzed, with beneficial effects due to substantial increases in mean monthly flow during drier water years in the Feather River.

After 3 to 5 years river lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. River lamprey migration generally occurs September through November (USFWS unpublished data). The effects of water operations on seasonal migration flows for river lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of river lamprey during the likely migration period (September through November) were examined to predict how Alternative 6A may affect migration flows for outmigrating macropthalmia. Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, the American River at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

Sacramento River

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate decreases in flow (to -17%) in wetter years during September and October, when effects of flow reductions would be less critical for migration conditions, a small increase during September in critical years (10%) that would have a small beneficial effect, and negligible effects (<5%) or small decreases in flow (to -11%) during October. Despite a prevalence of negligible effects or reductions in flow attributable to the project, decreases in mean monthly flow would be of small magnitude in drier water years (to -14%) when effects on migration would be more critical. Therefore, effects of Alternative 6A on flow would not have biologically meaningful negative effects on migration conditions.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River flow comparisons Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate project-related effects would cause decreases in mean monthly flow during September in wetter years (to -23%) when effects on migration would be less critical, and increases in drier years (to 95%) that would have beneficial effects on migration conditions. Project-related effects during October and November consist of negligible effects (<5%) or small increases (9%) or decreases in flow (to -8%) that would not have biologically meaningful negative effects for river lamprey macropthalmia migration in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River flow comparisons Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate an increased prevalence of negligible (<5%) or small-scale effects on mean monthly flow, with decreases (to -32%) during September in wet and above normal years when effects on migration would be less critical, increases (to 17%) during October, and negligible effects with a single, small decrease in flow (-7%) during November in below normal years. These results indicate that project-related effects of Alternative 6A on flows would not have biologically meaningful negative effects on river lamprey macropthalmia migration in the American River.

Stanislaus River

Comparisons for the American River at the confluence with the Sacramento River flow comparisons Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate no effect (0% difference) or negligible (<5%) for all months and water year types. These results indicate that project-related effects of Alternative 6A on flows would not affect river lamprey macropthalmia migration in the Stanislaus River.

Overall, these results indicate that, despite some variation in results by location, month, and water year type, effects of Alternative 6A on flow would generally not have biologically meaningful effects on river lamprey macropthalmia migration in the Sacramento River, Feather River, American River, and Stanislaus River.

Adults

Effects of Alternative 6A on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above. Results are the same; Alternative 6A would not have biologically meaningful negative effects on adult river lamprey migration in the Sacramento River, Feather River, American River, and Stanislaus River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Project-related effects consist primarily of negligible effects (<5%), increases in flow (to 95%) that would have a beneficial effect, infrequent small decreases (to -11%) in drier water years that would not have biologically meaningful effects, and more substantial decreases (to -32%) in wetter years when effects on migration would not be critical.

CEQA Conclusion: In general, under Alternative 6A water operations, the quantity and quality of river lamprey juvenile and adult migration habitat would not be reduced relative to the CEQA baseline.

Macropthalmia

Sacramento River

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate variable effects of Alternative 6A during September, with increases in mean monthly flow (to 38%) in wetter years and decreases (to -21%) in drier years, small-scale increases and decreases in flow (to 9%) during October that would not be expected to have biologically meaningful effects, and negligible effects (<5%) during November for all water year types. Flow reductions during September (to -21%) in dry years, and another small reduction during October in critical years (-9%) would have incremental effects on migration conditions but would not be substantial enough to cause biologically meaningful negative effects on migration conditions.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate variable results by month and water year type, with consistent increases in flow (to 83%) during September in all water years that would have beneficial effects on migration conditions, and negligible effects (<5%) or decreases during October and November (to -21%). Decreases in drier water years when effects of flow reductions would be more critical for migration conditions would be small (to -10%). These results indicate that the effects of Alternative 6A on flow would not have biologically meaningful negative effects on migration conditions in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate moderate to substantial reductions in flow (to -57%) during September through November in all water year types, and negligible effects (<5%) or small (9%) to moderate (30%) increases in flow during October. The substantial decrease during September in critical years (-57%) would be partially offset by an increase during October (30%), but would be followed by another decrease during November (-23%). Based on the prevalence of moderate to substantial reductions in flow during 2 out of the 3 months of the migration period and in all water year types, effects of Alternative 6A on flow are expected to have negative effects on migration conditions in the American River.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate negligible effects (<5%) or reductions in flow during September through November in all water year types, with reductions ranging from -5 to -17%. Reductions in drier water years when effects on migration conditions would be more critical would be limited to small-scale effects (-10%). Therefore, despite a predominance of decreases in mean monthly flows under Alternative 6A throughout the migration period, based on the relatively small magnitude, particularly in drier water years, effects are not expected to have biologically meaningful negative effects on river lamprey macropthalmia migration in the Stanislaus River.

Overall, these results indicate that effects of Alternative 6A on flow from September through November would not have biologically meaningful negative effects on river lamprey macropthalmia migration in the Sacramento River, Feather River, and Stanislaus River, but would affect migration conditions in the American River.

Adults

Effects of Alternative 6A on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above. These results indicate that Alternative 6A would affect adult migration conditions in the American River, and would not have biologically meaningful negative effects in the Sacramento River, Feather River, and Stanislaus River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on flow would affect river lamprey macropthalmia and adult migration conditions in the American River based on persistent and substantial decreases in mean monthly flow (to -57% in all water year types for September and November), and would not have biologically meaningful effects in the Sacramento River, Feather River, and Stanislaus River (based on primarily negligible effects, increases in flow to 38% that would have beneficial effects, and/or isolated decreases to -21% or more prevalent but small-magnitude decreases, to -10%, that would not have biologically meaningful negative effects).

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 6A indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for juvenile and adult river lamprey. This impact is found to be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6A compared to those described in detail for Alternative 1A, the effects described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198) also appropriately characterize effects under Alternative 6A.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6A.

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: These restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-187 through 198).

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A (Impact AQUA-187 through 198), and no mitigation is required.

Non-Covered Aquatic Species of Primary Management Concern

Construction and Maintenance of CM1

The effects of construction and maintenance of CM1 under Alternative 6A would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 6A would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-199), because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping. Additionally, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities on non-covered aquatic species of primary management concern would not be significant except potentially 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.

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. Also, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-200). Consequently, the effects would not be adverse.

CEQA Conclusion: As described above, these impacts would be less than significant.

Water Operations of CM1

The effects of water operations of CM1 under Alternative 6A include a detailed analysis of the following species:

- Striped Bass
- American Shad
- Threadfin Shad
- Largemouth Bass
- Sacramento tule perch
- Sacramento-San Joaquin roach – California species of special concern
- Hardhead – California species of special concern
- California bay shrimp

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Striped bass eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP Delta diversions and the alternate NBA intake as these life stages are passively transported downstream to the north Delta. Entrainment risk for egg and larval striped bass would be high since pumping rates at the north Delta intakes would be high given the elimination of exports from the south Delta facilities under Alternative 6A. State of the art fish screens on these north Delta intakes though would exclude juvenile and adult striped bass.

Entrainment losses under Alternative 6A to the SWP/CVP south delta intakes would be eliminated since there would be no south delta exports under this Alternative.

Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs (approximately 4–12% of diversions) would not increase entrainment and may provide a minor benefit.

Variations in striped bass survival rates during the first few months of life are moderated by a population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al. 2000). Therefore it would be expected that elimination of entrainment of juveniles and adults at the south Delta intakes would have a greater population impact than increases in entrainment of striped bass larvae and eggs at the proposed SWP/CVP north Delta intakes and the NBA intake.

Furthermore, decommissioning of agricultural diversions may also reduce entrainment of striped bass. Also, restoration activities as part of the conservation measures should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that these habitat changes would result in at least a minor improvement in production of juvenile striped bass.

NEPA Effects: Overall, the effect on striped bass entrainment would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of striped bass would be the same as described immediately above. The changes in entrainment under Alternative 6A would not substantially reduce the striped bass population when other conservation measures are taken into consideration. The impact would be less than significant and no mitigation would be required.

American Shad

American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP Delta diversions and the alternate NBA intake as these life stages are passively transported downstream to the north Delta. The majority of spawning takes place upstream of the Delta, so only limited numbers of American shad eggs and larvae would be exposed to entrainment risk at the north Delta intakes. State of the art fish screens on these north Delta intakes though would exclude juvenile and adult American shad.

American shad entrainment losses to the south Delta would be eliminated because there would not be any south Delta exports under Alternative 6A. Reduction or consolidation of agricultural diversions in ROAs would not increase entrainment of American shad, and may provide a modest benefit to the species.

NEPA Effects: Overall, the effect on American shad would not be adverse, and would be slightly beneficial to the species.

CEQA Conclusion: The impact of water operations on entrainment of American shad would be the same as described immediately above. The changes in entrainment under Alternative 6A would not substantially reduce the American shad population. The impact would be less than significant and no mitigation would be required.

Threadfin Shad

Entrainment at the south Delta would be eliminated since there would be no water exports from the south delta under Alternative 6A. Decommissioning agricultural diversions in Delta ROAs would potentially reduce threadfin shad entrainment. There would be entrainment of threadfin shad eggs and larvae to the north Delta intakes. However, overall threadfin shad entrainment would be reduced because they are most abundant in the southwestern portion of the Delta and would particularly benefit from the elimination of south Delta pumping.

NEPA Effects: The effect would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of threadfin shad would be the same as described immediately above. The changes in entrainment under Alternative 6A would not substantially reduce and may benefit the threadfin shad population. The impact would be less than significant and no mitigation would be required.

Largemouth Bass

Since largemouth bass are predominantly found in the south and central portions of the Delta, largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to the south Delta facilities would be effectively eliminated because there would be no water exports from the south Delta under Alternative 6A. As discussed for Alternative 1A (Impact AQUA-201) few larval largemouth bass would be vulnerable to entrainment at the five north Delta intakes and the alternative NBA intake since the majority of the population in the Delta would not encounter the intake structures and don't occur in the vicinity. Decommissioning agricultural diversions could reduce entrainment of largemouth bass since they hold in shallow water habitats where most agricultural diversions are sited.

NEPA Effects: Overall entrainment would be reduced under Alternative 6A and there would be a benefit for the species.

CEQA Conclusion: The impact of water operation on largemouth bass would be as described immediately above. The changes in entrainment under Alternative 6A could benefit the largemouth bass population. The impact would be less than significant and no mitigation would be required.

Sacramento Tule Perch

The effects and conclusion for this impact would be the same as Alternative 1A (Impact AQUA-201). Entrainment of Sacramento tule perch to the SWP/CVP south Delta facilities would be effectively eliminated because there would be no south delta exports under Alternative 6A. Because Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively screened at the proposed north Delta facilities. Reduction or consolidation of these agricultural diversions under the Plan would decrease entrainment of Sacramento tule perch into these agricultural intakes.

NEPA Effects: Overall the reduction in entrainment of Sacramento tule perch under Alternative 6A would not be adverse, and would provide a benefit for the species.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The changes in entrainment under Alternative 6A would be slightly beneficial to the Sacramento tule perch. The impact would be less than significant and no mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento-San Joaquin roach would be the same as described immediately above and would be less than significant.

Hardhead

NEPA Effects: The effect of water operations on entrainment of hardhead under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of hardhead would be the same as described immediately above and would be less than significant.

California Bay Shrimp

NEPA Effects: California bay shrimp do not occur in the vicinity of the intakes so there would be no entrainment effect on them.

CEQA Conclusion: California bay shrimp do not occur in the vicinity of the intakes so there would be no entrainment impact on them.

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

In general, Alternative 6A would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA during April through June, regardless of water year, except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June, except in critical years during April (7% lower), dry and critical years during May (24% and 11% lower, respectively), and dry years during June (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under NAA except in dry and critical years during April (13% and 5% lower, respectively) and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat relative to NAA. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 6A would generally be similar to or greater than flows under NAA, with relatively infrequent, small magnitude reductions in flow that would not have biologically meaningful negative effects. There would be small (7% lower) to moderate (31% lower) flow reductions in the Feather River below Thermalito Afterbay in drier water year types throughout the spawning, incubation, and rearing period. Considered collectively with the results for the other locations analyzed, this would not have biologically meaningful negative effects on striped bass spawning and rearing success. There would be no temperature related effects of Alternative 6A on striped bass.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for striped bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal years during April (7% lower), and wet and below normal years during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or substantially greater than flows under Existing Conditions during April through June, except in wet and above normal years during May (32% and 8% lower, respectively) and in wet and dry years during June (11% and 27% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows under Existing Conditions during April through June in all water year types with flows ranging from 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus River at the confluence with the San Joaquin River, flows under A6A_LLT would be from 11% to 27% lower in both wetter (to 14% lower) and drier (to 27% lower) water year types, except in wet years during June (10% greater), compared to Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

Summary of CEQA Conclusions

Collectively, these results indicate that the effect would not be significant because Alternative 6A would not cause a substantial reduction in striped bass spawning, incubation, and initial rearing habitat relative to CEQA Existing Conditions. Therefore, no mitigation is necessary. Flows in all rivers except the American and Stanislaus rivers during the April through June period under Alternative 6A would generally be similar to or greater than flows under CEQA Existing Conditions; there would be an infrequent occurrence of flow reductions for some locations that would be of small magnitude and/or would occur in wetter water year types when effects of flow reductions are less critical. There would be more persistent, moderate flow reductions in the American River and the Stanislaus River, including in drier water year types (to 45% lower in the American River and to 27% lower in the Stanislaus River). However, considered collectively with the results for the other locations analyzed, these reductions would not have biologically meaningful negative effects on striped bass spawning and rearing success. The percentage of months outside the 59°F to 68°F water temperature range under Alternative 6A would be similar to or lower than under CEQA Existing Conditions.

American Shad

In general, Alternative 6A would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA during April through June, regardless of water year, except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through June, except in critical years during April (7% lower), dry and critical years during May (24% and 11% lower, respectively), and dry years during June (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under NAA except in dry and critical years during April (13% and 5% lower, respectively) and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in American shad adult migration and spawning habitat. Flows in all rivers examined during the April through June adult migration and spawning period under Alternative 6A would generally be similar to or greater than flows under NAA, with relatively infrequent, small magnitude reductions in flow that would not have biologically meaningful negative effects. There would be small (7% lower) to moderate (31% lower) flow reductions in the Feather River below Thermalito Afterbay in drier water year types throughout the adult migration and spawning period. Considered collectively with the results for the other locations analyzed, this flow reduction would not have biologically meaningful negative effects on American shad adult migration and spawning success. There would be no temperature related effects of Alternative 6A on American shad.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for American shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal years during April (7% lower), and wet and below normal years during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or substantially greater than flows under Existing Conditions during April through June, except in wet and above normal years during May (32% and 8% lower, respectively) and in wet and dry years during June (11% and 27% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows under Existing Conditions during April through June in all water year types with flows ranging from 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus River at the confluence with the San Joaquin River, flows under A6A_LLT would be similar to or less than flows under Existing Conditions during April through June in all water year types with flows ranging from 11% to 27% lower in both wetter (to 14% lower) and drier (to 27% lower) water year types, except in wet years during June (10% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would not be significant because Alternative 6A would not cause a substantial reduction in American shad adult migration and spawning habitat, and no mitigation is necessary. Flows in all rivers except the American and Stanislaus rivers during the April through June adult migration and spawning period under Alternative 6A would generally be similar to or greater than flows under CEQA Existing Conditions; there would be an infrequent occurrence of flow reductions for some locations that would be of small magnitude and/or would occur in wetter water year types when effects of flow reductions are less critical. There would be more persistent, moderate flow reductions in the American River and the Stanislaus River, including in drier water year types (to 45% lower in the American River and to 27% lower in the Stanislaus River). However, considered collectively with the results for the other locations analyzed, these reductions would not have biologically meaningful negative effects on American shad adult migration and spawning success. The percentage of months outside the 60°F to 70°F water temperature range under Alternative 6A would be similar to or lower than under the CEQA Existing Conditions.

Threadfin Shad

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during April through August threadfin shad spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April through August except in drier water year types during August relative to NAA (7% to 10% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively small flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would be similar to or greater than flows under NAA during April through August in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA during April through August, regardless of water year, except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be similar to or greater than flows under NAA except in critical years during April (7% lower), dry and critical years during May (24% and 11% lower, respectively), dry years during June (31% lower), all water years during July (to 43% lower), and in wet and above normal years during August (to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects on habitat conditions would be most critical, consist of small to moderate reductions in dry (to 43% lower) and/or critical years (to 22% lower) for most of the spawning period.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows under NAA during April through August with the exception of relatively small increases (to 14% greater) or decreases (to 13% lower) that would not have biologically meaningful effects (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in threadfin shad spawning habitat relative to NAA. Flows in all rivers examined during the April through August spawning period under Alternative 6A would generally be similar to or greater than flows under NAA, with relatively infrequent, small magnitude reductions in flow that would not have biologically meaningful negative effects. There would be moderate to substantial (to 43% lower) flow reductions in the Feather River below Thermalito Afterbay in drier water year types throughout the spawning period. Considered collectively with the results for the other locations analyzed, this would not have biologically meaningful negative effects on threadfin shad spawning success. The percentage of months below the spawning temperature threshold would be similar under Alternative 6A relative to NAA.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during April through August spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through August, except in below normal years during April (7% lower), wet and below normal years during May (16% and 10% lower, respectively), and dry and critical years during August (7% and 20% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively small, isolated flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower), in wet years during July (14% lower), and in critical years during August (25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of small magnitude and/or isolated and would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows under Existing Conditions during April through August regardless of water year type, except in critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This isolated flow reduction would not have biologically meaningful negative effects.

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or substantially greater than flows under Existing Conditions during April through June, except in wet and above normal years during May (32% and 8% lower, respectively), in wet and dry years during June (11% and 27% lower, respectively), in all water year types during July (to 45% lower), and in dry years during August (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Persistent, moderate flow reductions would occur in dry years (to 45% lower) relative to Existing Conditions and would have a localized effect on spawning conditions for that particular type of water year.

In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows under Existing Conditions during April through August in all water year types with flows ranging from 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types, with the single exception of greater flows relative to Existing Conditions in critical years during July (30% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These persistent, substantial flow reductions would affect spawning conditions for this location.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus River at the confluence with the San Joaquin River, flows under A6A_LLT would be similar to or less than flows under Existing Conditions during April through August in all water year types with flows ranging from 11% to 27% lower in both wetter (to 23% lower) and drier (to 27% lower) water year types, except in wet years during June (10% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These persistent, substantial flow reductions would affect spawning conditions for this location, particularly in drier water year types.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

Summary of CEQA Conclusions

Collectively, these results indicate that the effect would be significant because Alternative 6A would cause a substantial reduction in threadfin shad spawning habitat relative to CEQA Existing Conditions. Flows in all rivers except the Feather, American and Stanislaus rivers during the April through August spawning period under Alternative 6A would generally be similar to or greater than flows under CEQA Existing Conditions; with infrequent occurrence of relatively small flow reductions for some locations that would be of small magnitude and/or would occur in wetter water year types when effects of flow reductions are less critical. Conversely, there would be more persistent, moderate to substantial flow reductions in the Feather River (to 45% lower), the American River (to 45% lower), and the Stanislaus River (to 27% lower), including in drier water year types when effects on spawning conditions would be more critical. The percentage of months outside all temperature thresholds is similar under Alternative 6A to CEQA Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 6A are due primarily to both the alternative and future climate change.

Largemouth Bass

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows under NAA during March through June in all water year types except in below normal years during March (6% lower) and in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be the same or greater than flows under NAA (up to 26% greater) during March through June except infrequently (to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions under A6A_LLT would not be consistent month to month in any specific water year type and would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under NAA with a few isolated, small to moderate flow reductions, including in critical years during March (21% lower), dry and critical years during April (13% and 5% lower, respectively), and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions are infrequent and relatively small and would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 6A would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and April (11% and 7% lower, respectively), and wet and below normal years during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable effects relative to flows under Existing Conditions, with flows under A6A_LLT greater than flows under Existing Conditions in wetter years during March, dry years during April, drier water year types during May, and above and below normal water years during June. Flows under A6A_LLT would be lower relative to flows under Existing Conditions in drier water year types during March (to 40% lower), in critical years during April (6% lower), in wetter water year types during May (to 32% lower), and in wet (11% lower) and dry (27% lower) years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This consists of relatively inconsistent effects during March through June for any specific water year type (i.e., increases in flow in some months would generally offset the decreases in other months) and would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March except in critical years (21% lower), and similar to or lower than flows under Existing Conditions during April through June (to 45% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to moderate flow reductions in dry (to 11% lower) or critical (to 45% lower) years in each month that would affect habitat conditions primarily in critical years.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow reductions in drier water years, when effects would be most critical for spawning conditions, consist of persistent, moderate reductions (14% to 30% lower) for March through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

Sacramento Tule Perch

NEPA Effects: The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on Sacramento tule perch spawning habitat would not be significant.

Sacramento-San Joaquin Roach – California Species of Special Concern

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows under NAA during March through June in all water year types except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be the same or greater than flows under NAA (up to 26% greater) during March through June except infrequently (to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions under A6A_LLT would not be consistent month to month in any specific water year type and would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under NAA with a few isolated, small to moderate flow reductions, including in critical years during March (21% lower), dry and critical years during April (13% and 5% lower, respectively), and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions are infrequent and relatively small and would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 6A would affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and April (11% and 7% lower, respectively), and wet and below normal years during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable effects relative to flows under Existing Conditions, with flows under A6A_LLT greater than flows under Existing Conditions in wetter years during March, dry years during April, drier water year types during May, and above and below normal water years during June. Flows under A6A_LLT would be lower relative to flows under Existing Conditions in drier water year types during March (to 40% lower), in critical years during April (6% lower), in wetter water year types during May (to 32% lower), and in wet (11% lower) and dry (27% lower) years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This consists of relatively inconsistent effects during March through June for any specific water year type (i.e., increases in flow in some months would generally offset the decreases in other months) and would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during March except in critical years (21% lower), and similar to or lower than flows under Existing Conditions during April through June (to 45% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to moderate flow reductions in dry (to 11% lower) or critical (to 45% lower) years in each month that would affect habitat conditions primarily in critical years.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for spawning conditions, consist of persistent, moderate reductions (14% to 30% lower) for March through May.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

Hardhead – California Species of Special Concern

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would be similar to or greater than flows under NAA during April and May in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always to be similar to flows under NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA except in critical years during April (7% lower) and in dry (24% lower) and critical years (11% lower) during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated, moderate magnitude flow reductions that are not expected to cause biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or greater than flows under NAA during April and May except in dry (13% lower) and critical (5% lower) years during April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are small flow reductions that would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to NAA.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream spawning habitat conditions for hardhead relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in below normal years during April (7% lower) and in wet and below normal years during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively small reductions in flow that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during April (6% lower), and in wet and above normal years during May (32% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of small magnitude and/or occur in wetter water year types when effects of flow reductions would be less critical for effects on habitat conditions.

In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or lower than flows under Existing Conditions during April and May, ranging from 7% to 32% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of negligible effects or relatively small flow reductions (7% and 26% in below normal years, negligible or to 14% lower in dry and critical years) that would not be expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus River at the confluence with the San Joaquin River, flows under A6A_LLT in drier water years, when effects would be more critical for habitat conditions, would consist of moderate flow reductions (to 19% lower in below normal years, 17% to 19% lower in dry and critical years). While persistent throughout the relatively short spawning period, the overall magnitude of these flow reductions is relatively small and would not have biologically meaningful negative effects on the hardhead population.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A.

California Bay Shrimp

NEPA Effects: The effect of water operations on spawning habitat of California bay shrimp under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact

AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on California bay shrimp rearing would be less than significant.

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

The discussion under Alternative 6A, Impact AQUA-202 for striped bass also addresses the embryo incubation and initial rearing period. That analysis indicates that there is no adverse effect on striped bass rearing during that period. Other effects of water operations on rearing habitat for striped bass under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on striped bass rearing habitat would be less than significant.

American Shad

The effects of water operations on rearing habitat for American shad under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on American shad rearing habitat would be less than significant.

Threadfin Shad

The effects of water operations on rearing habitat for threadfin shad under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on threadfin shad rearing habitat would be less than significant.

Largemouth Bass

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during all months but August, September, and November with infrequent exceptions (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August, September, and November would generally be lower by up to 16% depending on month, water year type, and time period. Flow reductions under A6A_LLT relative to NAA would be no greater than 13% lower in drier water years when effects of flow reductions would be more critical for habitat conditions and would therefore not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally similar to or greater than flows under NAA in August through November except in critical years during October (10% lower) and wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated, small flow reductions relative to NAA would not have biologically meaningful effects.

In Clear Creek at Whiskeytown Dam, April through November flows under A6A_LLT would generally be similar to or greater than flows under NAA except in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA during June and September, and similar to or lower than flows under NAA during April, May, July, August, October, and November (up to 43% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flow (to 43% lower) would be prevalent in drier water year types for May, June, and July.

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or lower than flows under NAA in April (to 13% lower), July (to 13% lower), and September (to 30% lower), and similar to or greater than flows under NAA in the remaining months with isolated occurrences of small flow reductions (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Based on the relatively small magnitude and infrequent occurrence of flow reductions, effects would not be biologically meaningful.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during all months but August, September, and November with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August, September, and November would be lower than flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when effects of flow reductions would be more critical for habitat conditions. These are relatively small flow reductions that are not expected to have biologically meaningful negative effects on adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT generally be similar to or greater than flows under NAA with two, isolated, small exceptions, in critical years during October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA from January through April, June, and September, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows under NAA, with flows generally similar to or greater than flows under NAA in January through June, August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year types) and would be intermittent by month and water year type and would be offset by increases in flow in other months and therefore are not expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and

Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally similar to or greater than flows under NAA in most months, with only infrequent, isolated reductions in flow. Flows from May through July (affecting juvenile and adult rearing) and December (affecting adult rearing) are generally lower in the Feather River high-flow channel in drier water year types (to 43% lower), although these reductions would not be biologically meaningful to the largemouth bass population. Also, there are no temperature-related effects in any of the rivers examined.

CEQA Conclusion: In general, Alternative 6A would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to CEQA Existing Conditions.

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions in all months but August, September, and October with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during August, September, and October under A6A_LLT would be as much as 21% lower than flows under Existing Conditions depending on the month and water year type, with fairly persistent, small to moderate flow reductions in dry and critical years for these months. Based on the relatively small magnitude, this effect is not expected to have biologically meaningful negative effects on rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT during April through July would generally be similar to or greater than flows under Existing Conditions throughout the year with a few, isolated exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August through November would be similar to or lower than flows under Existing Conditions (to 37% lower) with the largest flow reductions in critical years.

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the April through November period, except in critical years during August through November (ranging from 6% to 28% lower) and in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally have variable effects by water year type during April, May, and June, with increases in flow to 48% and decreases in flow to 32% lower; would generally be similar to or greater than flows under Existing Conditions during August and September, and would generally be similar to or less than flows under Existing Conditions during July, October, and November (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Occurrence of moderate flow reductions in drier water years would be infrequent and would be offset by increases in other months. The most persistent, moderate reductions would be in dry years during June (27% lower), July (45% lower), and August (31% lower).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or lower than flows under Existing Conditions for all months (to 48% lower) except during October, for which flows would be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through November in drier water years, when effects on habitat conditions would be most critical, include small to substantial (48% lower) flow reductions for most months.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for rearing conditions, consist of persistent, small to moderate reductions (6% to 27% lower) for April, May, July, October, and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during all months but August, September, and

October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow reductions in dry and critical years. Based on the relatively small magnitude, this effect is not expected to have biologically meaningful negative effects on adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during January through July, with a few, isolated exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August through November (ranging from 6% and 28% lower) and in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results relative to flows under Existing Conditions from February through June, with decreases to 46% lower than under Existing Conditions, and would generally be lower than flows under Existing Conditions during January (to 43% lower), July (to 45% lower), and October through December (to 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions for August and September, with one exception (31% lower in dry years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46% lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and December (to 41% lower).

In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to or greater than flows under Existing Conditions in February, March, and October with the exception of in critical years (6% lower during February and 21% lower during March), and would be similar to or lower than flows under Existing Conditions for the remaining months of the year (to 48% lower). Flows under A6A_LLT during January and April through December in drier water years, when effects on habitat conditions would be most critical, include small to substantial (48% lower) flow reductions for most months.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for rearing conditions, consist of persistent, small to moderate reductions (6% to 36% lower) for January through May, July, and October through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and

Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 6A would cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower during portions of the spawning period in two rivers, and much of the rearing periods in most of the locations analyzed, particularly in drier water year types, for most locations analyzed. There would be moderate to substantial reductions in flows in the American River and the Stanislaus River during the spawning period, particularly in critical water years (to 48% lower in the American River, to 36% lower in the Stanislaus River). For the juvenile and adult rearing periods, there would be moderate to substantial flow reductions in the Trinity River with the largest flow reductions in critical years (August through December, to 37% lower), in Clear Creek in critical water years (August through November, to 28% lower), in the Feather River in dry years (June through August, to 45% lower for juvenile rearing, with the addition of January and December, to 46% lower for adult rearing), in the American River in drier water years (April through November, to 48% lower for juvenile rearing and January and December, to 48% lower, for adult rearing), and in the Stanislaus River for much of the rearing periods in drier water years (to 36% lower). Combined, these flow reductions would substantially reduce or degrade upstream habitat for largemouth bass. The percentages of months outside all temperature thresholds are generally lower under Alternative 6A than under CEQA Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline (Existing Conditions) is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 6A are due primarily to both the alternative and future climate change.

Sacramento Tule Perch

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during all months but August, September, and November with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August, September, and November would be lower than flows under NAA (up to 16% lower, depending on month, water year type, and time period). Flow reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when effects of flow reductions would be more critical for habitat conditions. These are relatively small flow reductions that are not expected to have biologically meaningful negative effects on habitat conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA with two, isolated, small exceptions, in critical years during October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA from January through April, June, and September, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows under NAA, with flows generally similar to or greater than flows under NAA in January through June, August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year types) and would be intermittent by month and water year type and would be offset by increases in flow in other months and therefore are not expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in Sacramento tule perch habitat. Flows in all rivers examined during the year under Alternative 6A are generally similar to or greater than flows under NAA in most months, with only infrequent, isolated reductions in flow. Flows from May through July (affecting juvenile and adult rearing) and December (affecting adult rearing) are generally lower in the Feather River high-flow channel in drier water year types (to 43% lower), although these reductions would not be biologically meaningful to the Sacramento tule perch population. Also, there are no temperature-related effects in any of the rivers examined.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during all months but August, September, and October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow reductions in dry and critical years. Based on the relatively small magnitude, this effect is not expected to have biologically meaningful negative effects on rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during January through July, with a few, isolated exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August through November (ranging from 6% and 28% lower) and in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results relative to flows under Existing Conditions from February through June, with decreases to 46% lower than under Existing Conditions, and would generally be lower than flows under Existing Conditions during January (to 43% lower), July (to 45% lower), and October through December (to 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions for August and September, with one exception (31% lower in dry years during

August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46% lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and December (to 41% lower).

In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to or greater than flows under Existing Conditions in February, March, and October with the exception of in critical years (6% lower during February and 21% lower during March), and would be similar to or lower than flows under Existing Conditions for the remaining months of the year (to 48% lower). Flows under A6A_LLT during January and April through December in drier water years, when effects on habitat conditions would be most critical, include small to substantial (48% lower) flow reductions for most months.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for rearing conditions, consist of persistent, small to moderate reductions (6% to 36% lower) for January through May, July, and October through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A which indicates generally higher temperatures.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 6A would cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially lower during much of the rearing periods, particularly in drier water year types, for most locations analyzed. There would be moderate to substantial flow reductions in the Trinity River with the largest flow reductions in critical years (August through December, to 37% lower), in Clear Creek in critical water years (August through November, to 28% lower), in the Feather River in dry years (June through August, January and December, to 46% lower), in the American River in drier water years (April through January, to 48% lower), and in the Stanislaus River for much of the year in drier water years (to 36% lower). The percentages of months outside both temperature thresholds are generally higher under Alternative 6A than under CEQA Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison (NAA) is assumed to occur during the late long-term implementation period whereas CEQA Existing Conditions are assumed to occur during existing climate conditions. Therefore, differences in model outputs between CEQA Existing Conditions and the Alternative 6A are due primarily to both the alternative and future climate change.

Sacramento-San Joaquin Roach

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during all months but August, September, and November with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August, September, and November would be lower than flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when effects of flow reductions would be more critical for habitat conditions. These are relatively small flow reductions that are not expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA with two, isolated, small exceptions, in critical years during October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA from January through April, June, and September, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows under NAA, with flows generally similar to or greater than flows under NAA in January through June, August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year types) and would be intermittent by month and water year type and would be offset by increases in flow in other months and therefore are not expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally similar to or greater than flows under NAA in most months, with only infrequent, isolated reductions in flow. Flows from May through July and December are generally lower in the Feather River high-flow channel in drier water year types (to 43% lower), although these reductions would not be biologically meaningful to the Sacramento-San Joaquin roach population. Also, there are no temperature-related effects in any of the rivers examined.

CEQA Conclusion: In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during all months but August, September, and October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow reductions in dry and critical years. Based on the relatively small magnitude, this effect is not expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during January through July, with a few, isolated exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August through November (ranging from 6% and 28% lower) and in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results relative to flows under Existing Conditions from February through June, with decreases to 46% lower than under Existing Conditions, and would generally be lower than flows under Existing Conditions during January (to 43% lower), July (to 45% lower), and October through December (to 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions for August and September, with one exception (31% lower in dry years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46% lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and December (to 41% lower).

In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to or greater than flows under Existing Conditions in February, March, and October with the exception of in critical years (6% lower during February and 21% lower during March), and would be similar to or lower than flows under Existing Conditions for the remaining months of the year (to 48% lower). Flows under A6A_LLT during January and April through December in drier water years, when effects on habitat conditions would be most critical, include small to substantial (48% lower) flow reductions for most months.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for rearing conditions, consist of persistent, small to moderate reductions (6% to 36% lower) for January through May, July, and October through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of rearing habitat and increased stress and mortality of rearing juveniles and adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 6A would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be substantially lower during portions of the spawning period in two rivers, and much of the rearing periods in most of the locations analyzed, particularly in drier water year types, for most locations analyzed. There would be moderate to substantial reductions in flows in the American River and the Stanislaus River during the spawning period, particularly in critical water years (to 45% lower in the American River, to 30% lower in the Stanislaus River). For the juvenile and adult rearing periods, there would be moderate to substantial flow reductions in the Trinity River with the largest flow reductions in critical years (August through December, to 37% lower), in Clear Creek in critical water years (August through November, to 28% lower), in the Feather River in dry years (June through August, January and December, to 45% lower), in the American River in drier water years (April through January, to 48% lower), and in the Stanislaus River for much of the year in drier water years (to 36% lower). Combined, these flow reductions would substantially reduce or degrade upstream habitat for roach. The percentages of months outside all temperature thresholds are generally higher under Alternative 6A than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas CEQA Existing Conditions are assumed to occur during existing climate conditions. Therefore, differences in model outputs between CEQA Existing Conditions and Alternative 6A are due primarily to both the alternative and future climate change.

Hardhead

In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under NAA during all months but August, September, and November with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August, September, and November would be lower than flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when effects of flow reductions would be more critical for habitat conditions. These are relatively small flow reductions that are not expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under NAA with two, isolated, small exceptions, in critical years during October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or greater than flows under NAA from January through April, June, and September, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows under NAA with flows generally similar to or greater than flows under NAA in January through June, August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year types) and would be intermittent by month and water year type and would be offset by increases in flow in other months and therefore are not expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for year-round juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally similar to or greater than flows under NAA in most months, with only infrequent, isolated reductions in flow. Flows during May, July, August, and October through December are generally lower in the Feather River high-flow channel in drier water year types (to 43% lower). Based on the fact that these fairly persistent, moderate flow reductions would only occur in one of the locations analyzed, they are not expected to have biologically meaningful negative effects on the hardhead population. Also, there are no temperature-related effects in any of the rivers examined.

CEQA Conclusion: In general, Alternative 6A would reduce the quality and quantity of upstream habitat conditions for hardhead relative to CEQA Existing Conditions, based on reductions in flow that would affect juvenile and adult rearing conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during all months but August, September, and October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow reductions in dry and critical years. Based on the relatively small magnitude, this effect is not expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during January through July, with a few, isolated exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August through November (ranging from 6% and 28% lower) and in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results relative to flows under Existing Conditions from February through June, with decreases to 46% lower than under Existing Conditions, and would generally be lower than flows under Existing Conditions during January (to 43% lower), July (to 45% lower), and October through December (to 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions for August and September, with one exception (31% lower in dry years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46%

lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and December (to 41% lower).

In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to or greater than flows under Existing Conditions in February, March, and October with the exception of in critical years (6% lower during February and 21% lower during March), and would be similar to or lower than flows under Existing Conditions for the remaining months of the year (to 48% lower). Flows under A6A_LLT during January and April through December in drier water years, when effects on habitat conditions would be most critical, include small to substantial (48% lower) flow reductions for most months.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years, when effects would be most critical for rearing conditions, consist of persistent, small to moderate reductions (6% to 36% lower) for January through May, July, and October through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water Temperature

The percentage of months in which year-round in-stream temperatures would be outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or the Clear Creek.

Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 6A would cause a substantial reduction in hardhead rearing habitat. Flows would be substantially lower during portions of the rearing period in two rivers, and much of the rearing period in most locations analyzed, particularly in drier water year types, for most locations analyzed. There would be moderate to substantial reductions in flows in the Trinity River (August through December, to 37% lower), in Clear Creek in critical years (August to November, to 28% lower), in the Feather River in drier water years (January through March, June through August, and December, to 45% lower), in the American River in drier water years (April through January, to 48% lower), and in the Stanislaus River for much of the year in drier water years (to 36% lower). Combined, these flow reductions would substantially reduce or degrade upstream rearing habitat for hardhead. Flows under Alternative 6A would generally be similar to or greater than flows under Existing Conditions during the April-May hardhead spawning period, except for moderate reductions in the Feather River that would not be prevalent enough to have biologically meaningful negative effects on the population. The percentages of months outside all temperature thresholds are generally higher under Alternative 6A than under Existing Conditions. This impact 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 impact to a less than significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas CEQA Existing Conditions are assumed to occur during existing climate conditions. Therefore, differences in model outputs between CEQA Existing Conditions and Alternative 6A are due primarily to both the alternative and future climate change.

California Bay Shrimp

NEPA Effects: The effect of water operations on rearing habitat of California bay shrimp under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. These effects would not be adverse.

CEQA Conclusion: As described above the impacts on rearing habitat of California bay shrimp would be less than significant.

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Monthly flows in the Sacramento River downstream of the north Delta intakes would be reduced (23–26% for NAA) under Alternative 6A during the adult striped bass migration. Sacramento River flows are highly variable interannually, and striped bass are still able to migrate upstream the Sacramento River during lower flow years.

NEPA Effects: The effect of reduced Sacramento flows under Alternative 6A would not be adverse.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (27–34% lower compared to Existing Conditions) would not interfere substantially with movement of pre-spawning striped bass through the Delta. No mitigation would be required.

American Shad

Flows in the Sacramento River downstream of the north Delta diversion facilities would be reduced relative to NAA during March-May. Monthly flows on average would be reduced 23–26% relative to NAA. Flows from the San Joaquin River at Vernalis would be unchanged under Alternative 6A.

Sacramento River flows are highly variable interannually, and American shad are still able to migrate upstream the Sacramento River during years of lower flows.

NEPA Effects: Overall, the impact to American shad migration habitat conditions would not be adverse under Alternative 6A.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (25–34% lower compared to Existing Conditions) would not interfere substantially with movement of American shad from the Delta to upstream spawning habitat. No mitigation would be required.

Threadfin Shad

NEPA Effects: Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats. Threadfin shad found in the Delta to not actively migrate upstream to spawn. Therefore there is no effect on migration habitat conditions.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because flow changes in the Delta under Alternative 6A would not alter movement patterns for threadfin shad. No mitigation would be required.

Largemouth Bass

NEPA Effects: Largemouth bass are non-migratory fish within the Delta. Therefore they do not use the Delta as migration habitat corridor. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes under Alternative 6A would not affect largemouth movements within the Delta. No mitigation would be required.

Sacramento Tule Perch

NEPA Effects: Similar with largemouth bass, Sacramento tule perch are a non-migratory species and do not use the Delta as a migration corridor as they are a resident Delta species. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes would not affect Sacramento tule perch movements within the Delta. No mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 6A, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

Hardhead

NEPA Effects: For hardhead the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 6A, Impact AQUA-

202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for hardhead would not be significant and no mitigation is required.

California Bay Shrimp

NEPA Effects: The effect of water operations on migration conditions of California bay shrimp under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on migration conditions of California bay shrimp would be less than significant.

Restoration and Conservation Measures

The effects of restoration and conservation measures under Alternative 6A would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species. However, the detailed discussions of impacts and conclusions from restoration and conservation measures provided under Alternative 1A are identical for Alternative 6A.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

Refer to Impact AQUA-7 through Impact AQUA-18 for delta smelt under Alternative 1A, for detailed discussions of potential effects of these restoration and conservation measures on aquatic species.

NEPA Effects: These restoration and conservation impact mechanisms have been determined to range from no effect, to not adverse, or beneficial to aquatic species of primary management concern for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-205 through AQUA-216).

CEQA Conclusion: These restoration and conservation impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on aquatic species of primary management concern, for the reasons identified for Alternative 1A (Impact AQUA-205 through AQUA-216), and no mitigation is required.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6A would not be substantially reduced when compared to the No Action Alternative.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 6A would reduce the quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-11A-102. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.12 Alternative 6B—Isolated Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Alternative 6B includes the same five intakes on the Sacramento River as Alternative 1A and 6A, and the same culvert and tunnel siphons, and barge landings as Alternative 1B and 2B. Alternative 6B also has an east-side alignment surface canal conveyance like the one included in Alternatives 1B and 2B. Alternative 6B differs from Alternative 1B because it does not include the south Delta intakes. However, because no construction impacts on the aquatic environment are associated with the south Delta intakes, construction impacts would be the same as those described under Alternatives 1B and 2B. In addition, only one barge landing would be constructed under Alternative 6B compared to six under Alternative 1A. 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 as Scenario D. However, Alternative 6B has the same diversion and conveyance operations as Alternative 1A; consequently, the analysis under Alternative 1A is applicable to Alternative 6B.

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 6B.

Delta Smelt

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on delta smelt or designated critical habitat would be similar to those described under Alternative 1A (Impact AQUA-1 and AQUA-2) because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A. The effects described for delta smelt and critical habitat under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-1 and AQUA-2, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or critical habitat.

CEQA Conclusion: As described in Impact AQUA-1 and AQUA-2 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities and maintenance activities on delta smelt or their 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.

Water Operations of CM1

Alternative 6B has the same diversion and conveyance operations as Alternative 6A. The primary difference between the two alternatives is that conveyance under Alternative 6B would be in a lined or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity or operations, there would be no differences between these two alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-3 through Impact AQUA-6), the fish effects described for Alternative 6A also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 6A that are identical for Alternative 6B.

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: The impact mechanisms listed above, would be beneficial or not adverse to delta smelt under Alternative 6B, including beneficial effects of Impact AQUA-3 and AQUA-4. This is the same conclusion as described in detail under Alternative 6A, and is based on the expected overall limited or beneficial impacts.

CEQA Conclusion: The effects of the above listed impact mechanisms would be less than significant, or beneficial to delta smelt, and no mitigation would be required. Detailed discussions regarding these conclusions are presented in Alternative 6A.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects described for Alternative 1A (Impact AQUA-7 through Impact AQUA-18) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: As described in detail under Alternative 1A (Impact AQUA-7 through AQUA-18), none of these impact mechanisms would be adverse to delta smelt, and most would be at least slightly beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: All of these impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Longfin Smelt

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on longfin smelt would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on longfin smelt would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-19 and AQUA-20), the effects described for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 6B.

The following impacts on longfin smelt are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: These impact mechanisms would not be adverse to longfin smelt. While construction activities (Impact AQUA-19) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternatives 1A and 6A, Impact AQUA-19 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on longfin smelt would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment for Impact AQUA-21 through AQUA-24, the effects described for longfin smelt under Alternatives 6A also appropriately characterize effects under Alternative 6B.

Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt

Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt

NEPA Effects: As discussed in detail under Alternative 6A, the effects on longfin smelt from Impact AQUA-22 could be an adverse effect. Despite a growing body of evidence supporting a positive correlation between longfin smelt abundance and spring outflow, the specific timing and amount of outflow needed to conserve longfin smelt is less clear, especially in light of potential increases in food resources in the Plan Area and other benefits to spawning and rearing habitat. Therefore, the implementation of adaptive management procedures under Alternative 6B, that could be used to adjust spring operations, is expected to reduce potential effects to not be adverse. These adaptive management procedures are described in Mitigation Measures 22a through 22c, under Alternative 1A.

CEQA Conclusion: As described above under Alternatives 1A and 6A, water operations under Alternative 6B would generally reduce the quantity and quality of longfin smelt rearing habitat relative to Existing Conditions. The results also indicate that the difference in rearing habitat could be significant because Delta outflows would be reduced in the spring, which would have the potential to contribute to substantial reductions in longfin smelt abundances. These effects are due to the specific reservoir operations and resulting flows associated with this alternative. However, the implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced larval entrainment would reduce this impact to less than significant, so no additional mitigation would be required.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Spawning and Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on longfin smelt would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 6B.

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these impact mechanisms have been determined to range from no effect, to not adverse, or beneficial to longfin smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Winter-Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on winter-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on winter-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-37 and AQUA-38). The effects described for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: These impact mechanisms would not be adverse to winter-run Chinook salmon. While construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, Impact AQUA-37 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on winter-run Chinook salmon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impacts AQUA-39 through AQUA-42), the effects described for winter-run Chinook salmon also appropriately characterize the effects under Alternative 6B.

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Winter-Run ESU)

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

NEPA Effects: As discussed for Alternative 6A, with the exception of Impact AQUA-42, the impact mechanisms listed above would not be adverse to winter-run Chinook salmon under Alternative 6B. However, Alternative 6B would be adverse to migration conditions for winter-run Chinook salmon. While the effect on migration conditions is adverse, the implementation of applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as described in Chapter 3 (Section 3.6) would minimize potential effects, although the effect would still be adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 6A, Impact AQUA-42 would result in significant effects on migration conditions. While the implementation of applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as described in Chapter 3 (Section 3.6) would minimize potential effects, the effect would remain significant and unavoidable.

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"), including the NDD intakes. This conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness.

In addition to these conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact, although the effect would still likely remain significant and unavoidable. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-42) for winter-run Chinook salmon.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on winter-run Chinook salmon would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects described for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, the impact mechanisms listed above would not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be less than significant, or beneficial, so no additional mitigation would be required.

Spring-Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on spring-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on spring-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-55 through Impact AQUA-72), the fish effects described for spring-run Chinook salmon under Alternative 1A also appropriately characterize effects for spring-run Chinook salmon under Alternative 6B.

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: These impact mechanisms would not be adverse to spring-run Chinook salmon. While construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on spring-run Chinook salmon would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to Alternative 6A (Impact AQUA-57 through AQUA-60), the effects described for spring-run Chinook salmon under Alternatives 6A also appropriately characterize effects under Alternative 6B.

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

NEPA Effects: As discussed in detail for Alternative 6A, the impact mechanisms listed above would range from beneficial to adverse under Alternative 6B for spring-run Chinook salmon. Adverse effects would occur because migration conditions for juvenile spring-run Chinook salmon would be substantially reduced, and because it has the potential to substantially increase predation, and remove important instream habitat as the result of the presence of five north Delta intake structures. While the implementation of the mitigation measures listed below, as well as CM6, *Channel Margin Enhancement* and CM15, *Predator Control* would reduce potential effects, the effect would likely remain adverse.

CEQA Conclusion: As discussed in detail for Alternative 6A, the effects of the impact mechanisms listed above would range from beneficial to significant under Alternative 6B for spring-run Chinook salmon. Impact AQUA-60 would result in significant effects on migration conditions. Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce them to a level considered less than significant.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"), including the NDD intakes. This conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness.

In addition to these conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact, although the effect would still likely remain significant and unavoidable. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on spring-run Chinook salmon would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: As discussed for Alternative 1A and 6A, the other impact mechanisms would not be adverse, and with the implementation of environmental commitments and conservation measures, the effects would typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Fall-/Late Fall–Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on fall- and late fall-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on fall- and late fall-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-73 and AQUA-74), the effects described for fall- and late fall-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of

Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-73 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on fall- and late fall-run Chinook salmon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impacts AQUA-75 through AQUA-78), the effects described for fall- and late fall-run Chinook salmon also appropriately characterize the effects for Alternative 6B.

Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Overall, the effects of water operations vary by location. Similar to effects described in detail under Alternative 6A, Alternative 6B would have an adverse effect on fall-/late fall-run Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-delta conditions on the Sacramento River would substantially affect migration conditions relative to NAA while through-Delta conditions on the San Joaquin River would be positive. However, upstream of the Delta, Alternative 6B conditions relative to NAA would not substantially affect migration conditions. The implementation of the conservation and mitigation measures listed below, would reduce the overall effects, but the they would still likely remain adverse.

CEQA Conclusion: The results of the Impact AQUA-78 CEQA analysis indicate differences between the CEQA baseline and Alternative 6B depending on location. Through-Delta conditions on the Sacramento River would substantially impact migration conditions relative to Existing Conditions while through-Delta conditions on the San Joaquin River would be positive relative to Existing Conditions. Upstream of the Delta conditions relative to Existing Conditions would be reduced although the impacts are related to climate change. Alternative 6B also has the potential to substantially increase predation and remove important instream habitat as the result of the presence of five NDD structures.

Implementation of *CM6 Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory Fishes (Predator Control)* would address habitat and predation losses, therefore, would potentially minimize impacts to some extent but not to a less than significant level.

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"), including the NDD intakes. This conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness.

As with the conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact though not necessarily to a less-than-significant level. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall–Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Restoration and Conservation Measures

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, these restoration and conservation commitment impact mechanisms (Impact AQUA-79 through AQUA-90),would not be adverse, and would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Steelhead

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on steelhead would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on steelhead would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-91 and AQUA-92). Therefore, the effects described for steelhead under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

NEPA Effects: These impact mechanisms would typically not be adverse to steelhead. While construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-91 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of` water conveyance facility operations on steelhead would be similar to those described above under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-93 through AQUA-96), the fish effects described for steelhead under Alternative 6A also appropriately characterize effects under Alternative 6B.

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

NEPA Effects: As described in detail under Alternative 6A, these impact mechanisms would adversely affect steelhead migration conditions, primarily as a result of unacceptable levels of uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the presence and operation of the five intakes.

While the implementation of the conservation and mitigation measures described below would address these impacts, these measures are not anticipated to reduce the impact to a level considered not adverse. Therefore, the effects would remain adverse to steelhead under Alternative 6B.

CEQA Conclusion: Collectively, the analysis indicates that the difference between the CEQA baseline and Alternative 6B could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with steelhead migrations in some areas. Alternative 6B would also negatively affect juvenile and adult migration conditions in some areas.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

In addition to the conservation measures, the mitigation measures identified below would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures. However, this would not necessarily result in a less than significant determination.

Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-96a under Alternative1A for steelhead.

Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts on Steelhead Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-96b under Alternative1A for steelhead.

Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-96a under Alternative1A for steelhead.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 6B without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 6B operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this alternative, and the impact on steelhead would remain significant and unavoidable.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on steelhead would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B, compared to those described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the fish effects described for steelhead also appropriately characterize the effects under Alternative 6B.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: As discussed for Alternative 1A and 6A, the other impact mechanisms would not be adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Sacramento Splittail

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on Sacramento splittail would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on Sacramento splittail would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-109 and AQUA-110), the fish effects described for Sacramento splittail under Alternative 1A also appropriately characterize effects for Sacramento splittail under Alternative 6B.

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: These impact mechanisms would generally not be adverse to Sacramento splittail. While construction activities (Impact AQUA-109) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-109 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no additional mitigation would be required.

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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on Sacramento splittail would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B, compared to those described in detail for Alternative 6A (Impacts AQUA-111 through AQUA-114), the fish effects described would also appropriately characterize the effects under Alternative 6B.

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

NEPA Effects: As discussed in detail for Alternative 6A, the operations impact mechanisms would not be adverse to Sacramento splittail.

CEQA Conclusion: Similar to the discussion provided above for Alternative 6A, these impact mechanisms would be less than significant, and no mitigation would be required.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on Sacramento splittail would be similar to those described for Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126), the fish effects described also appropriately characterize the effects under Alternative 6B.

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: As discussed for Alternative 1A, the other impact mechanisms would not be adverse, and would typically be beneficial to Sacramento splittail. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Green Sturgeon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on green sturgeon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on green sturgeon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-127 and AQUA-128), the fish effects described for green sturgeon under Alternative 1A also appropriately characterize effects for green sturgeon under Alternative 6B.

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon

NEPA Effects: While the maintenance impact mechanism (Impact AQUA-128) would not be adverse to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-127 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than significant. The other impact mechanism would be less than significant, so no additional mitigation would be required.

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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on green sturgeon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impacts AQUA-129 through AQUA-132), the fish effects described for green sturgeon also appropriately characterize the effects under Alternative 6B.

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

NEPA Effects: As discussed for Alternative 6A, Impact AQUA-129 would be beneficial for green sturgeon because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities. As discussed for Alternative 1A and 6A, Impact AQUA-130 and AQUA-132 are expected to negatively affect green sturgeon spawning and rearing habitat conditions under Alternative 6B. These effects are a result of the specific reservoir operations and resulting flows associated with this alternative. However, as discussed for Alternative 6A, the overall effect would not be adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, Impact AQUA-130 through AQUA-132, effects on spawning, incubation, and rearing habitat conditions would be negatively affected, compared to CEQA baseline. However, this would not in itself result in a significant impact on green sturgeon, if adjusted to exclude sea level rise and climate change. In addition, entrainment effects would likely be beneficial. Therefore, the overall effect would be less than significant, and no mitigation would be needed.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects of the restoration and conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-144) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: As described in Alternative 1A, these impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144), and no mitigation is required.

White Sturgeon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on white sturgeon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on white sturgeon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-145 and Impact AQUA-146), the effects described for white sturgeon under Alternative 1A also appropriately characterize effects for white sturgeon under Alternative 6B.

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental commitments and mitigation measures would be available to avoid and minimize potential effects, so the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the impact of the construction and maintenance of water conveyance facilities on white sturgeon would be less than 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.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on white sturgeon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impacts AQUA-147 through AQUA-150), the effects described for white sturgeon also appropriately characterize the effects under Alternative 6B.

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

NEPA Effects: The effect on entrainment and entrainment-related predation under Alternative 6B would be beneficial to the species, because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities. In general, Alternative 6B would not be adverse to spawning, egg incubation, or rearing habitat for white sturgeon relative to NAA. However, there is scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and high river/Delta flow, which could be affected by Alternative 6B operations. These uncertainties will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations find that the positive correlation is related to in-Delta and through-Delta flow conditions, then Alternative 6B would be deemed adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 6B as compared to NAA. However, adaptive management procedures would be implemented to meet the biological goals and objectives.

CEQA Conclusion: The impact and conclusion for entrainment are the same as described immediately above, and would be mostly beneficial, due to elimination of entrainment losses at the south Delta diversions. Collectively, the results of the Impact AQUA-149 and AQUA-150 analyses indicate that the difference between the CEQA baseline and Alternative 6B could be significant, but the differences would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6B, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would be less than significant. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. This impact is found to be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects of these measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-162) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: The restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: The restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is required.

Pacific Lamprey

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on Pacific lamprey would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on Pacific lamprey would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-163 and Impact AQUA-164), the effects described for Pacific lamprey under Alternative 1A also appropriately characterize effects for Pacific lamprey under Alternative 6B.

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less than 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on Pacific lamprey would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-165 and Impact AQUA-168), the effects described for Pacific lamprey under Alternative 6A also appropriately characterize effects for Pacific lamprey under Alternative 6B.

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for Pacific Lamprey

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

NEPA Effects: As discussed in detail for Alternative 6A, entrainment and entrainment-related predation on Pacific lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6B would not be adverse because it would not substantially reduce suitable spawning habitat, or substantially interfere with the movement of fish. In addition, the effects would not increase egg or ammocoete mortality. As a result, the overall effects would not be adverse.

CEQA Conclusion: As described in detail under Alternative 6A, while entrainment effects are likely to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and Alternative 6A could be significant, contrary to the NEPA conclusion set forth above, due to reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate change, Alternative 6B would be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects of these measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-180) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: As discussed in detail for Alternative 1A and 6A, the restoration and conservation measure impact mechanisms (Impact AQUA-169 through AQUA-180) have been determined to range from no effect, to not adverse, or beneficial to Pacific lamprey for NEPA purposes. Therefore, the effect would not be adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant under Alternative 6B, and no mitigation would be required.

River Lamprey

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on river lamprey would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on river lamprey would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-181 and Impact AQUA-182), the fish effects described for river lamprey under Alternative 1A also appropriately characterize effects for river lamprey under Alternative 6B.

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact of the construction and maintenance of water conveyance facilities on river lamprey would be less than 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on river lamprey would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-183 through Impact AQUA-186). Therefore, the effects described for river lamprey under Alternative 6A also appropriately characterize effects under Alternative 6B.

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

NEPA Effects: As discussed in detail for Alternative 6A, entrainment and entrainment-related predation on river lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6B would not be adverse because it would not substantially reduce suitable spawning or rearing habitat, and would not increase egg or ammocoete mortality. The water operations would also not substantially interfere with the movement of fish. As a result, the overall effects would not be adverse.

CEQA Conclusion: As described in detail under Alternative 6A, while entrainment effects are likely to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and Alternative 6A could be significant, contrary to the NEPA conclusion set forth above, due to reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate change, Alternative 6B would be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects of these measures described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, the restoration and conservation measure impact mechanisms (Impact AQUA-187 through AQUA-198) have been determined to range from no effect, to not adverse, or beneficial to river lamprey for NEPA purposes.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Non-Covered Aquatic Species of Primary Management Concern

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on non-covered species of primary concern would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on non-covered species would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A (Impact AQUA-199 and Impact AQUA-200), the effects described for non-covered aquatic species of primary management concern under Alternative 1A also appropriately characterize effects for non-covered aquatic species of primary management concern under Alternative 6B.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the impact of the construction and maintenance of water conveyance facilities on non-covered aquatic species of primary management concern would be less than significant except potentially 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on non-covered species would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-201 through Impact AQUA-204), the effects described for non-covered aquatic species of primary management concern under Alternative 6A also appropriately characterize effects for non-covered aquatic species of primary management concern under Alternative 6B.

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: These impact mechanisms would not be adverse to the non-covered species of primary management concern, and with the implementation of environmental commitments and conservation measures, the effects would typically be beneficial to non-covered fish species of primary management concern.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, most of these impact mechanisms would be beneficial or less than significant, although Impact AQUA-203 and AQUA-204 could result in significant, but unavoidable effects on rearing habitat and migration habitat conditions for several fish species of primary management concern. These species include largemouth bass, Sacramento-San Joaquin roach, and hardhead. There are also no feasible mitigation measures available to mitigate for these impacts. The other impact mechanisms would be less than significant, or beneficial, so no additional mitigation would be required.

Restoration and Conservation Measures

Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A, the effects of these measures described for non-covered aquatic species of primary management concern under Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize effects under Alternative 6B.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6B.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

NEPA Effects: As discussed in detail under Alternative 1A and 6A, these impact mechanisms would not be adverse, and would typically be beneficial to non-covered fish species of primary management concern.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, Impact AQUA-217 would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6B would not be substantially reduced when compared to the No Action Alternative.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 6B would reduce the quantity of coldwater fish habitat in the CVP and SWP. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6B does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 6B, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.13 Alternative 6C—Isolated Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario D)

Construction impacts from Alternative 6C would be the same as those discussed for Alternative 1C. Like Alternative 1C, Alternative 6C would convey water from five fish-screened intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through a tunnel and two large canal segments to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, like Alternatives 6A and 6B, Alternative 6C would be an isolated conveyance, no longer involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant. Other than the isolated conveyance, the culvert siphons, and the number of barge landings, the physical and structural components would be similar to those under Alternative 1C. 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 as Scenario D. However, Alternative 6C has the same diversion and conveyance operations as Alternative 1A; consequently, the analysis under Alternative 1A is applicable to Alternative 6C.

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 6C.

Delta Smelt

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on delta smelt or designated critical habitat would be similar to those described under Alternative 1A (Impact AQUA-1 and AQUA-2) because no differences in fish or habitat effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A. The effects described for delta smelt and critical habitat under Alternative 1A also appropriately characterize effects under Alternative 6C.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-1 and Impact AQUA-2, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or designated critical habitat.

CEQA Conclusion: As described in Impact AQUA-1 and Impact AQUA-2 under Alternative 1A for delta smelt, the impact of the construction and maintenance 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.

Water Operations of CM1

Alternative 6C has the same diversion and conveyance operations as Alternative 6A. The primary difference between the two alternatives is that conveyance under Alternative 6C would be in a lined or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity or operations, there would be no differences between these two alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 6A (Impact AQUA-3 through Impact AQUA-6), the fish effects described for Alternative 6A also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 6A that are identical for Alternative 6C.

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: With the exception of Impact AQUA-5, the other impact mechanisms listed above, would be beneficial or not adverse to delta smelt under Alternative 6C, including beneficial effects of Impact AQUA-3 and AQUA-4. This is the same conclusion as described in detail under Alternative 6A, and is based on the expected overall limited or slightly beneficial impacts. However, the overall effect of Impact AQUA-5 on delta smelt rearing habitat would remain adverse because there likely would still be a loss of suitable habitat even with BDCP restoration efforts (see Alternative 1A, AQUA-5 for details on expected effects).

CEQA Conclusion: The effects of three of the above listed impact mechanisms would be less than significant, or slightly beneficial to delta smelt, and no mitigation would be required. In addition, the effects of Impact AQUA-5 would also be considered less than significant, because it would not substantially reduce rearing habitat. Therefore, no mitigation would be required for any of the impact mechanisms listed above. Detailed discussions regarding these conclusions are presented in Alternative 6A.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A, the effects described for Alternative 1A (Impact AQUA-7 through Impact AQUA-18) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: As described in detail under Alternative 1A, none of these impact mechanisms (Impact AQUA-7 through AQUA-18) would be adverse to delta smelt, and most would be at least slightly beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Longfin Smelt

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on longfin smelt would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on longfin smelt would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-19 and Impact AQUA-20), the effects described for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 6C.

The following impacts on longfin smelt are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: These impact mechanisms would not be adverse to longfin smelt. While construction activities (Impact AQUA-19) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternatives 1A and 6A, Impact AQUA-19 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on longfin smelt would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment for Impact AQUA-21 through AQUA-24, the effects described for longfin smelt under Alternatives 6A also appropriately characterize effects under Alternative 6C.

Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt

Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt

NEPA Effects: The potential effects of water operations on longfin smelt under Alternative 6C would be similar to those described above under Alternative 6A. As discussed under Alternative 6A, the effects on longfin smelt from Impact AQUA-22 could be an adverse effect. Despite a growing body of evidence supporting a positive correlation between longfin smelt abundance and spring outflow, the specific timing and amount of outflow needed to conserve longfin smelt is less clear, especially in light of potential increases in food resources in the Plan Area and other benefits to spawning and rearing habitat. Therefore, the implementation of adaptive management procedures under Alternative 6C, that could be used to adjust spring operations, is expected to reduce potential effects to not be adverse. These adaptive management procedures are described in Mitigation Measures 22a through 22c, under Alternative 1A.

CEQA Conclusion: As described above under Alternatives 1A and 6A, water operations under Alternative 6C would generally reduce the quantity and quality of longfin smelt rearing habitat relative to Existing Conditions. The results also indicate that the difference in rearing habitat could be significant because Delta outflows would be reduced in the spring, which would have the potential to contribute to substantial reductions in longfin smelt abundances. These effects are due to the specific reservoir operations and resulting flows associated with this alternative. However, the implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced larval entrainment would reduce this impact to less than significant, so no additional mitigation would be required.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Spawning and Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on longfin smelt would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 6C.

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these impact mechanisms have been determined to range from no effect, to not adverse, or beneficial to longfin smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Winter-Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on winter-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on winter-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-37 and Impact AQUA-38), the effects described for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6C.

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: These impact mechanisms would not be adverse to winter-run Chinook salmon. While construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, Impact AQUA-37 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on winter-run Chinook salmon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impacts AQUA-39 through AQUA-42), the effects described for winter-run Chinook salmon also appropriately characterize the effects under Alternative 6C.

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU) Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Winter-Run ESU)

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

NEPA Effects: As discussed for Alternative 6A, with the exception of Impact AQUA-42, the impact mechanisms listed above would not be adverse to winter-run Chinook salmon under Alternative 6C. However, Alternative 6C would be adverse to migration conditions for winter-run Chinook salmon. While the implementation of applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as described in Chapter 3 (Section 3.6), would minimize potential effects, the effect would remain adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 6A, Impact AQUA-42 would result in significant effects on migration conditions. While the implementation of applicable conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as described in Chapter 3 (Section 3.6) would minimize potential effects, the effect would remain significant and unavoidable.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on winter-run Chinook salmon would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects described for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6C.

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, the impact mechanisms listed above would not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be less than significant, or beneficial, so no additional mitigation would be required.

Spring-Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on spring-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on spring-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-55 and Impact AQUA-56). The fish effects described for spring-run Chinook salmon under Alternative 1A also appropriately characterize effects for spring-run Chinook salmon under Alternative 6C.

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: These impact mechanisms would not be adverse to spring-run Chinook salmon. While construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on spring-run Chinook salmon would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to Alternative 6A (Impact AQUA-57 through AQUA-60), the effects described for spring-run Chinook salmon under Alternatives 6A also appropriately characterize effects under Alternative 6C.

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

NEPA Effects: As discussed in detail for Alternative 6A, the impact mechanisms listed above would range from beneficial to adverse under Alternative 6C for spring-run Chinook salmon. Adverse effects would occur because migration conditions would be substantially reduced, and because it has the potential to substantially increase predation, and remove important instream habitat as the result of the presence of five north Delta intake structures. While the implementation of the conservation and mitigation listed below, would reduce potential effects, the effect would likely remain adverse.

CEQA Conclusion: As discussed in detail for Alternative 6A, the effects of the impact mechanisms listed above would range from beneficial to significant under Alternative 6C for spring-run Chinook salmon. Impact AQUA-60 would result in significant effects on migration conditions. Implementation of CM6, *Channel Margin Enhancement* (Chapter 3, Section 3.6.2.5) and CM15, *Localized Reduction of Predatory Fishes* (Chapter 3, Section 3.6.3.4) would address these impacts, but are not anticipated to reduce them to a level considered less than significant.

Applicable conservation measures are briefly described below and full descriptions are found in Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15).

> **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

> **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"), including the NDD intakes. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness.

In addition to these conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact, although the effect would still likely remain significant and unavoidable. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for spring-run Chinook salmon.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on spring-run Chinook salmon would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects under Alternative 6C.

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: As discussed for Alternative 1A and 6A, the other impact mechanisms would not be adverse, and with the implementation of environmental commitments and conservation measures, the effects would typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Fall-/Late Fall–Run Chinook Salmon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on fall- and late fall-run Chinook salmon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on fall- and late fall-run Chinook salmon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-73 and Impact AQUA-74), the fish effects described for fall- and late fall-run Chinook salmon under Alternative 1A also appropriately characterize effects for fall- and late fall-run Chinook salmon under Alternative 6C.

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-73 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on fall- and late fall-run Chinook salmon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impacts AQUA-75 through AQUA-78), the effects described for fall- and late fall-run Chinook salmon also appropriately characterize the effects for Alternative 6C.

Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Overall, the effects of water operations vary by location. Similar to effects described in detail under Alternative 6A, Alternative 6C would have an adverse effect on fall-/late fall-run Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-delta conditions on the Sacramento River would substantially affect migration conditions relative to NAA while through-Delta conditions on the San Joaquin River would be positive. The implementation of the conservation and mitigation measures listed below, would reduce the overall effects, but the they would still likely remain adverse.

CEQA Conclusion: The results of the Impact AQUA-78 CEQA analysis indicate differences between the CEQA baseline and Alternative 6C depending on location. Through-Delta conditions on the Sacramento River would substantially impact migration conditions relative to Existing Conditions while through-Delta conditions on the San Joaquin River would be positive. Implementation of *CM6 Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory Fishes (Predator Control)* would address habitat and predation losses, therefore, would potentially minimize impacts to some extent, but not to a less than significant level.

CM6 Channel Margin Enhancement. CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

CM15 Localized Reduction of Predatory Fishes (Predator Control). CM15 would seek to reduce populations of predatory fishes at specific locations or modify holding habitat at selected locations of high predation risk (i.e., predation "hotspots"), including the NDD intakes. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness.

As with the conservation measures, the implementation of the mitigation measures listed below also has the potential to reduce the severity of the impact though not necessarily to a less-than-significant level. These mitigation measures would provide an adaptive management process, that 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), for assessing impacts and developing appropriate minimization measures.

Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall–Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall–Run Chinook Salmon Migration Conditions Consistent with CM1

Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for fall/late fall-run Chinook salmon.

Restoration and Conservation Measures

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, these restoration and conservation commitment impact mechanisms (Impact AQUA-79 through AQUA-90),would not be adverse, and would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Steelhead

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on steelhead would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on steelhead would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-91 and Impact AQUA-92), the fish effects described for steelhead under Alternative 1A also appropriately characterize effects for steelhead under Alternative 6C.

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

NEPA Effects: These impact mechanisms would typically not be adverse to steelhead. While construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-91 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts 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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of` water conveyance facility operations on steelhead would be similar to those described above under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impact AQUA-93 through AQUA-96), the fish effects described for steelhead under Alternative 6A also appropriately characterize effects under Alternative 6C.

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

NEPA Effects: As described in detail under Alternative 6A, these impact mechanisms would result in variable effects on steelhead, but the effects would not result in biologically meaningful reductions in overall survival of steelhead. Therefore, the effects would not be adverse to steelhead under Alternative 6C.

CEQA Conclusion: Collectively, the analysis indicates that the difference between the CEQA baseline and Alternative 6C could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with steelhead migrations in some areas. Alternative 6C would also negatively affect juvenile and adult migration conditions in some areas. Despite the variability in effects of Alternative 6C, if adjusted to exclude sea level rise and climate change, the alternative would not in itself result in a significant impact on steelhead.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on steelhead would be similar to those described under Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C, compared to those described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the fish effects described for steelhead also appropriately characterize the effects under Alternative 6C.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: As discussed for Alternative 1A and 6A, the other impact mechanisms would not be adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Sacramento Splittail

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on Sacramento splittail would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on Sacramento splittail would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-109 and Impact AQUA-110). The fish effects described for Sacramento splittail under Alternative 1A also appropriately characterize effects for Sacramento splittail under Alternative 6C.

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: These impact mechanisms would generally not be adverse to Sacramento splittail. While construction activities (Impact AQUA-109) could result in adverse effects from impact pile driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-109 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no additional mitigation would be required.

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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of water conveyance facility operations on Sacramento splittail would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C, compared to those described in detail for Alternative 6A (Impacts AQUA-111 through AQUA-114), the fish effects described would also appropriately characterize the effects under Alternative 6C.

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

NEPA Effects: As discussed in detail for Alternative 6A, the operations impact mechanisms would not be adverse to Sacramento splittail.

CEQA Conclusion: Similar to the discussion provided above for Alternative 6A, these impact mechanisms would be less than significant, and no mitigation would be required.

Restoration and Conservation Measures

The potential effects of restoration measures and other conservation measures on Sacramento splittail would be similar to those described for Alternative 1A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126), the fish effects described also appropriately characterize the effects under Alternative 6C.

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: As discussed for Alternative 1A, the restoration and conservation impact mechanisms would not be adverse, and would typically be beneficial to Sacramento splittail. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, the restoration and conservation measures impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Green Sturgeon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on green sturgeon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on green sturgeon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-127 and Impact AQUA-128). Overall, the fish effects described for green sturgeon under Alternative 1A also appropriately characterize effects for green sturgeon under Alternative 6C.

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon

NEPA Effects: While the maintenance impact mechanism (Impact AQUA-128) would not be adverse to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, Impact AQUA-127 could result in significant underwater noise effects from impact pile driving, although implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of impacts to less than significant. The other impact mechanism would be less than significant, so no additional mitigation would be required.

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 Impact AQUA-1 in delta smelt.

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 delta smelt.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on green sturgeon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impacts AQUA-129 through AQUA-132), the effects described for green sturgeon also appropriately characterize the effects under Alternative 6C.

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

NEPA Effects: As discussed for Alternative 6A, Impact AQUA-129 would be beneficial for green sturgeon because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities. As discussed for Alternative 6A, Impact AQUA-130 and AQUA-132 are expected to negatively affect green sturgeon spawning and rearing habitat conditions under Alternative 6C. These effects are a result of the specific reservoir operations and resulting flows associated with this alternative. However, as discussed for Alternative 6A, the overall effect would not be adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 6A, Impact AQUA-130 through AQUA-132, effects on spawning, incubation, and rearing habitat conditions would be negatively affected, compared to Existing Conditions. However, this would not in itself result in a significant impact on green sturgeon, if adjusted to exclude sea level rise and climate change. In addition, entrainment effects would likely be beneficial. Therefore, the overall effect would be less than significant, and no mitigation would be needed.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A, the effects of the restoration and conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-144) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: As described in Alternative 1A, these impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: These impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144), and no mitigation is required.

White Sturgeon

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on white sturgeon would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on white sturgeon would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-145 and Impact AQUA-146), the fish effects described for white sturgeon under Alternative 1A also appropriately characterize effects for white sturgeon under Alternative 6C.

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental commitments and mitigation measures would be available to avoid and minimize potential effects, so the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the impact of the construction and maintenance of water conveyance facilities on white sturgeon would be less than 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.

Water Operations of CM1

The potential effects of operations of water conveyance facilities on white sturgeon would be similar to those described for Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impacts AQUA-147 through AQUA-150), the effects described for white sturgeon also appropriately characterize the effects under Alternative 6C.

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

NEPA Effects: As discussed for Alternative 6A, Impact AQUA-147 would be beneficial for white sturgeon because of the elimination of entrainment and entrainment-related predation loss at the south Delta facilities. As described in detail under Alternative 6A, the effects of water operations on white sturgeon would not be adverse. However, uncertainty regarding the mechanisms responsible for the positive correlation between year class strength and high river/Delta flow would be addressed through targeted research and monitoring, prior to the initiation of north Delta facilities operations. If these targeted investigations determine that Alternative 6C operations are likely to be adverse, adaptive management procedures would be implemented to meet the biological goals and objectives.

CEQA Conclusion: The impact and conclusion for entrainment are the same as described immediately above, and would be mostly beneficial, due to elimination of entrainment losses at the south Delta diversions. Collectively, the results of the Impact AQUA-149 and AQUA-150 analyses indicate that the difference between the CEQA baseline and Alternative 6C could be significant, but the differences would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 6C, if adjusted to exclude sea level rise and climate change would be less than significant. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. Therefore, these impact measures would be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C, compared to those described in detail for Alternative 1A, the effects of these measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-162) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: The restoration and conservation measure impact mechanisms have been determined to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: The restoration and conservation measure impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is required.

Pacific Lamprey

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on Pacific lamprey would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on Pacific lamprey would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-163 and Impact AQUA-164), the fish effects described for Pacific lamprey under Alternative 1A also appropriately characterize effects for Pacific lamprey under Alternative 6C.

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less than 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on Pacific lamprey would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impact AQUA-165 and Impact AQUA-168), the effects described for Pacific lamprey under Alternative 6A also appropriately characterize effects for Pacific lamprey under Alternative 6C.

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for Pacific Lamprey

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

NEPA Effects: As discussed in detail for Alternative 6A, entrainment and entrainment-related predation on Pacific lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6C would not be adverse because it would not substantially reduce suitable spawning habitat, or substantially interfere with the movement of fish. In addition, the effects would not increase egg or ammocoete mortality. Therefore, the overall effects would not be adverse.

CEQA Conclusion: As described in detail under Alternative 6A, while entrainment effects are likely to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and Alternative 6C could be significant, contrary to the NEPA conclusion set forth above, due to reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate change, Alternative 6C would be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A, the effects of these measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-180) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: As discussed in detail for Alternatives 1A and 6A, the restoration and conservation measure impact mechanisms (Impact AQUA-169 through AQUA-180) have been determined to range from no effect, to not adverse, or beneficial to Pacific lamprey for NEPA purposes. Therefore, the effect would not be adverse.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these impact mechanisms would be beneficial or less than significant under Alternative 6C, and no mitigation would be required.

River Lamprey

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on river lamprey would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on river lamprey would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-181 and Impact AQUA-182). As a result, the fish effects described for river lamprey under Alternative 1A also appropriately characterize effects for river lamprey under Alternative 6C.

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact of the construction and maintenance of water conveyance facilities on river lamprey would be less than 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on river lamprey would be similar to those described under Alternative 6A. Because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C, compared to those described in detail for Alternative 6A (Impact AQUA-183 through Impact AQUA-186). Therefore, the effects described for river lamprey under Alternative 6A also appropriately characterize effects under Alternative 6C.

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

NEPA Effects: As discussed in detail for Alternative 6A, entrainment and entrainment-related predation on river lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6C would not be adverse because it would not substantially reduce suitable spawning or rearing habitat, and would not increase egg or ammocoete mortality. The water operations would also not substantially interfere with the movement of fish. As a result, the overall effects would not be adverse.

CEQA Conclusion: As described in detail under Alternative 6A, while entrainment effects are likely to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and Alternative 6C could be significant, contrary to the NEPA conclusion set forth above, due to reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate change, Alternative 6C would be less than significant and no mitigation is required.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A, the effects of the measures described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: As discussed in detail for Alternative 1A, these restoration and conservation measure impact mechanisms (Impact AQUA-187 through AQUA-198) have been determined to range from no effect, to not adverse, or beneficial to river lamprey for NEPA purposes.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A, these restoration and conservation measure impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Non-Covered Aquatic Species of Primary Management Concern

The potential effects of construction and maintenance of water conveyance facilities, operations of water conveyance facilities, restoration measures and other conservation measures on non-covered species would be similar to those described under Alternative 1A.

Construction and Maintenance of CM1

The potential effects of construction and maintenance activities on non-covered species of primary concern would be similar to those described under Alternative 1A because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A (Impact AQUA-199 and Impact AQUA-200), the effects described for non-covered aquatic species of primary management concern under Alternative 1A also appropriately characterize effects for non-covered aquatic species of primary management concern under Alternative 6C.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the impact of the construction and maintenance of water conveyance facilities on non-covered aquatic species of primary management concern would be less than significant except potentially 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.

Water Operations of CM1

The potential effects of water conveyance facility operations on non-covered species would be similar to those described under Alternative 6A, because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 6A (Impact AQUA-201 through Impact AQUA-204), the effects described for non-covered aquatic species of primary management concern under Alternative 6A also appropriately characterize effects for non-covered aquatic species of primary management concern under Alternative 6C.

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: These impact mechanisms would not be adverse to the non-covered species of primary management concern, and with the implementation of environmental commitments and conservation measures, the effects would typically be beneficial.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, most of these impact mechanisms would be beneficial or less than significant. However, Impact AQUA-203 and AQUA-204 could result in significant, but unavoidable effects on rearing habitat and migration habitat conditions for several fish species of primary management concern. These species include largemouth bass, Sacramento-San Joaquin roach, and hardhead. There are also no feasible mitigation measures available to mitigate for these impacts. The other impact mechanisms would be less than significant, or beneficial, so no additional mitigation would be required.

Restoration and Conservation Measures

Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no substantial differences in fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A, the effects of these measures described for non-covered aquatic species of primary management concern under Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize effects under Alternative 6C.

The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

NEPA Effects: As discussed in detail under Alternative 1A and 6A, these restoration and conservation measure impact mechanisms would not be adverse, and would typically be beneficial to non-covered fish species of primary management concern.

CEQA Conclusion: Similar to the discussion provided above for Alternative 1A and 6A, these restoration and conservation measure impact mechanisms would be beneficial or less than significant, and no mitigation would be required.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, Impact AQUA-217 would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6C would not be substantially reduced when compared to the No Action Alternative.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 6C would reduce the quantity of coldwater fish habitat in the CVP and SWP. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 6C does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 6C, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.14 Alternative 7—Dual Conveyance with Tunnel, Intakes 2, 3, and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational Scenario E)

Alternative 7 is the same as Alternative 1A except that it involves Intakes 2, 3, and 5 instead of Intakes 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would divert up to 15,000 cfs and uses Operational Scenario A, Alternative 7 would divert up to 9,000 cfs and uses Operational Scenario E. The dimensions of the intakes are in Table 11-5 Alternative 7 has Enhanced Aquatic Conservation which would enhance 20,000 acres of floodplain habitat versus 10,000 acres for Alternative 1A. A total of 40 linear miles of channel margin habitat would be enhanced under Alternative 7 instead of 20 linear miles for Alternative 1A. Alternative 7 has the same six barge facilities as Alternative 1A.

Delta Smelt

Construction and Maintenance of CM1

Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June during construction of intake facilities. Small numbers of delta smelt eggs and larvae could also be present in June or July during construction of the barge landings in the east Delta and south Delta (see Table 11-6). Very low delta smelt abundance would be expected in the south Delta near the southern barge landings during the in-water construction period. The construction and maintenance sites also occur entirely within designated critical habitat for delta smelt.

Construction impacts on delta smelt and critical habitat would be as described for Alternative 1A (Impact AQUA-1) except that Alternative 7 would include only Intakes 2, 3, and 5. Therefore, no impacts would occur at the locations of Intakes 1 and 4 that are proposed under Alternative 1A.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

The potential effects of construction of the water conveyance facilities on delta smelt or critical habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or their critical habitat.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-1, the impact of the construction of water conveyance facilities on delta smelt or critical habitat would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-2) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for delta smelt or critical habitat.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the maintenance of water conveyance facilities on delta smelt or critical habitat would be less than significant and no mitigation would be required.

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Water Exports from SWP/CVP South Delta Facilities

Overall, operational activities under Alternative 7 would benefit delta smelt by substantially reducing proportional entrainment losses of larvae/juveniles and adults at the south Delta facilities (Figure 11-7-1 and 11-7-2). Average larval/juvenile proportional entrainment across all years under Alternative 7 (about 0.09, or 9% of the juvenile population) would be 0.15 less (about 15% of the population) than under NAA, representing a 36% relative decrease (Figure 11-7-1, Table 11-7-1). Average adult proportional entrainment would be approximately 0.072 (7.2% of the population) across all water years, which would be 0.028 less (2.8% of adult population) compared to NAA, a 38% relative decrease (Figure 11-7-2, Table 11-7-1). Combined Juvenile and adult delta smelt average proportional entrainment would be reduced by 0.081 (8.1% of the population, a 36% relative decrease compared to NAA) (Table 11-7-1).

Table 11-7-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities for Alternative 7

	Proportional Entrainment[a] Difference in Proportions (Relative Change in Proportions)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Total Population		
Wet	-0.030 (-27%)	-0.055 (-41%)
Above Normal	-0.064 (-39%)	-0.091 (-48%)
Below Normal	-0.068 (-31%)	-0.098 (-39%)
Dry	-0.078 (-29%)	-0.096 (-34%)
Critical	-0.082 (-26%)	-0.081 (-25%)
All Years	-0.059 (-30%)	-0.081 (-36%)
Juvenile Delta Smelt (March–June)		
Wet	-0.006 (-16%)	-0.032 (-50%)
Above Normal	-0.030 (-37%)	-0.059 (-54%)
Below Normal	-0.033 (-24%)	-0.065 (-38%)
Dry	-0.043 (-24%)	-0.064 (-31%)
Critical	-0.053 (-22%)	-0.058 (-23%)
All Years	-0.029 (-24%)	-0.052 (-36%)
Adult Delta Smelt[b] (December–March)		
Wet	-0.024 (-34%)	-0.023 (-33%)
Above Normal	-0.033 (-42%)	-0.032 (-41%)
Below Normal	-0.035 (-43%)	-0.033 (-41%)
Dry	-0.034 (-42%)	-0.033 (-41%)
Critical	-0.029 (-38%)	-0.023 (-33%)
All Years	-0.030 (-39%)	-0.028 (-38%)

Note: Negative values indicate lower entrainment loss under Alternative than under Existing Conditions.
[a] Proportional entrainment index calculated in accordance with UFWS BiOp (U.S. Fish and Wildlife Service 2008a).
[b] Adult proportional entrainment adjusted according to Kimmerer (2011).

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes. Potential entrainment and impingement would be limited since delta smelt rarely occur in the vicinity of the proposed intake site. The intake would be screened to exclude fish larger than 15mm SL. Alternative 7 would have only three intakes, compared to five intakes for Alternative 1A, and therefore potential entrainment and impingement risks would be even lower.

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 models was low, averaging 1.6% under Alternative 7 compared to 2.0% under NAA, or 22% lower in relative terms (Table 11-7-2).

Tidal habitat restoration under CM4 would potentially result in the decommissioning of more than 12% of Plan Area agricultural diversions. Particle entrainment under Alternative 7 would be sometimes slightly increased (0.73%, n=6 for NAA) and sometimes reduced (~0.8%, n=11 runs for NAA) compared to baseline conditions, but the difference was negligible (Table 11-7-2).

Table 11-7-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 7 and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A7_LLT	A7_LLT vs. EXISTING CONDITIONS	A7_LLT vs. NAA
2.1	2.0	1.6	-0.55 (-26%)	-0.45 (-22%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

Predation Associated with Entrainment

Because proportional entrainment of combined juvenile and adult delta smelt would be reduced under Alternative 7 (36% relative decrease compared to NAA), predation loss would also be reduced concomitantly. Predation loss at the proposed north Delta intakes would be limited because few delta smelt occur that far upstream.

NEPA Effects: Under Alternative 7 overall potential entrainment of delta smelt would be reduced at the south Delta SWP/CVP facilities and the NBA. 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, Alternative 7 would benefit delta smelt due to a reduction in entrainment and associated predation losses at the south Delta facilities and minimizing entrainment at the north Delta facilities and NBA intakes. The impact on delta smelt is considered to be beneficial.

CEQA Conclusion: As described above, Alternative 7 would result in an overall reduction of entrainment as a whole compared to Existing Conditions. At the south Delta facilities, proportional entrainment of juvenile and adult delta smelt would be substantially reduced (Table 11-7-1, Figures 11-7-1 and 11-7-2) due to substantial reductions in water exports from the south Delta. Proportional entrainment averaged across years would be reduced by 0.030 for adults (i.e., 3% of population, a 39% relative decrease) and reduced by 0.029 for juveniles (a 24% relative decrease) compared to Existing Conditions (Table 11-7-1). The risk of entrainment and impingement at the proposed north Delta intake facilities due to low abundances of delta smelt in the vicinity, and would be minimized by state-of-the-art screens. Potential entrainment of larvae is low under Existing Conditions and under Alternative 7 would be slightly reduced (<1%) at the NBA and changed negligibly (<0.5%) at agricultural diversions compared to Existing Conditions (Table 11-7-2). Overall, Alternative 7 would benefit delta smelt due to a substantial reduction in entrainment and associated predation losses at the south Delta facilities and minimizing entrainment at the north Delta facilities and NBA intakes. The impact is considered to be beneficial.

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

The effects of operations under Alternative 7 on abiotic spawning habitat would be the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning timing, would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes.

NEPA Effects: The effect of Alternative 7 operations on spawning would not be adverse, because there would be little change in abiotic spawning conditions for delta smelt.

CEQA Conclusion: As described above, operations under Alternative 7 would not reduce abiotic spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

As described for other Alternatives (Impact AQUA-5 for delta smelt), rearing habitat conditions for juvenile delta smelt are considered with respect to an abiotic habitat index (Feyrer et al. 2011) with and without the assumption that BDCP habitat restoration benefits are realized.

NEPA Effects: The average abiotic habitat index across all water years would increased13% under Alternative 7 without restoration compared to NAA (Table 11-7-3). There would be substantial increases in the abiotic habitat index in below normal and dry years (25–29% increase) compared to NAA.

Alternative 7 would further benefit delta smelt by habitat restoration (CMs 2 and 4), particularly in the Suisun Marsh, West Delta, and Cache Slough ROAs which are closer to delta smelt's main range. Habitat restoration, similar in scale to Alternative 1A, has the potential to increase spawning and rearing habitat and supplement food production and export to rearing areas. With habitat restoration, Alternative 7 flows could result in a 44% increase in the abiotic habitat index compared to NAA when all water years are averaged. The abiotic habitat index would be increased greatest in below normal and dry years, increasing 59–64% compared to NAA. These overall effects would be due to the inundation of new areas of the Delta resulting from habitat restoration effects; it is assumed that 100% of the newly restored habitat would be utilized by delta smelt. However, because delta smelt are a pelagic species, the actual proportional use would likely be lower.

CEQA Conclusion: Without BDCP habitat restoration efforts, delta smelt fall abiotic habitat index would increase by 38% when compared to Existing Conditions, which do not include Fall X2 criteria. The abiotic habitat index would increase in all water years under Alternative 7 flows, even without habitat restoration. As described above, habitat restoration under Alternative 7 could further increase the delta smelt fall abiotic habitat index, resulting in an estimated 76% increase in habitat relative to Existing Conditions when averaged for all water years (Figure 11-7-3). The impact on delta smelt rearing habitat would be beneficial, because fall abiotic habitat would be increased substantially even without habitat restoration actions.

Table 11-7-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 7 and Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type

	Without Restoration		With Restoration	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT	vs. A7_LLT	NAA vs. A7_LLT
All	1,525 (38%)	639 (13%)	3,037 (76%)	2,152 (44%)
Wet	2,590 (55%)	394 (6%)	4,611 (98%)	2,415 (35%)
Above Normal	2,227 (58%)	559 (10%)	3,870 (101%)	2,202 (40%)
Below Normal	832 (20%)	980 (25%)	2,201 (53%)	2,350 (59%)
Dry	909 (25%)	1,001 (29%)	2,138 (60%)	2,230 (64%)
Critical	303 (10%)	303 (10%)	1,189 (40%)	1,188 (40%)

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: The effects of operations under Alternative 7 on migration conditions would be the same as described for Alternative 1A (Impact AQUA-6). Alternative 7 would not affect the first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta water temperatures would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes under BDCP operations.

As described for other Alternatives, Alternative 7 may decrease sediment supply to the estuary by 8 to 9 percent, with the potential for decreased habitat suitability for delta smelt in some locations.

CEQA Conclusion: As described above, operations under Alternative 7 would not substantially alter the turbidity cues associated with winter flush events that may initiate migration, nor would there be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt migration conditions would be less than significant, and no mitigation would be required.

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

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-7). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-7, restoration construction activities are not expected to adversely affect delta smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-7 for delta smelt, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-8). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-8, contaminants associated with restoration measures are not expected to adversely affect delta smelt with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-8 for delta smelt, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-9). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As discussed in Alternative 1A, Impact AQUA-9 for delta smelt, CM5 is not expected to have any effects on delta smelt, while CM6 may provide some benefits. As concluded in Alternative 1A, Impact AQUA-9, restored habitat conditions are expected to be beneficial for delta smelt and the additional CM6 restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-9 for delta smelt, the potential impact of restored habitat conditions on delta smelt is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on delta smelt are the same as those described under Alternative 1A (Impact AQUA-10 through 18). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Longfin Smelt

Construction and Maintenance of CM1

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

The potential effects of construction of the water conveyance facilities on longfin smelt would be similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-19, the impact of the construction of water conveyance facilities on longfin smelt would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-20) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-20, the impact 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 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

Potential entrainment risk for larval longfin smelt, as simulated by mean percent particles entrained at the south Delta diversions, was 0% under Alternative 7, compared to 2.2 for NAA (Table 11-7-4). Entrainment risk of larval longfin smelt to the south Delta facilities is expected to be minimal under Alternative 7.

Table 11-7-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 7 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Starting Distribution	EXISTING CONDITIONS	NAA	A7_LLT	A7_LLT vs. EXISTING CONDITIONS	A7_LLT vs. NAA
Wetter	1.9	1.6	0.0	-1.88 (-100%)	-1.70 (-100%)
Drier	2.5	2.2	0.0	-2.51 (-100%)	-2.24 (-100%)

Longfin smelt entrainment at the south Delta SWP/CVP facilities would be reduced to negligible levels for juveniles (reduced 100%) and substantially reduced for adults (82% less) compared NAA (Table 11-7-5).

These entrainment reductions would be due to strict limits on south Delta pumping under Alternative 7, which would substantially reduce OMR reverse flows. From December through May, OMR flows would be strongly positive under Alternative 7 for all water year types, whereas baseline conditions typically would have negative flows in December to March (all water years), and sometimes April and May (drier water years).

Table 11-7-5. Longfin Smelt Entrainment Index[a] (March–June) at the SWP and CVP Salvage Facilities and Differences (Absolute and Percentage) between Model Scenarios

		Absolute Difference (Percent Difference)	
Life Stage	Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Juvenile (March–June)	Wet	-63,749 (-100%)	-69,191 (-100%)
	Above Normal	-4,521 (-100%)	-4,810 (-100%)
	Below Normal	-3,040 (-99%)	-3,249 (-99%)
	Dry	-529,626 (-100%)	-587,933 (-100%)
	Critical	-567,468 (-100%)	-493,597 (-100%)
	All Years	-267,511 (-100%)	-292,522 (-100%)
Adult (December–March)	Wet	-95 (-73%)	-98 (-74%)
	Above Normal	-508 (-78%)	-548 (-79%)
	Below Normal	-1,721 (-89%)	-1,644 (-88%)
	Dry	-1,171 (-98%)	-1,106 (-97%)
	Critical	-24,331 (-100%)	-22,198 (-100%)
	All Years	-2,964 (-82%)	-2,928 (-82%)
	Shading indicates entrainment increased 10% or more.		

[a] Estimated annual number of fish lost, based on normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed new north Delta intakes would increase entrainment potential in this area and locally attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species is only expected to occur occasionally in very low numbers this far upstream.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

For larval longfin smelt, entrainment risk was simulated using particle tracking modeling. Average entrainment loss as modeled by PTM under the wetter starting distribution was 0.14% under Alternative 7 compared to 0.08% under NAA, a 71% relative increase (Table 11-7-6). Under the drier starting distribution, average entrainment was 0.17% under Alternative 7 compared to 0.11% under NAA, a 62% increase in relative terms. Overall, entrainment of larval longfin smelt under Alternative 7 to the NBA is expected to be low and similar to NAA.

Table 11-7-6. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct under Alternative 7 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Distribution	EXISTING CONDITIONS	NAA	A7_LLT	A7_LLT vs. EXISTING CONDITIONS	A7_LLT vs. NAA
Wetter	0.20	0.08	0.14	-0.07 (-32.6%)	0.06 (70.8%)
Drier	0.25	0.11	0.17	-0.08 (-30.5%)	0.06 (61.5%)

In summation, under Alternative 7 entrainment of longfin smelt would be substantially reduced or eliminated at the SWP/CVP South Delta facilities, especially for juveniles longfin smelt. Longfin smelt entrainment to the NBA would also be reduced. Entrainment loss of longfin smelt at the proposed North Delta intakes would be rare since longfin smelt are not expected to occur in that area of the Sacramento River, and the intakes would be screened.

Predation Associated with Entrainment

Pre-screen losses of longfin smelt at the SWP/CVP facilities are believed to be high. Based on a study of tagged delta smelt (Castillo et al. 2012), over 90% of delta smelt entrained at CCF were presumed to be lost to predation prior to the screens. It is assumed that predation loss of longfin smelt would be similar based on their similar size, shape, and pelagic nature. Thus reduced entrainment of longfin smelt at the south Delta would also reduce predation loss. Predation loss of juveniles would be eliminated and predation loss of adults would also be substantially reduced (82% reduction). Predation loss at the proposed north Delta intakes would be limited because few longfin smelt occur that far upstream.

NEPA Effects: The impact and conclusion for the risk of entrainment and entrainment-related predation associated with the NPB structures would be the same as described for Alternative 1A.The effect under Alternative 7 would be beneficial because fewer longfin smelt would be lost to predation.

CEQA Conclusion: As described above, entrainment loss of longfin smelt should be avoided or substantially reduced under Alternative 7. Entrainment to the south Delta facilities under Alternative 7 would be nearly eliminated for juveniles and significantly reduced (82% less) for adults compared to Existing Conditions, with concomitant reduction in pre-screen losses due to predation at the facilities. Larval longfin smelt entrainment to the south delta facilities would be reduced under Alternative 7. Larval entrainment to the NBA would increase slightly compared to Existing Conditions, however total entrainment to that facility would affect less than 1% of the population.

Predation loss of juveniles at the south Delta facilities would be eliminated while predation loss of adult would be reduced by 82% compared to Existing Conditions. Little predation loss would occur at the SWP/CVP north Delta intakes because longfin smelt rarely occur in that vicinity.

In summary, the impact would be beneficial because of the substantial reduction in entrainment and entrainment-related predation loss; no mitigation would be required.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and Bay Midwater trawl data have been correlated to outflow (expressed as the location of X2) in the preceding winter and spring months, when spawning and rearing is occurring (January through June) (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer et al. (2009), reduced outflows in January through June have the potential to reduce longfin smelt abundance.

NEPA Effects: Average relative longfin smelt abundance would be 20% greater (based on Fall Midwater Trawl index estimates) to 25% greater (based on Bay Otter Trawl indices) under

Alternative 7 compared to NAA. The biggest increases occur in below normal (21–26% more), dry (30–37% more) and critical (46–58% more) water year types (Table 11-7-7).

Rearing conditions for larval and juvenile longfin smelt can also be analyzed by assessing Delta outflows. On average, Delta outflow would be similar under Alternative 7 compared to NAA from January through May, and increased by 12% in June.

Table 11-7-7. Estimated Differences Between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl[a]

	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
All	-730 (-14%)	747 (20%)	-2,390 (-17%)	2,366 (25%)
Wet	-5,089 (-28%)	1,275 (11%)	-21,096 (-33%)	5,052 (13%)
Above Normal	-2,584 (-30%)	249 (4%)	-9,197 (-35%)	848 (5%)
Below Normal	-668 (-16%)	631 (21%)	-2,104 (-18%)	1,916 (26%)
Dry	-2 (0%)	490 (30%)	-7 (0%)	1,330 (37%)
Critical	244 (26%)	378 (46%)	592 (31%)	906 (58%)
	Shading indicates a decrease of 10% or greater in relative abundance.			

a Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

CEQA Conclusion: Under Alternative 7, average flows for Sacramento River at Rio Vista would be similar (<10% difference) to Existing Conditions from January through March, and reduced 10% in December. The impact of Alternative 7 on spawning habitat would be less than significant because flow conditions near longfin smelt spawning habitat would be largely similar to baseline. No mitigation would be required.

In general, under Alternative 7 water operations, the quantity and quality of rearing habitat for longfin smelt would be reduced relative to Existing Conditions, but largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 7 (which is under LLT conditions that include future sea level rise and climate change) and the Existing Conditions may therefore either overstate the effects of Alternative 7 or suggest significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 7.

Relative longfin smelt abundance (based on Kimmerer et al. 2009) averaged across all water years would be 14–17% less compared to Existing Conditions (Table 11-7-7). Relative abundance by water year type would be greater under Alternative 7 in critical years (26–31%), similar in dry years, and lower in below normal (16–18%) and wetter water years (28–35% less). During the larval longfin smelt transport period from January-June, average Delta outflows would be increased 12% in January, but reduced 18% in May compared to Existing Conditions. During the other months, Delta outflow would be similar (<10% difference) to Existing Conditions.

Collectively, the results of the Impact AQUA-23 CEQA analysis indicate that the difference between Existing Conditions and Alternative 7 could be significant because, the alternative could substantially reduce modeled longfin smelt population indices, contrary to the NEPA conclusion set forth above. Habitat restoration conservation measures (CM2 and CM4) and reduced larval entrainment may reduce the severity of this impact. In addition, adaptive management plans included in Mitigation Measures AQUA-22a through 22c have the potential to reduce the severity of impact, potentially to a less-than-significant level. If this impact is found to be less than significant, as a result of the adaptive management process, no additional mitigation would be required.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt

Discussion provided above, under Impact AQUA-22

Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt

Discussion provided above, under Impact AQUA-22

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

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-25). This would include potential effects of turbidity, mercury methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation elements.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-25, restoration construction activities are not expected to adversely affect longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-25 for longfin smelt, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-26). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-26, contaminants associated with restoration measures are not expected to adversely affect longfin smelt with respect to selenium, copper, ammonia and pesticides. The effects of mercury on longfin smelt are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-26 for longfin smelt, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-27). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-27, restored habitat conditions are expected to be beneficial for longfin smelt and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-27 for longfin smelt, the potential impact of restored habitat conditions on longfin smelt is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on longfin smelt for Alternative 7 are the same as those described under Alternative 1A (Impact AQUA-28 through 36). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-28 through 36), and no mitigation is required.

Winter-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

The potential effects of construction of the water conveyance facilities on winter-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-37) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for winter-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-38) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 7 would substantially reduce overall entrainment of juvenile winter-run Chinook salmon at the south Delta export facilities, estimated as salvage density, by about 82% (~5,500–5,700 fish; Table 11-7-8) across all years compared to NAA. As discussed for Alternative 1A (Impact AQUA-39), entrainment is highest in wet years and decreases with reduced flows. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

The proportion of the annual winter-run Chinook population entrained would decrease slightly (difference less than 1.5%) under Alternative 7 (compared to NAA). The proportion of the annual winter-run Chinook population (assumed to be 500,000 juveniles approaching the Delta) lost at the south Delta facilities across all years averaged 1.4% under baseline scenario and decreased to 0.4% under Alternative 7.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook Salmon under Alternative 1A. Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon under Alternative 1A. Potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

Table 11-7-8. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Winter-run Chinook salmon		
Wet	-8,255 (-73%)	-8,675 (-74%)
Above Normal	-5,358 (-81%)	-5,483 (-81%)
Below Normal	-5,953 (-83%)	-5,529 (-82%)
Dry	-3,701 (-98%)	-3,393 (-97%)
Critical	-1,261 (-100%)	-1,122 (-100%)
All Years	-5,565 (-82%)	-5,505 (-82%)

[a] Estimated annual number of fish lost, based on normalized data.

NEPA Effects: Overall, the effects of entrainment and predation would not be an adverse effect on Chinook salmon because of the minimal population level impacts.

CEQA Conclusion*:* As described above, entrainment losses of juvenile Chinook salmon at the south Delta facilities would decrease under Alternative 7 compared to Existing Conditions (Table 11-7-8). Overall, impacts of water operations on entrainment of Chinook salmon (winter-run ESU) would be beneficial due to a reduction in entrainment and no mitigation would be required.

Although combined predation losses at the south Delta and the proposed north Delta intakes would increase for all races of juveniles, there would not be substantial effects on population levels. Thus the impact would be less than significant, 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, effects of Alternative 7 on spawning and egg incubation habitat conditions for winter-run Chinook salmon relative to NAA are uncertain.

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 A7_LLT during May through September would generally be similar to or greater than flows under NAA, except in above normal, and below normal years during September (7% to 8% and 18% to 20% lower, respectively). These results indicate that there would be intermittent negligible to small flow-related effects of Alternative 7 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 A7_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-7-9).

These results indicate that there would be negligible (<5%) effects of Alternative 7 relative to NAA on winter-run Chinook salmon spawning and egg incubation habitat.

Table 11-7-9. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-42 (-1%)	-8 (0%)
Above Normal	-126 (-3%)	-40 (-1%)
Below Normal	-249 (-6%)	-51 (-1%)
Dry	-431 (-11%)	13 (0%)
Critical	-627 (-26%)	-43 (-2%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run 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 7 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-12. There would be no difference in levels of concern between NAA and Alternative 7.

Table 11-7-10. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided by NMFS and Used in the BDCP Effects Analysis

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
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
Feather River			
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
American River			
Watt Avenue Bridge	May–Oct	65	Juvenile steelhead rearing

Table 11-7-11. Number of Days per Month Required to Trigger Each Level of Concern for Water Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided 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

Table 11-7-12. Differences between Baseline and Alternative 7 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern[a]	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
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.
[a] For definitions of levels of concern, see Table 11-7-11.

Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type during May through September (Table 11-7-13). Total degree-days under Alternative 7 would be similar to those under NAA during May, 2% lower than under NAA during June and July, and 7% higher during August and September.

Table 11-7-13. Differences between Baseline and Alternative 7 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 Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	1,121 (297%)	-81 (-5%)
	Above Normal	328 (154%)	-27 (-5%)
	Below Normal	549 (251%)	86 (13%)
	Dry	444 (239%)	30 (5%)
	Critical	403 (182%)	-7 (-1%)
	All	2,845 (234%)	1 (0%)
June	Wet	472 (123%)	-239 (-22%)
	Above Normal	226 (153%)	-3 (-1%)
	Below Normal	412 (296%)	60 (12%)
	Dry	598 (318%)	64 (9%)
	Critical	601 (150%)	51 (5%)
	All	2,308 (183%)	-68 (-2%)
July	Wet	626 (121%)	20 (2%)
	Above Normal	269 (332%)	-1 (0%)
	Below Normal	372 (253%)	-84 (-14%)
	Dry	847 (300%)	-81 (-7%)
	Critical	1,805 (219%)	19 (0.7%)
	All	3,919 (212%)	-127 (-2%)
August	Wet	2,094 (300%)	131 (5%)
	Above Normal	833 (204%)	174 (16%)
	Below Normal	1,137 (429%)	102 (8%)
	Dry	1,851 (276%)	241 (11%)
	Critical	2,812 (189%)	193 (5%)
	All	8,726 (247%)	839 (7%)
September	Wet	816 (111%)	107 (7%)
	Above Normal	538 (75%)	138 (12%)
	Below Normal	1,659 (222%)	513 (27%)
	Dry	2,608 (204%)	12 (0%)
	Critical	1,975 (95%)	84 (2%)
	All	7,599 (137%)	854 (7%)

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be 11%, 100%, and 45% greater than mortality under NAA in above normal, below normal, and dry water years, respectively (Table 11-7-14). The increase in the percent of winter-run population subject to mortality would be 0.2%, 2%, and 3% in above normal, below normal, and dry years, respectively. Therefore, the increase in mortality of up to 3% from NAA to A7_LLT, although relatively large, would be negligible at an absolute scale to the winter-run population. These results indicate that climate change would cause the majority of the increase in winter-run egg mortality.

Table 11-7-14. 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. A7_LLT	NAA vs. A7_LLT
Wet	1 (269%)	-0.04 (-2%)
Above Normal	2 (404%)	0.2 (11%)
Below Normal	3 (273%)	2 (100%)
Dry	9 (596%)	3 (45%)
Critical	45 (169%)	1 (2%)
All	10 (210%)	1 (9%)

SacEFT predicts that there would be a 28% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-15). These results indicate that there may be small negative effects of Alternative 7 on spawning habitat availability. SacEFT predicts that the percentage of years with good (lower) redd scour risk under A7_LLT would be similar to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A7_LLT would be similar to (<5% difference) that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A7_LLT would be 17% lower (5% lower on an absolute scale) than risk under NAA.

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 11-7-15. 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. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-35 (-60%)	-9 (-28%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-22 (-23%)	1 (1%)
Redd Dewatering Risk	-1 (-4%)	-5 (-17%)
Juvenile Rearing WUA	-27 (-54%)	-2 (-8%)
Juvenile Stranding Risk	2 (10%)	-9 (-29%)

WUA = Weighted Usable Area.

NEPA Effects: Available analytical tools show conflicting results regarding the temperature effects of relatively small changes in predicted summer and fall flows in the Sacramento River. Several models (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in upstream conditions as a result of Alternative 7. However, one model, SacEFT, shows adverse effects under some conditions. After extensive investigation of these results, they appear to be a function of high model sensitivity to relatively small changes in estimated upstream conditions, which may or may not accurately predict adverse effects. The new NDD structures allow for spring time deliveries of water south of the Delta that are currently constrained under the NAA. For this reason, additional spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion, Alternative 7 modeling results support a finding that effects are uncertain, but modeled results are mixed and operations that match the CALSIM modeling are not assured. Model results will be submitted to independent peer review to confirm that adverse effects are not reasonably anticipated to occur.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to CEQA Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during June through August would generally be similar to or greater than flows under Existing Conditions, except in wet years during August (6% lower) and critical years during July (7% to 8% lower depending on location) and August (21% to 25% lower depending on location). Flows under A7_LLT during May and September would generally be lower than flows under Existing Conditions by up to 23%.

Shasta Reservoir storage volume at the end of May under A7_LLT would be similar to Existing Conditions in wet and above normal water years, but lower by 6% to 26% in below normal, dry, and critical water years (Table 11-7-9). This indicates that there would be a small to moderate effect of Alternative 7 on flows during the spawning and egg incubation period.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no (<5%) differences in mean monthly water temperature between Existing Conditions and Alternative 7 during June and one water year type with greater than 5% difference during May and July. Mean monthly water temperature would be up to 11% higher under Alternative 7 during August and September depending on month, water year type, and location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. The number of years classified as "red" would increase by 67% under Alternative 7 relative to Existing Conditions (Table 11-7-12).

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be 169% to 596% greater than mortality under Existing Conditions depending on water year type (Table 11-7-14). These increases would only affect the winter-run population during dry and critical years, in which the absolute percent increase of the winter-run population would be 9 and 45%, respectively. These results indicate that Alternative 7 would cause increased winter-run Chinook salmon mortality in the Sacramento River.

SacEFT predicts that there would be a 60% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A7_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of years with good egg incubation conditions under A7_LLT would be 23% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A7_LLT would be similar to the percentage of years under Existing Conditions. These results indicate that Alternative 7 would cause small to moderate reductions in spawning WUA and egg incubation conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7.

Egg mortality in drier years, during which winter-run Chinook salmon would already be stressed due to reduced flows and increased temperatures, would be up to 45% greater due to Alternative 7 compared to Existing Conditions (Table 11-7-14). Further, the extent of spawning habitat would be 60% lower due to Alternative 7 compared to Existing Conditions (Table 11-7-15), which represents a substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying capacity.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 7 would not affect the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to NAA.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing habitat. Flows under A7_LLT would generally be similar to or greater than flows under NAA during August, October, and December, but up to 18% lower than flows under NAA during September and November.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run juvenile rearing 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 7 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A7_LLT would be 8% lower than that under NAA (Table 11-7-14). In addition, the percentage of years with good (low) juvenile stranding risk under A7_LLT is predicted to be 29% lower than that under NAA. On an absolute scale, the reduction in juvenile rearing habitat availability and stranding risk would be small (2% and 9%, respectively) and would not have a biologically meaningful effect on winter-run Chinook salmon. These results indicate that neither the quantity nor quality of juvenile rearing habitat in the Sacramento River would differ between NAA and Alternative 7.

SALMOD predicts that mean winter-run smolt equivalent habitat-related mortality under A7_LLT would be negligible (<5%) compared to NAA.

NEPA Effects: These results indicate that the effect is not adverse because it has the potential to substantially reduce the amount of suitable habitat and substantially interfere with the winter-run Chinook salmon rearing. Differences in flows are generally small and inconsistent among months and water year types. SALMOD and SacEFT predicted contradicting results regarding habitat-related mortality although the magnitude of effect predicted by both models would not be biologically meaningful.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of fry and juvenile rearing habitat for winter-run Chinook salmon relative to Existing Conditions.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during October and November, but up to 21% lower than flows under Existing Conditions during August, September, and December.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 15% higher under Alternative 7 in

August through October depending on month, water year type, and location. There would be no differences (<5%) between Existing Conditions and Alternative 7 in mean monthly water temperature during November and December at either location.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A7_LLT would be 54% lower than under Existing Conditions (Table 11-7-15). In addition, the percentage of years with good (low) juvenile stranding risk under A7_LLT is predicted to be 10% greater than under Existing Conditions. These results indicate that the quantity of juvenile rearing habitat in the Sacramento River would be lower under A7_LLT relative to Existing Conditions.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A7_LLT would be 12% higher than under Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7.

Differences in flows are moderately large during the majority of months and water year types. Further, a 54% reduction in rearing habitat quantity risk would reduce upstream habitat conditions for winter-run fry and juveniles.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on juvenile rearing habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

In general, the effects of Alternative 7 winter-run Chinook salmon migration conditions relative to NAA are uncertain.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined for the July through November juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run Chinook salmon to migrate effectively down the Sacramento River. Flows under A7_LLT would be up to 14% lower than under NAA during November depending on water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). However, flows under A7_LLT would generally be similar to flows under NAA during the rest of the juvenile winter-run Chinook salmon migration period (July through October).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration 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 7 in any month or water year type throughout the period at either location.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August). A reduction in flows may reduce the olfactory cues needed by adult winter-run Chinook salmon to return to natal spawning grounds in the upper Sacramento River. Flows under A7_LLT would generally be similar to or greater than those under NAA with few exceptions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 7 in any month or water year type throughout the period at either location.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows (up to 25% lower averaged over all water year types) below the north Delta intakes compared to baseline. Predation at the north Delta would be increased at the three new intake structures. The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The predation effects would be the same as those described for Alternative 4, which also has three proposed intakes. Three NDD intakes would remove or modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be less than 2% compared to the annual production estimated for the Sacramento Valley (Table 11-

1A-17). A conservative assumption of 5% loss per intake would yield a cumulative loss of 11.6% of juvenile winter-run Chinook that reach the north Delta. This assumption is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

Through-Delta survival by emigrating juvenile winter-run Chinook salmon under Alternative 7 (A7_LLT) would average 33% across all years, ranging from 26% in drier years to 45% in wetter years. Under Alternative 7, juvenile survival would increase slightly in wetter years (1% greater survival, or 2% more in relative percentage) compared to NAA (Table 11-7-16).

Table 11-7-16. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 7

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wetter Years	46.3	46.1	45.1	-1.2 (-3%)	-1.0 (-2%)
Drier Years	28.0	27.1	26.3	-1.7 (-6%)	-0.9 (-3%)
All Years	34.9	34.2	33.3	-1.6 (-4%)	-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).

Adults

Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, decreased under Alternative 7A by no more than 10% during the December through June migration period for winter-run adults (Table 11-7-17). The proportion of Sacramento River flows in the Delta would represent 56-73% of Delta outflows, and would thus still provide strong olfactory cues. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A. 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 7.

Table 11-7-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7

Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
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
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
	Shading indicates a difference of 10% or greater in flow proportion.				

NEPA Effects: Overall, the effect of Alternative 7 is uncertain due to absence of information regarding the near-field effects of a new intake structure in the north Delta on migrating juvenile winter-run Chinook salmon.

Upstream of the Delta, the effects of Alternative 7 on flows and water temperatures would not be adverse relative to the NAA. Within the Delta, effects of Alternative 7 on adult attraction flows would not be adverse relative to the NAA.

Adult attraction flows in the Delta under Alternative 7 would be lower than those under NAA, but adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

Near-field effects of Alternative 7 NDD on winter-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 7 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 7 on winter-run Chinook salmon migration remains uncertain.

CEQA Conclusion: In general, Alternative 7 would not affect migration conditions for winter-run Chinook salmon relative to CEQA Existing Conditions.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined during the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT for juvenile migrants would generally be greater than or similar to flows under Existing Conditions during all months except July, in which flows would be up to 11% greater under A7_LLT, and September, in which flows would be up to 19% lower under A7_LLT. These reductions would not be frequent enough to have biologically meaningful effects on juvenile emigration conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 7 in July through October depending on month, water year type, and location. There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 7 during November.

Flows in the Sacramento River upstream of Red Bluff were examined during the December through August adult migration period. Flows under A7_LLT would generally be similar to flows under Existing Conditions, except during February, June, and July, in which flows would be up to 11% greater under A7_LLT, and during September, in which flows would be 3% to 6% lower than flows under Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 Existing Conditions and Alternative 7 during December through June. Mean monthly water temperature would be up to 14% higher under Alternative 7 in July through August depending on month, water year type, and location (although in only one water year during July).

Through-Delta

As described above, Alternative 7 would result in a slight reduction in through-Delta survival by emigrating juvenile winter-run Chinook salmon across all water years (1.6% less survival, or 4% less in relative percentage [A7_LLT]) compared to Existing Conditions. Survival under Alternative 7 would decrease by 1.7% in drier years and by 1.2% in wetter years. Migrating juveniles would face potential predation losses, reduced flows and lost aquatic habitat at the three intake structures.

Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions for adult winter-run Chinook salmon migrating through the Delta.

Summary of CEQA Conclusion

Collectively, these results indicate that the effect would be less than significant because it does not have the potential to substantially reduce migration habitat or substantially interfere with the movement of fish. Upstream flows and water temperatures would not be difference between Alternative 7 and Existing Conditions. Similarly, Alternative 7 would result in a slight increase in through-Delta juvenile survival in wetter water years compared to Existing Conditions. Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions for adult winter-run Chinook salmon migrating through the Delta. Collectively, the overall impact of Alternative 7 on winter-run Chinook salmon migration conditions would be less than significant, and no mitigation would be required.

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

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-43). This would include potential effects of turbidity, mercury methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-43, restoration construction activities under Alternative 7 are not expected to adversely affect Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-43 for Chinook salmon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-44). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-44, contaminants associated with restoration measures are not expected to adversely affect Chinook salmon with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on Chinook salmon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-44 for Chinook salmon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-45). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-45, restored habitat conditions are expected to be beneficial for Chinook salmon and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-45 for Chinook salmon, the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on winter run Chinook salmon are the same as those described under Alternative 1A (Impact AQUA-46 through 54). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-46 through 54), and no mitigation is required.

Spring-Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 7 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.

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

The potential effects of construction of the water conveyance facilities on spring-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for spring-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-55, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than under Alternative 1A because only three intakes would be constructed rather than five. 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 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-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-56) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-56, the impact would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-56, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 7 would substantially reduce overall entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities, estimated as salvage density, by about 94% (~36,000–37,000 fish (Table 11-7-18) across all years compared to NAA. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities. As discussed for Alternative 1A (Impact AQUA-3 for spring-run Chinook salmon), entrainment is highest in wet years and lowest in below normal water years.

The proportion of the annual spring-run Chinook population entrained at the south Delta facilities would be less under Alternative 7 compared to NAA. The annual spring-run Chinook salmon population (assumed to be 750,000 juveniles approaching the Delta) lost at the south Delta facilities across all years averaged 12% under NAA, and would decrease to <1% under Alternative 7.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon. Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon. Potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

Table 11-7-18. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spring-Run Chinook Salmon		
Wet	-79,036 (-89%)	-82,664 (-90%)
Above Normal	-25,330 (-95%)	-28,398 (-95%)
Below Normal	-5,919 (-93%)	-6,714 (-94%)
Dry	-16,412 (-100%)	-17,605 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,525 (-94%)	-37,135 (-94%)

[a] Estimated annual number of fish lost, based on normalized data.

NEPA Effects: Overall, the effects of entrainment and entrainment-related predation would be the same as concluded in Alternative 1A, Impact AQUA-57, the impact would not be adverse for spring-run Chinook salmon.

CEQA Conclusion: As described above, entrainment losses of juvenile spring-run Chinook salmon at the south Delta facilities would decrease under Alternative 7 compared to Existing Conditions (Table 11-7-23). Overall, impacts of water operations on entrainment of juvenile Chinook salmon (spring-run ESU) would be beneficial due to a reduction in entrainment and no mitigation would be required.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, the effects of Alternative 7 on spawning and egg incubation habitat conditions for spring-run Chinook salmon relative to NAA are uncertain.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January Flows under A7_LLT would generally be similar to or greater than flows under NAA during all months except November, in which flows would be up to 14% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir storage volume at the end of September influences flows downstream of the dam during the spring-run spawning and egg incubation period (September through January). Storage volume under A7_LLT would be similar to (<5% difference) storage under NAA in all water year types (Table 11-7-19).

Table 11-7-19. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-585 (-18%)	-73 (-3%)
Above Normal	-611 (-19%)	4 (0%)
Below Normal	-383 (-13%)	-29 (-1%)
Dry	-517 (-21%)	-6 (0%)
Critical	-392 (-33%)	-10 (-1%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon 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 7 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-12 for Bend Bridge and in Table 11-7-20 for Red Bluff. There would be no difference in levels of concern between NAA and Alternative 7 at Bend Bridge. At Red Bluff, there would be 0 (0%) and -2 (-20%) fewer years with a “red” and “yellow” level of concern, respectively, under Alternative 7. The level of concern in these years would be reduced to an “orange” level or no level.

Table 11-7-20. Differences between Baseline and Alternative 7 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Red Bluff, October through April

Level of Concern[a]	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Red	36 (300%)	0 (0%)
Orange	9 (150%)	2 (13%)
Yellow	-3 (-23%)	-2 (-20%)
None	-42 (-82%)	0 (0%)

[a] For definitions of levels of concern, see Table 11-7-11.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 7 would be up to 2% lower than those under NAA during May through July and up to 7% higher during August through September (Table 11-7-13). At Red Bluff, total degree-days under Alternative 7 would be 3%, 9% 12%, and 6% higher during October, November, March and April, respectively, than those under NAA, and similar during remaining months (Table 11-7-21).

Table 11-7-21. Differences between Baseline and Alternative 7 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. A7_LLT	NAA vs. A7_LLT
October	Wet	1,177 (458%)	8 (1%)
	Above Normal	487 (187%)	10 (1%)
	Below Normal	839 (401%)	133 (15%)
	Dry	1,053 (214%)	-18 (-1%)
	Critical	958 (160%)	35 (2%)
	All	4,514 (248%)	168 (3%)
November	Wet	93 (9,300%)	3 (3%)
	Above Normal	68 (NA)	7 (11%)
	Below Normal	69 (NA)	21 (44%)
	Dry	165 (2,063%)	14 (9%)
	Critical	107 (2,675%)	-3 (-3%)
	All	502 (3,862%)	42 (9%)
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	8 (NA)	-1 (-11%)
	Above Normal	5 (NA)	1 (25%)
	Below Normal	36 (400%)	15 (50%)
	Dry	64 (457%)	0 (0%)
	Critical	30 (3,000%)	3 (11%)
	All	143 (596%)	18 (12%)
April	Wet	261 (227%)	0 (0%)
	Above Normal	207 (148%)	-22 (-6%)
	Below Normal	289 (366%)	59 (19%)
	Dry	367 (197%)	47 (9%)
	Critical	164 (1,367%)	13 (8%)
	All	1,288 (242%)	97 (6%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be lower than or similar to mortality under NAA in above normal, dry, and critical years, but greater in wet (11% greater) and below normal (30% greater) water years (Table 11-7-22). Increases of 3% of the spring-run population in wet water years would be negligible to the overall population. However, the 13% increase in mortality in below normal years is considered a small effect on the spring-run population. Combining all water years, there would be no effect of Alternative 7 on egg mortality (2% absolute change).

Table 11-7-22. 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. A7_LLT	NAA vs. A7_LLT
Wet	17 (173%)	3 (11%)
Above Normal	23 (170%)	1 (2%)
Below Normal	42 (353%)	13 (30%)
Dry	53 (270%)	-4 (-5%)
Critical	22 (30%)	0 (0%)
All	31 (138%)	2 (5%)

SacEFT predicts that there would be a no difference in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A7_LLT relative to NAA. SacEFT predicts that there would be an 8% decrease on an absolute scale (24% relative decrease) in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to NAA. SacEFT predicts that there would be a 6% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to NAA.

Table 11-7-23. 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. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-60 (-70%)	-8 (-24%)
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.

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 (8% absolute scale decrease) and the Reclamation egg mortality model predicts that overall egg mortality would be unaffected by the Alternative 7, except in below normal water years. The SacEFT uses mid-August through early March as the egg incubation period, based on Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations. The Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August) that it takes to accumulate 750 temperature units to hatching and another 750 temperature units to emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and are computed on a daily basis. As a result, egg incubation duration is generally mid-August through January, but is dependent on river temperature. The Reclamation model uses the reach between ACID Dam and Jelly's Ferry (approximately 5 river miles downstream of Battle Creek), which includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data (Reclamation 2008). These differences in egg incubation period and location likely account for the difference between model results. Although the SacEFT model has been peer-reviewed, the Reclamation egg mortality model has been extensively reviewed and used in prior biological assessments and BiOps. Therefore, both results are considered valid and were considered in drawing conclusions about spring-run egg mortality in the Sacramento River.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A7_LLT would be similar to or greater than flows under NAA except in critical years during September (13% decrease) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A7_LLT would be the same or of a lower magnitude as that under NAA in all water year types (Table 11-7-24).

Water temperatures were not modeled in Clear Creek.

Table 11-7-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-3 (-4%)	31 (31%)

NA = could not be calculated because the denominator was 0.

[a] 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.

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) where spring-run primarily spawn during September through January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_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.

Oroville Reservoir storage volume at the end of September influence flows downstream of the dam during the spring-run spawning and egg incubation period. Storage volume under A7_LLT would be similar to or greater than storage under NAA depending on water year type (Table 11-7-25). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 7.

Table 11-7-25. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-885 (-31%)	129 (7%)
Above Normal	-675 (-28%)	116 (7%)
Below Normal	-322 (-16%)	287 (20%)
Dry	162 (12%)	515 (51%)
Critical	-90 (-9%)	98 (12%)

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month over the egg incubation period compared to the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel during October through January were identical between A7_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 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 7 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 11-7-26). The percent of months exceeding the threshold under Alternative 7 would generally be lower (up to 23% lower on an absolute scale) than the percent under NAA during October and November and similar during other months, except for the >4.0 and >5.0 degree categories during September when they would be slightly lower (5% and 9% absolute scale decrease).

Table 11-7-26. Differences between Baseline and Alternative 7 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
September	0 (0%)	0 (0%)	6 (7%)	19 (25%)	33 (82%)
October	44 (200%)	41 (550%)	30 (480%)	28 (1,150%)	16 (650%)
November	41 (1,650%)	38 (3,100%)	26 (2,100%)	17 (NA)	6 (NA)
December	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A7_LLT					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-5 (-5%)	-9 (-10%)
October	-20 (-23%)	-17 (-26%)	-20 (-36%)	-19 (-38%)	-21 (-53%)
November	-23 (-35%)	-20 (-33%)	-22 (-45%)	-15 (-46%)	-19 (-75%)
December	-1 (-33%)	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.

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 11-7-27). Total degree-months would be similar between NAA and Alternative 7 during December, and January, and 9%, 29%, and 34% lower during September, October and November, respectively.

Table 11-7-27. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, September through January

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
September	Wet	26 (24%)	1 (1%)
	Above Normal	15 (35%)	5 (9%)
	Below Normal	26 (43%)	-5 (-5%)
	Dry	50 (72%)	-38 (-24%)
	Critical	50 (77%)	-12 (-9%)
	All	167 (48%)	-49 (-9%)
October	Wet	50 (1,000%)	-46 (-46%)
	Above Normal	30 (300%)	-5 (-11%)
	Below Normal	35 (500%)	-19 (-31%)
	Dry	64 (914%)	-16 (-18%)
	Critical	30 (375%)	-11 (-22%)
	All	208 (562%)	-98 (-29%)
November	Wet	33 (NA)	-23 (-41%)
	Above Normal	21 (700%)	-4 (-14%)
	Below Normal	18 (1,800%)	-16 (-46%)
	Dry	34 (NA)	-17 (-33%)
	Critical	21 (NA)	-7 (-25%)
	All	126 (3,150%)	-68 (-34%)
December	Wet	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	3 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	5 (NA)	0 (0%)
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.

NEPA Effects: Available analytical tools show conflicting results regarding the temperature effects of relatively small changes in predicted summer and fall flows in the Sacramento River. Several models (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in upstream conditions as a result of Alternative 7. However, one model, SacEFT, shows adverse effects under some conditions. After extensive investigation of these results, they appear to be a function of high model sensitivity to relatively small changes in estimated upstream conditions, which may or may not accurately predict adverse effects. The new NDD structures allow for spring time deliveries of water south of the Delta that are currently constrained under the NAA. For this reason, additional spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta

Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion, Alternative 7 modeling results support a finding that effects are uncertain. Modeled results are mixed and operations that match the CALSIM modeling are not assured. Model results will be submitted to independent peer review to confirm that adverse effects are not reasonably anticipated to occur.

There would be no effects of Alternative 7 on spawning and egg incubation conditions in Clear Creek. There would be no effects of Alternative 7 on flows and no or small beneficial effects on water temperatures in the Feather River.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to CEQA Existing Conditions.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during October, November, and January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be up to 19% lower than those under Existing Conditions during September and December depending on water year type.

Shasta Reservoir Storage volume at the end of September would be 13% to 33% lower under A7_LLT relative to Existing Conditions (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 7 during September and October would be 7% greater, than those under Existing Conditions, but not different in other months during the period. At Bend Bridge, temperatures under Alternative 7 during September and October would be 9% and 6% greater, respectively, than those under Existing Conditions, but not different in other months during the period.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-12 for Bend Bridge and in Table 11-7-20 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years with a "red" level of concern under Alternative 7 relative to Existing Conditions. At Red Bluff, there would be 300% and 150% increases in the number of years with "red" and "orange" levels of concern under Alternative 7 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 7 would be up to 137% to 234% higher than those under Existing Conditions depending on the month (Table 11-7-13). At Red Bluff, total degree-days under Alternative 7 would be 242% to 3,862% higher than those under Existing Conditions during

October, November, March, and April, and similar during December through February (Table 11-7-21).

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be 30% to 353% greater than mortality under Existing Conditions depending on water year type (Table 11-7-22).

SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 70% decrease in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to Existing Conditions, respectively. SacEFT predicts that there would be a 35% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A7_LLT would generally be similar to or greater than flows under Existing Conditions except in critical years during September (38% reduction) and below normal years during October (6% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A7_LLT would be similar to or lower magnitude than that under Existing Conditions in wet and below normal water years (Table 11-7-24). The greatest reduction in flows under A7_LLT would be 27% to 67% lower (more negative) than Existing Conditions in above normal, dry, and critical years.

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River low-flow channel under A7_LLT are not different from Existing Conditions during the spring-run spawning and egg incubation period (September through January) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

Oroville Reservoir storage volume at the end of September would be 9% to 31% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during October through January were identical between A7_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 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*). Temperatures under Alternative 7 would be 7% to 10% greater than those under Existing Conditions in all months during the period except September which would be 7% greater in only one year.

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 11-7-26). The percent of months exceeding the threshold under Alternative 7 would be similar to or up to 44% higher (absolute scale) than under Existing Conditions during September through November. There would be no difference in the percent of months exceeding the threshold between Existing Conditions and Alternative 7 during December and January.

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 11-7-27). Total degree-months exceeding the threshold under Alternative 7 would be 48% to 3,150% greater than those under Existing Conditions during September through November. There would be no difference in total degree-months between Existing Conditions and Alternative 7 during December and January.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7.

Reservoir storage volume and instream flows would be lower and water temperatures would be greater under Alternative 7 relative to the CEQA baseline. Biological model results mirror these physical model results.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding

Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 7 would not affect the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to NAA.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Except for November, flows under A7_LLT would mostly be similar to or greater than flows under NAA, although flows would be up to 18% lower in some months and water year types. In November flows would be lower in all water years except critical years (up to 17% lower).

As reported in Impact AQUA-40, May Shasta storage volume under A7_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-7-9).

As reported in Impact AQUA-58, September Shasta storage volume would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round spring-run Chinook salmon juvenile rearing 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 7 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A7_LLT would be similar to or lower than that under NAA (Table 11-7-23). However, the percentage of years with good (lower) juvenile stranding risk conditions under A7_LLT would be 14% lower than under NAA. On an absolute scale, juvenile stranding risk would decrease in only 2% of years. This reduction would not have a biologically meaningful effect on spring-run Chinook salmon. SALMOD predicts that spring-run smolt equivalent habitat-related mortality would not differ between A7_LLT and NAA.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A7_LLT would generally be similar to or greater than flows under NAA, except for below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LLT would not differ from those under NAA. In the high-flow channel, under A7_LLT would be mostly lower (up to 27%) during December and generally similar to or greater than flows under NAA during November and from January through June.

May Oroville storage under A7_LLT would be similar to or greater than storage under NAA (Table 11-7-28).

September Oroville storage volume would be greater than storage under NAA in all water year types (Table 11-7-25).

Table 11-7-28. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-56 (-2%)	-10 (0%)
Above Normal	-158 (-5%)	-2 (0%)
Below Normal	-123 (-4%)	230 (8%)
Dry	-243 (-9%)	277 (12%)
Critical	-76 (-4%)	240 (16%)

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during November through June (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 7 in any month or water year type throughout the period at either location.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-7-29). The percent of months exceeding the threshold under Alternative 7 would generally be similar to or lower (up to 20% lower on an absolute scale) than the percent under NAA.

Table 11-7-29. Differences between Baseline and Alternative 7 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 63°F Threshold, May through August

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
May	4 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
June	26 (47%)	31 (114%)	31 (625%)	12 (NA)	4 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	46 (116%)
August	0 (0%)	12 (14%)	37 (64%)	46 (161%)	31 (313%)
NAA vs. A7_LLT					
May	-2 (-40%)	-1 (-50%)	-1 (-100%)	0 (NA)	0 (NA)
June	-7 (-8%)	-20 (-25%)	-11 (-24%)	-9 (-41%)	-1 (-25%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-9 (-9%)
August	0 (0%)	0 (0%)	-4 (-4%)	-7 (-9%)	-16 (-28%)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-7-30). Total degree-months under Alternative 7 would be similar to or lower than those under NAA depending on the month.

Table 11-7-30. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Feather River above Thermalito Afterbay, May through August

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	3 (NA)	-1 (-25%)
	All	8 (NA)	0 (0%)
June	Wet	29 (193%)	0 (0%)
	Above Normal	16 (114%)	-1 (-3%)
	Below Normal	23 (177%)	1 (3%)
	Dry	34 (148%)	1 (2%)
	Critical	18 (300%)	-7 (-23%)
	All	119 (168%)	-7 (-4%)
July	Wet	41 (34%)	0 (0%)
	Above Normal	20 (45%)	0 (0%)
	Below Normal	26 (44%)	-2 (-2%)
	Dry	39 (55%)	3 (3%)
	Critical	35 (67%)	3 (4%)
	All	161 (47%)	4 (1%)
August	Wet	41 (46%)	8 (7%)
	Above Normal	20 (80%)	2 (5%)
	Below Normal	28 (74%)	-1 (-1%)
	Dry	46 (115%)	-7 (-8%)
	Critical	26 (62%)	-14 (-17%)
	All	160 (68%)	-13 (-3%)

NA = could not be calculated because the denominator was 0.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because habitat would not be substantially reduced. There are some reductions in flow rates in the Sacramento River, although temperature conditions are predicted to be similar between the NEPA point of comparison and Alternative 7. In addition, rearing habitat conditions in other rivers are expected to be similar or better under Alternative 7.

CEQA Conclusion: In general, Alternative 7 would not reduce the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to CEQA Existing Conditions.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally similar to or greater than those under Existing Conditions with some exceptions.

As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A7_LLT would be similar to Existing Conditions in wet and above normal water years, but lower by 6% to 26% in below normal, dry, and critical water years (Table 11-7-9). As reported in Impact AQUA-58, storage volume at the end of September under A7_LLT would be 13% to 33% lower relative to Existing Conditions (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 7 in most months, except for 5% to 10% increases during August through October and in critical years during July.

SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-7). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 70% decrease in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 35% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing Conditions.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A7_LLT would be 32% lower than under Existing Conditions.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A7_LLT would generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not model in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A7_LLT would be mostly lower (up to 44%) during November through January and March and mostly similar to or greater than flows under Existing Conditions during February and April through June with few exceptions, during which flows would be up to 46% lower under A7_LLT.

May Oroville storage volume under A7_LLT would be similar to storage under Existing Conditions, except in above normal and dry water years (5% and 9% lower, respectively) (Table 11-7-28).

September Oroville storage volume would be 9% to 31% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during the November through June juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 7 would be 5% to 10% greater than those under Existing Conditions during November through March, but similar (<5% difference) during April through June.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-7-29). The percent of months exceeding the threshold under Alternative 7 would be similar to those under Existing Conditions during May, but up to 46% greater (absolute scale) during June through August.

Total degree-days exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-7-30). Total degree-months under Alternative 7 would be similar to those under Existing Conditions during May, but 47% to 168% higher during June through August.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7.

Reservoir storage volume and instream flows would be lower and water temperatures would be greater under Alternative 7 relative to the CEQA baseline. Biological model results mirror these physical model results.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on juvenile rearing habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

In general, the effects of Alternative 7on spring-run Chinook salmon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during December through May would be similar to or greater than flows under NAA, except in above normal years during December (5% lower) and dry and critical years during January (7% and 11% lower, respectively).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 7 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to or greater than flows under NAA during all months and in all water year types.

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A7_LLT would generally be similar to or greater than flows under NAA except in below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A7_LLT would be similar to or greater than flows under NAA in all months and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be mostly lower than under NAA during December. During January through May, flows under A7_LLT would generally be similar to or greater than flows under NAA except in critical years during January (10% lower) and in below normal and dry years during May (7% and 16% lower, respectively).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration 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 7 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during April through June would generally be similar to or greater than flows under NAA. Flows under A7_LLT during July and August would generally be lower than flows under NAA by up to 38%.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to NAA. Predation at the north Delta would be increased at the three new intake structures, as described for Alternative 4 (Impact AQUA-60). The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The predation effects would be the same as those described for Alternative 4, which also has three proposed intakes. Potential predation losses at the north Delta intakes were estimated to range from 0.2% (bioenergetics, Table 11-4-11) to 12.3% (fixed rate of 5% per intake), of juvenile spring-run Chinook that reach the north Delta. This assumption is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

Through-Delta survival of migrating juvenile spring-run Chinook salmon, as estimated by DPM, averaged 29% across all years, 38% in wetter years, and 24% in drier years under Alternative 7 (Table 11-7-31). This is similar (<5% difference) to results under NAA (about 1% lower survival compared to NAA, a 5% relative decrease).

Table 11-7-31. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Alternative 7

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wetter Years	42.1	40.4	38.1	-4.1 (-10%)	-2.3 (-6%)
Drier Years	24.8	24.3	23.5	-1.3 (-5%)	-0.8 (-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 WYs (6 years).
Drier = Below Normal, Dry and Critical WYs (10 years).

Adults

During the overall spring-run upstream migration from March-June, the proportion of Sacramento River water in the Delta would decrease 11–16% in March-May relative to NAA, but would be similar to NAA in June (Table 11-7-17).

The reductions in percentage are small in comparison with the magnitude of change in dilution reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not expected to affect winter-run migration. Furthermore, olfactory cues for spring-run adults would still be strong as the proportion of Sacramento River under Alternative 7 would still represent 53–65% of Delta outflows. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A.

NEPA Effects: Upstream of the Delta, these results indicate that the effect would not be adverse because it does not have the potential to substantially interfere with the movement of fish. Upstream migration conditions under Alternative 7 would generally be similar to or better than those under the NEPA point of comparison. Flows in the Feather River would be lower during two of five months during the adult migration period, although these reductions are not expected to be large enough or frequent enough to have a biologically meaningful effect on spring-run Chinook salmon.

Near-field effects of Alternative 7 NDD on spring-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for spring-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 7 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 7 on spring-run Chinook salmon migration remains uncertain.

CEQA Conclusion:

Upstream of the Delta

In general, Alternative 7 would not affect migration conditions for spring-run Chinook salmon relative to CEQA Existing Conditions.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions except in wet water years during May (18% decrease), in below normal water years during March, April, and May (9% to 11% decrease), and in dry years during April (6%).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than Existing Conditions with few exceptions.

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 Existing Conditions and Alternative 7 during April through July except for wet years during April and critical years during July. Mean monthly water temperatures under Alternative 7 would be up to 12% greater relative to Existing Conditions during August.

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A7_LLT would be similar to or greater than flows under Existing Conditions except in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A7_LLT would generally be similar to or greater than flows under Existing Conditions with exceptions during August of critical water years (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows were examined for the Feather River at the confluence with the Sacramento River during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November through January and May under A7_LLT would generally be lower than flows under Existing Conditions by up to 34%. Flows under A7_LLT during February through May would generally be similar to or greater than flows under Existing Conditions, with few exceptions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alterative 7 would be 5% greater than those under Existing Conditions in November and December, but similar during January through May.

Flows were examined for the Feather River at the confluence with the Sacramento River during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May and July under A7_LLT would generally be lower by up to 49% than flows under Existing Conditions. Flows under A7_LLT during April, June, and August would generally be similar to or greater than flows under Existing Conditions with few exceptions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 7 would be up to 9% higher than those under Existing Conditions during July and August, and similar during April through June except for dry years during June.

Through-Delta

Through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 7 (A7_LLT) would average 29% across all years, ranging from 24% in drier years to 38% in wetter years (Table 11-7-31). Modeled juvenile survival under Alternative 7 is similar to Existing Conditions (<5% difference) about 2% lower survival compared to Existing Conditions (7% relative decrease). Estimates of potential predation losses at the three north Delta intakes ranged from 0.2% (bioenergetics, Table 11-4-11) to 12.3% (fixed rate of 5% per intake), of juvenile spring-run Chinook that reach the north Delta. This assumption is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

For migrating adults, the proportion of Sacramento River flows in the Delta would be reduced during the adult spring-run Chinook salmon upstream migration through the Delta (up to 10% relative to Existing Conditions); however Sacramento River flow olfactory cues would be strong since Sacramento River water would still represent 59–78% of Delta water under Alternative 7 (Table 11-7-32). The reductions in percentage are small in comparison with 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 11-7-32. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7

Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
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
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
	Shading indicates a difference of 10% or greater in flow proportion.				

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-60 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce migration conditions, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7.

Flows in the Feather River would be lower during substantial portions of the juvenile and adult migration periods, elevating water temperatures and reducing olfactory cues, although the importance of olfactory cues is thought to be low with low certainty. There are no effects in other upstream rivers or on through-Delta migration conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat conditions for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

The effects on construction of restoration measures on spring-run Chinook would be identical to those on winter-run Chinook; please refer to the discussion of Impact AQUA-43 above.

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

The effects of contaminants associated with restoration measures would be the same for all four ESUs. Accordingly, please refer to the discussion of Impact AQUA-44 for winter-run Chinook salmon.

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

The overall effects of construction of restored habitat conditions would be the same for all four ESUs. Accordingly, please refer to the discussion of Impact AQUA-45 for winter-run Chinook salmon. Under Alternative 7 more restored floodplain habitat may occur in the south Delta. If it does, there would be additional benefits expected for spring-run, fall-run, and late-fall run Chinook salmon since they occupy these areas while winter-run Chinook salmon do not.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on spring- run Chinook salmon are the same as those described under Alternative 1A (Impact AQUA-64 through 72). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-64 through 72), and no mitigation is required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 7 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.

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

The potential effects of construction of the water conveyance facilities on fall-run/late fall-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-73) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for fall-run/late fall-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-38), except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

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 7 would substantially reduce overall entrainment of juvenile fall-run/late fall–run Chinook salmon at the south Delta export facilities. Under Alternative 7, juvenile fall-run Chinook salmon, estimated as salvage density, would be reduced by 92% (~51,000 fish reduction) (Table 11-7-33) and juvenile late fall–run Chinook would be reduced by 88–89% (~1,600–1,800 fish reduction) (Table 11-7-34) across all years compared to NAA. As discussed for Alternative 1A (Impact AQUA-39 for fall-run and late fall–run Chinook salmon), entrainment for fall-run Chinook salmon is highest in wet years and lowest in below normal water years (Table 11-7-33) while entrainment for late fall–run Chinook salmon is greatest in wet years and one to two orders of magnitude less in other water year types (Table 11-7-34). Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

The proportion of the annual juvenile fall-run and late fall–run Chinook populations (assumed to be 23 million fall-run juveniles and 1 million late fall–run juveniles) entrained at the south Delta facilities is very low (<0.6%) under NAA for all water year types, and decreased to negligible levels under Alternative 7.

Water Exports from SWP/CVP North Delta Intake Facilities

The effects and conclusion are the same as for Impact AQUA-39 for winter-run Chinook salmon. Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effects and conclusion are the same as for Impact AQUA-39 for winter-run Chinook salmon. Potential entrainment and impingement effects would be minimal because intakes would have state-of-the-art screens installed.

In conclusion, Alternative 7 would significantly reduce the total number of juvenile Chinook salmon of all races entrained at the south Delta facilities relative to Existing Conditions. Entrainment of Chinook salmon at the proposed SWP/CVP north Delta intakes and the alternate NBA intake would not be expected to occur due to the state-of-the-art fish screens; there would be a potential for impingement, but this risk would be minimal for these relatively large fish due to the design and operation of the facilities. Overall, effects would be beneficial because entrainment would be substantially reduced. This effect is not adverse and would provide a modest benefit to the species.

Table 11-7-33. Juvenile Fall-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Fall-Run Chinook Salmon		
Wet	-111,614 (-87%)	-111,791 (-87%)
Above Normal	-29,355 (-89%)	-29,829 (-89%)
Below Normal	-12,068 (-89%)	-12,428 (-89%)
Dry	-19,616 (-100%)	-21,264 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,579 (-92%)	-50,635 (-92%)

[a] Estimated annual number of fish lost, based on normalized data.

Table 11-7-34. Juvenile Late Fall–Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Late Fall–Run Chinook Salmon		
Wet	-4,739 (-79%)	-4,652 (-79%)
Above Normal	-506 (-88%)	-492 (-88%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,717 (-89%)	-1,636 (-88%)

[a] Estimated annual number of fish lost, based on normalized data.

NEPA Effects: The overall effects on entrainment and entrainment-related predation would not be adverse.

CEQA Conclusion: As described above (Tables 11-7-33 and 11-7-34), overall entrainment losses of juvenile fall-run and late fall–run Chinook salmon at the south Delta facilities across all water years would decrease under Alternative 7 compared to Existing Conditions. Overall, impacts of water operations on entrainment of juvenile Chinook salmon (fall- and late fall–run ESU) would be beneficial due to a reduction in entrainment and no mitigation would be required.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 7 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 A7_LLT would generally be greater than or similar to NAA during October, December, and January, and generally lower than under NAA by up to 14% during November depending on water year type.

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Alternative 7 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years with a "red" and "yellow" level of concern, respectively, under Alternative 7. The level of concern in these years would be reduced to an "orange" level (from "red") or no (from "yellow") level.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 7 would be 3% higher than those under NAA during October, 9% higher during November, 12% higher during March, 6% higher during April, and similar during remaining months (Table 11-7-21).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be lower than or similar to mortality under NAA in all water year types including below normal years (10% greater relative to NAA, but absolute increase of 2% of fall-run population) (Table 11-7-35). These results indicate that Alternative 7 would have negligible effects on fall-run Chinook salmon egg mortality.

Table 11-7-35. 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. A7_LLT	NAA vs. A7_LLT
Wet	11 (108%)	1 (5%)
Above Normal	11 (102%)	0 (0%)
Below Normal	13 (125%)	2 (10%)
Dry	16 (113%)	0 (-1%)
Critical	9 (32%)	0 (0%)
All	12 (88%)	1 (2%)

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Alternative 7 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years with a "red" and "yellow" level of concern, respectively, under Alternative 7. The level of concern in these years would be reduced to an "orange" level (from "red") or no (from "yellow") level.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 7 would be 3% higher than those under NAA during October, 9% higher during November, 12% higher during March, 6% higher during April, and similar during remaining months (Table 11-7-21).

SacEFT predicts that there would be a 49% increase (17% on absolute scale) in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-36). SacEFT predicts that there would be a 12% reduction (8% on absolute scale) in the percentage of years with good (lower) redd scour risk under A7_LLT relative to NAA. SacEFT predicts that there would be a 6% reduction (4% on absolute scale) in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to NAA. SacEFT predicts that there would be a 11% reduction (3% on absolute scale) in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to NAA.

Table 11-7-36. 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. A7_LLT	NAA vs. A7_LLT
Spawning WUA	4 (8%)	17 (49%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-29 (-31%)	-4 (-6%)
Redd Dewatering Risk	-3 (-11%)	-3 (-11%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-13 (-42%)	-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 A7_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 under Alternative 1A for spring-run Chinook, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Alternative 7 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years with a "red" and "yellow" level of concern, respectively, under Alternative 7. The level of concern in these years would be reduced to an "orange" level (from "red") or no (from "yellow") level.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 7 would be 3% higher than those under NAA during October, 9% higher during November, 12% higher during March, 6% higher during April, and similar during remaining months (Table 11-7-21).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be similar to mortality under NAA in all water years, including below normal water years in which, although there would be an 19% relative increase, the absolute increase would be 1% of the late fall–run population (Table 11-7-37).

Table 11-7-37. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	4 (194%)	0 (-5%)
Above Normal	4 (160%)	-1 (-9%)
Below Normal	5 (342%)	1 (19%)
Dry	5 (199%)	0 (6%)
Critical	3 (145%)	0 (0%)
All	4 (201%)	0 (2%)

SacEFT predicts negligible differences between NAA and A7_LLT in the percentage of years with good spawning availability, redd scour risk, egg incubation conditions, and redd dewatering risk for late fall–run Chinook salmon, (Table 11-7-38).

Table 11-7-38. 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. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	-2 (-2%)	-2 (-2%)
Redd Dewatering Risk	-3 (-5%)	2 (4%)
Juvenile Rearing WUA	6 (13%)	-12 (-19%)
Juvenile Stranding Risk	-35 (-49%)	-9 (-20%)

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 A7_LLT would be similar to or greater than flows under NAA_LLT throughout the period.

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 A7_LLT would be similar to or lower magnitude than the reduction under NAA for all water year types (Table 11-7-39).

Table 11-7-39. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-3 (-4%)	31 (31%)

NA = could not be calculated because the denominator was 0.

[a] 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.

Feather River

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel under A7_LLT would be identical to those under NAA. Flows in the high-flow channel under A7_LLT would generally be similar to or greater than those under NAA during October, November, and January, but would be up to 27% lower than flows under NAA during December.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during November through January were identical between A7_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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 Alternative 7 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 at Gridley was evaluated during October through April (Table 11-7-40). The percent of months exceeding the threshold under Alternative 7 would similar to or up to 19% lower (absolute scale) than the percent under NAA.

Table 11-7-40. Differences between Baseline and Alternative 7 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
October	2 (3%)	14 (16%)	21 (29%)	44 (109%)	51 (273%)
November	42 (1,133%)	27 (2,200%)	14 (NA)	7 (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	28 (383%)	20 (533%)	7 (600%)	6 (NA)	2 (NA)
April	12 (18%)	17 (30%)	37 (120%)	35 (200%)	23 (211%)
NAA vs. A7_LLT					
October	0 (0%)	0 (0%)	-2 (-3%)	-4 (-4%)	-9 (-11%)
November	-16 (-26%)	-12 (-30%)	-19 (-58%)	-11 (-60%)	-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	-9 (-19%)	-5 (-17%)	-2 (-22%)	-1 (-17%)	-1 (-33%)
April	-7 (-8%)	-6 (-8%)	-5 (-7%)	-7 (-13%)	-4 (-10%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-7-41. Total degree-months would be similar between NAA and Alternative 7 for all months except October, November, and March, in which degree-months would be 6% to 100% lower under Alternative 7.

Table 11-7-41. Differences between Baseline and Alternative 7 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. A7_LLT	NAA vs. A7_LLT
October	Wet	84 (115%)	-18 (-10%)
	Above Normal	34 (77%)	-2 (-3%)
	Below Normal	41 (75%)	-8 (-8%)
	Dry	65 (123%)	-6 (-5%)
	Critical	44 (107%)	0 (0%)
	All	269 (101%)	-33 (-6%)
November	Wet	26 (NA)	-11 (-30%)
	Above Normal	18 (900%)	-1 (-5%)
	Below Normal	16 (1,600%)	-5 (-23%)
	Dry	18 (NA)	-13 (-42%)
	Critical	19 (1,900%)	1 (5%)
	All	96 (2,400%)	-30 (-23%)
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	1 (NA)	0 (0%)
	Dry	1 (NA)	1 (NA)
	Critical	2 (NA)	0 (0%)
	All	3 (NA)	0 (0%)
March	Wet	6 (NA)	1 (20%)
	Above Normal	3 (300%)	1 (33%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	25 (625%)	2 (7%)
	Critical	17 (425%)	0 (0%)
	All	70 (700%)	2 (3%)
April	Wet	38 (271%)	0 (0%)
	Above Normal	25 (109%)	-2 (-4%)
	Below Normal	27 (68%)	2 (3%)
	Dry	44 (90%)	3 (3%)
	Critical	30 (103%)	-1 (-2%)
	All	164 (106%)	2 (1%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A7_LLT would be similar to or lower than mortality under NAA in all water years (Table 11-7-42).

Table 11-7-42. 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. A7_LLT	NAA vs. A7_LLT
Wet	15 (1,041%)	-5 (-23%)
Above Normal	9 (769%)	-4 (-27%)
Below Normal	8 (445%)	-5 (-35%)
Dry	11 (478%)	-8 (-39%)
Critical	20 (411%)	-3 (-12%)
All	13 (590%)	-5 (-26%)

American River

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 A7_LLT would generally be similar to or greater than flows under NAA, except for above and below normal water years during October (13% and 12% lower, respectively) and critical water years during November (6% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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 Alternative 7 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-7-43). The percent of months exceeding the threshold under Alternative 7 would similar to or up to 60% lower (absolute scale) than the percent under NAA.

Table 11-7-43. Differences between Baseline and Alternative 7 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
November	0 (0%)	1 (5%)	0 (0%)	5 (200%)	2 (200%)
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	23 (190%)	16 (217%)	6 (250%)	5 (400%)	2 (NA)
April	12 (18%)	12 (20%)	22 (49%)	20 (62%)	7 (27%)
NAA vs. A7_LLT					
November	-47 (-51%)	-57 (-67%)	-60 (-82%)	-49 (-87%)	-37 (-91%)
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%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-14 (-28%)	-9 (-27%)	-7 (-46%)	-6 (-50%)	-2 (-50%)
April	-14 (-14%)	-19 (-20%)	-12 (-15%)	-20 (-28%)	-22 (-39%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-7-44). Total degree-months would be similar between NAA and Alternative 7 for all months.

Table 11-7-44. Differences between Baseline and Alternative 7 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. A7_LLT	NAA vs. A7_LLT
November	Wet	78 (312%)	-4 (-4%)
	Above Normal	34 (309%)	-2 (-4%)
	Below Normal	42 (525%)	-1 (-2%)
	Dry	48 (369%)	-3 (-5%)
	Critical	33 (206%)	-5 (-9%)
	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	11 (367%)	0 (0%)
	Dry	23 (575%)	-2 (-7%)
	Critical	22 (220%)	2 (7%)
	All	74 (389%)	-3 (-3%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	40 (111%)	-1 (-1%)
	Dry	47 (62%)	2 (2%)
	Critical	37 (63%)	2 (2%)
	All	214 (97%)	1 (0.2%)

NA = could not be calculated because the denominator was 0.

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 A7_LLT would be similar to or lower magnitude than under NAA in all months except critical years, in which the greatest reduction under A7_LLT would be 35% greater magnitude than that under NAA (Table 11-7-45).

Table 11-7-45. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-14 (-64%)	11 (23%)
Above Normal	10 (33%)	20 (50%)
Below Normal	-29 (-151%)	-2 (-4%)
Dry	2 (5%)	0 (0%)
Critical	-2 (-5%)	-14 (-35%)

NA = could not be calculated because the denominator was 0.

[a] 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.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A7_LLT would be similar to mortality under NAA in all water years (Table 11-7-46).

Table 11-7-46. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	24 (158%)	0 (1%)
Above Normal	22 (211%)	0 (-1%)
Below Normal	22 (178%)	0 (0%)
Dry	16 (96%)	-1 (-2%)
Critical	9 (45%)	0 (-1%)
All	19 (128%)	0 (-1%)

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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 A7_LLT would generally not differ from flows under NAA.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 7 throughout the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 Alternative 7 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 Alternative 7 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect is not adverse because habitat conditions are not substantially reduced. There are no reductions in reservoir storage volume or instream flows or increases in temperatures under Alternative 7 that would translate into adverse biological effects on fall-run Chinook salmon spawning and egg incubation habitat.

CEQA Conclusion: In general, under Alternative 7 water operations, the quantity and quality of spawning and egg incubation habitat for fall-/late fall–run Chinook salmon would not be reduced relative to the CEQA baseline.

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A7_LLT would generally be greater than or similar to Existing Conditions during October, November, and January, except in dry years during November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During December, flows under A7_LLT would be 3% to 6% lower than under Existing Conditions depending on water year type.

Storage volume at the end of September would be 13% to 33% lower under A7_LLT relative to Existing Conditions (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Existing Conditions and Alternative 7 during the period, except during October, in which temperatures would be 6% higher under Alternative 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 increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-20. There would be 300% and 150% increases in the number of years with "red" and "orange" levels of concern under Alternative 7 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 7 would be 242% to 3,862% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-7-21).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be 32% to 125% greater than mortality under Existing Conditions (Table 11-7-35).

SacEFT predicts that there would be an 8% increase in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-36). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 31% decrease in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be an 11% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing Conditions.

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A7_LLT would generally be greater than or similar to flows under Existing Conditions, except in wet years during May (18% lower), below normal years during March (11% lower), April (9% lower), and May (11% lower), and dry years during April (6% lower).

Shasta Reservoir storage volume at the end of September would be 13% to 33% lower under A7_LLT relative to Existing Conditions (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period except for 5% higher during wet years in May.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-20. There would be 300% and 150% increases in the number of years with "red" and "orange" levels of concern under Alternative 7 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 7 would be 143% to 4,514% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-7-21).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A7_LLT would be 145% to 342% greater than mortality under Existing Conditions (Table 11-7-37).However, absolute differences in the percent of the late-fall population subject to mortality would be minimal in all but below normal and dry years, in which there is a 5% increase

SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning availability for late fall-run Chinook salmon, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-38). SacEFT predicts that there would be a 7% decrease in the percentage of years with good (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 2% reduction in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 5% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were reviewed during the September through February fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal water years during October (6% lower).

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 occurred. The greatest monthly reduction in Clear Creek flows during September through February under A7_LLT would be similar to or lower magnitude than those under Existing Conditions in wet below normal, and critical water years, but the reduction would be 27% and 67% greater (absolute, not relative, differences) under A7_LLT in above normal and dry water years, respectively (Table 11-7-39).

Feather River

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel A7_LLT would be identical to those under Existing Conditions. Flows in the high-flow channel under A7_LLT would be similar to or greater than flows under Existing Conditions during October. During November through January, flows would generally be lower by up to 43% than flows under Existing Conditions.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel were identical between A7_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A7_LLT would be 411% to 1,041% greater than mortality under Existing Conditions (Table 11-7-42).

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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*). Mean monthly water temperatures would be under Alternative 7 relative to Existing Conditions by 5% to 10% higher in the low-flow channel and 5% to 8% higher in the high-flow channel depending on month.

The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley was evaluated during October through April (Table 11-7-40). The percent of months exceeding the threshold under Alternative 7 would similar to or up to 51% higher (absolute scale) than the percent under Existing Conditions during all months except December through February, during which there would be no difference in the percent of months exceeding the threshold.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-7-41). Total degree-months under Alternative 7 would be 101% to 2,400% higher than total degree-months under Existing Conditions, except during December through February, in which there would be no difference between Existing Conditions and Alternative 7 in total degree-months exceeding the 56°F threshold.

American River

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 A7_LLT would generally be lower by up to 31% than flows under NAA during November through January.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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*). Mean monthly temperatures under Alternative 7 would be 5% to 13% greater than those under Existing Conditions depending on month.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-7-43). The percent of months exceeding the threshold under Alternative 7 would be up to 23% greater (absolute scale) than the percent under Existing Conditions during November, March, and April and similar to the percent under Existing Conditions during December through February.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-7-44). Total degree-months under Alternative 7 would be 97% to 389% greater than total degree-months under Existing Conditions during November, March and April and similar to total degree months under Existing Conditions during December through February.

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 monthly reduction in American River flows under A7_LLT during November through January would be lower magnitude than or similar to that under Existing Conditions in above normal, dry, and critical water years, but 64% and 151% greater magnitude under A7_LLT in wet and below normal years, respectively (Table 11-7-45).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A7_LLT would be 45% to 211% greater than mortality under Existing Conditions (Table 11-7-46).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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 A7_LLT would generally be lower than flows under Existing Conditions in all months and water year types by up to 18%.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would not be different from those under Existing Conditions during October except in wet and critical years, but 5% to 7% higher during November through January.

San Joaquin River

Flows in the San Joaquin River at Vernalis 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*). Mean monthly flows under Alternative 7 would be similar to those under Existing Conditions throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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*). Mean monthly flows under Alternative 7 would be similar to those under Existing Conditions during October and December, 10% lower during November, and 14% higher during January.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat of fish. There would be flow reductions in the Sacramento, Feather, American, and Stanislaus Rivers that would affect the fall-/late fall-run ESU, contrary to the NEPA conclusion set forth above. Further, the Reclamation egg mortality model and SacEFT predict moderate to substantial negative effects of Alternative 7.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for fall-/late fall–run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 7 would reduce the quantity and quality of larval and juvenile rearing 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 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be greater than or similar to flows under NAA throughout the period, except in dry and critical water years during January (9% to 11% lower, respectively).

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 7 in any month or water year type throughout the period.

SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-36). SacEFT predicts that there would be a 10% increase in the percentage of years with “good” (lower) juvenile stranding risk under A7_LLT relative to NAA.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A7_LLT would be similar to mortality under NAA.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during this period under A7_LLT were generally similar to or greater than those under NAA.

Shasta Reservoir storage at the end of September and May would affect flows during the late fall–run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

As reported in Impact AQUA-40 for winter-run Chinook salmon, Shasta storage at the end of May under A7_LLT would be similar to or greater than storage under NAA for all water year types (Table 11-7-9).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 7 in any month or water year type throughout the period.

SacEFT predicts that there would be a 19% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-38). Further, SacEFT predicts that there would be a 20% reduction in the percentage of years with “good” (lower) juvenile stranding risk under A7_LLT relative to NAA.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A7_LLT would be similar to mortality under NAA.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under NAA, except in below normal years during March (6% reduction).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LLT would not differ from those under NAA. In the high-flow channel, flows under A7_LLT would be mostly lower (up to 27%) during December and generally similar to or greater than flows under NAA from January through June.

As reported in Impact AQUA-59, May Oroville storage under A7_LLT T would be similar to or greater than storage under NAA (Table 11-7-28).

As reported in Impact AQUA-58, September Oroville storage volume under A7_LLT would be greater than storage under NAA in all water year types (Table 11-7-25).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing 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 7 in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under NAA, except in dry years during March and April (6% and 15%, respectively) and in critical years during February through March (7% to 17% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing 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 7 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under NAA throughout the period, regardless of water year type.

Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA and Alternative 7 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under NAA throughout the period, regardless of water year type.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under NAA throughout the period, regardless of water year type.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Taken together, these results indicate that the effect is adverse because it has the potential to substantially reduce the amount of suitable habitat of fish. Late fall–run Chinook salmon in the Sacramento River under Alternative 7 experience small to moderate reductions relative to the NEPA point of comparison during September and November in most water year types. These reductions in flows would reduce the quantity and quality of larval and juvenile rearing habitat under Alternative 7. SacEFT results corroborate this effect by predicting that there would be a 19% reduction in years with good juvenile rearing habitat availability and a 20% reduction in years with good juvenile stranding risk for late fall-run Chinook salmon. Despite small or intermittent flow reductions, there are no effects of Alternative 7 on late-fall-run in other waterways or on fall-run in any waterways examined that would rise to the level of adverse. 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. Even so, proposed mitigation (Mitigation Measure AQUA-77a through AQUA-77c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 7 would reduce the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to CEQA Existing Conditions.

Sacramento River

Fall-Run

Flow Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be greater than or similar to flows under Existing Conditions, except in wet years during May (18% lower), below normal years during March through May (9% to 11% lower), and dry years during April (6% lower).

As reported in Impact AQUA-58 for spring-run Chinook salmon, end of September Shasta Reservoir storage would be 13% to 33% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

SacEFT predicts that there would be an 15% increase in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table 11-7-36). SacEFT predicts that there would be a 42% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A7_LLT relative to Existing Conditions.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A7_LLT would be 11% lower than mortality under Existing Conditions.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during most months would generally be similar to or greater than those under Existing Conditions.

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 13% to 33% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-19).

As reported in Impact AQUA-40, end of May Shasta storage under A7_LLT would be similar to Existing Conditions in wet and above normal water years, but lower by 6% to 26% in below normal, dry, and critical water years (Table 11-7-9).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period except for wet years during April and critical years during July.

SacEFT predicts that there would be an 13% increase in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under

A7_LLT relative to Existing Conditions (Table 11-7-38). SacEFT predicts that there would be a 46% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A7_LLT relative to Existing Conditions.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A7_LLT would be 8% higher than mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to or greater than flows under Existing Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under A7_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A7_LLT would be mostly lower (up to 38%) during December and mostly similar to or greater than flows under NAA during January through June with few exceptions during which flows would be up to 46% lower under A7_LLT.

As reported under Impact AQUA-59, May Oroville storage volume under A7_LLT would be similar to storage under Existing Conditions, except in above normal and dry water years (5% and 9% lower, respectively) (Table 11-7-28). Storage would not be different between Existing Conditions and A7_LLT in other water year types.

As reported in Impact AQUA-58, September Oroville storage volume would be 9% to 31% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 7 would be 5% to 10% lower than those under Existing Conditions during December through March, but not different from those under Existing Conditions during April through June. In the high-flow channel, mean monthly water temperatures under Alternative 7 would be 5% to 8% lower than those under Existing Conditions during December through March, but not different from those under Existing Conditions during April through June.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March and April, except in critical years during February (24% lower) and March (20% lower). Flows under A7_LLT would be mostly lower (by up to 31%) than flows under Existing Conditions during January, April, and May.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% to 8% lower than those under Existing Conditions in all months during the period. Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be mostly lower than flows under Existing Conditions by up to 36%.Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 7 would be 6% lower than those under Existing Conditions throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A7_LLT would be similar to flows under Existing Conditions throughout the period, regardless of water year type.

Water temperature modeling was not conducted in the San Joaquin River

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A7_LLT would be similar to flows under Existing Conditions throughout the period, regardless of water year type.

Water temperature modeling was not conducted in the Mokelumne River.

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce the amount of suitable habitat of fish. Changes in Sacramento River flows under Alternative 7 would substantially increase (42% to 46%) the risk of stranding for late fall- and fall-run Chinook salmon relative to CEQA Existing Conditions. There are moderate flow reductions in the Sacramento River that would negatively affect late fall–run rearing. Flows and water temperatures in the American, Feather, and Stanislaus rivers would be negatively affected by

Alternative 7 during portions of the fall-run rearing period, reducing the habitat quantity and quality for rearing fall-run. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-77a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall–Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 7 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 7.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 7 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 7.

Mitigation Measure AQUA-77b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall–Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 7. 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).

Mitigation Measure AQUA-77c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall–Run Chinook Salmon Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on Chinook salmon habitat, the BDCP proponents will consult with [NMFS/FWS] and the Department of Fish and Wildlife 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-77a.

If feasible means are identified to reduce impacts on rearing habitat consistent with the overall operational framework of Alternative 7 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on fall-run and late fall-run Chinook salmon habitat is not feasible under Alternative 7 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on fall-run and late fall-run Chinook salmon would remain significant and unavoidable.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, the effects of Alternative 7 on fall- and late fall-run Chinook salmon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants during February through May. Flows under A7_LLT would be similar to or greater than flows under NAA throughout the juvenile fall-run migration period in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 7 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run Chinook salmon upstream migration period (September through October). Flows under A7_LLT would generally be similar to or greater than those under NAA except during above normal years during September (7% lower) and below normal years during September and October (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A7_LLT would generally be similar to or greater than flows under NAA except in dry and critical water years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 7 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A7_LLT would generally be similar to or greater than flows under NAA except in above normal water years during December (5% lower) and in dry and critical water years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration 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 7 in any month or water year type throughout the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants during February through May. Flows under A7_LLT would generally be similar to or greater than those under NAA, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A7_LLT would be similar to or greater than those under NAA, except in critical water years during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were reviewed during the February through May fall-run juvenile migration period Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).Flows under A7_LLT would generally be similar to or greater than flows under NAA except in below normal and dry water years during May (7% and 16% lower, respectively).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 7 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A7_LLT would generally be lower by up to 25% lower than flows under NAA during September and similar to or greater than flows under NAA during October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration 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 7 in any month or water year type throughout the period.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally similar to or greater than flows under NAA, except for dry years during March and April (6% and 15% lower, respectively) and critical years during February, March, and April (7% to 17% lower).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 7 in any month or water year type throughout the period.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during September under A7_LLT would be mostly lower by up to 15% than those under NAA. Flows during October would be generally similar to or greater than flows under NAA, except during above and below normal water years (13% and 12% lower, respectively).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Sacramento River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under NAA throughout the period. This indicates that climate change would affect juvenile migration flows in the Stanislaus River, but Alternative 7 would not.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under NAA throughout the period. This indicates that climate change would affect adult migration flows in the Stanislaus River, but Alternative 7 would not.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 7 in any month or water year type throughout the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Fall-Run

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to baseline. The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the three intake structures. The predation effects would be the same as those described for Alternative 4 (Impact AQUA-78). Estimates of potential predation losses at the north Delta intakes range from about 0.25% to 13% of those migrating juveniles that reach the Delta. This topic is further discussed in Impact AQUA-42 for Alternative 1A. The overall effect of the predation and habitat loss associated with the three intake structures is not considered substantial.

Through-Delta average survival by emigrating juvenile fall-run Chinook salmon under Alternative 7 (A7_LLT) would be similar for the Sacramento River, slightly greater for the Mokelumne River (1.8% greater survival, or 11% more in relative percentage), compared to NAA (Table 11-7-47). In drier years, mean survival would be slightly greater in the Mokelumne River (1.2% more, or 7% more in relative percentage).

Table 11-7-47. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Alternative 7

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
Wetter Years	34.5	31.1	29.2	-5.3 (-15%)	-1.9 (-6%)
Drier Years	20.6	20.8	20.5	-0.1 (1%)	-0.3 (-1%)
All Years	25.8	24.7	23.7	-2.1 (-8%)	-0.9 (-4%)
Mokelumne River					
Wetter Years	17.2	15.7	18.5	1.3 (8%)	2.8 (18%)
Drier Years	15.6	15.9	17.1	1.5 (10%)	1.2 (7%)
All Years	16.2	15.9	17.6	1.4 (9%)	1.8 (11%)

Note: Delta Passage Model results for survival to Chipps Island.
Results for San Joaquin River runs may be anomalous when applying DPM to operations scenarios with low or no south Delta exports.
Wetter = Wet and Above Normal WYs (6 years).
Drier = Below Normal, Dry and Critical WYs (10 years).

Adults

The adult fall-run migration extends from September-December. The proportion of Sacramento River water in the Delta under Alternative 7 would be similar (<10% change) to (NAA during the adult-Fall-Run migration (Table 11-7-32).

Flows at Rio Vista would be similar (<5% difference) between Alternative 7 and Alternative 1A in December, but substantially changed from September-November depending on year type. In Wet and above normal years Rio Vista flows would be substantially increased in September relative to Alternative 1A but would be decreased 33–46% in all years in October and November.

Late Fall-Run

Juveniles

During the late fall–run juvenile Chinook salmon migration occurs from December-May, flows at Rio Vista under Alternative 7 would be similar (<5% difference) to those predicted for Alternative 1A. Based on DPM results for Alternative 1A, juvenile late fall–run survival would decrease less than 0.5%.

Table 11-7-48. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon under Alternative 7

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wetter Years	28.8	27.3	27.2	-1.6 (-6%)	-0.2 (-1%)
Drier Years	18.8	20.2	20.4	1.6 (9%)	0.2 (1%)
All Years	22.5	22.9	22.9	0.4 (2%)	0.0 (0%)

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).

Adults

The adult late fall–run migration is from November through March, peaking in January through March. The proportion of Sacramento River water in the Delta would be similar to NAA from November–February, and decreased slightly in March (11%). Rio Vista flows under Alternative 7 would be similar Alternative 1A from December–March, which overlaps with the peak migration months; however Rio Vista flows would decrease 33% relative to Alternative 1A in November. Based on the similarity in Sacramento River olfactory cues and Rio Vista flows during the vast majority of the adult late fall–run migration, it is assumed that adult migration success through the Delta would be similar to those described for Alternative 1A.

San Joaquin River

Fall-Run

Juveniles

As discussed for Alternative 6A (Impact AQUA-78), the DPM can produce anomalous results for certain Alternatives and operations scenarios with highly reduced south Delta exports, such as Alternative 7. A qualitative assessment is therefore more appropriate given this modeling limitation.

There is a beneficial effect of Alternative 7 to all San Joaquin River basin fish due to positive Old and Middle River flows during migratory months resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under Alternative 7, entrainment and entrainment-related mortality at the South Delta Facilities would be reduced.

Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would alleviate one of the primary concerns related to potential Old and Middle River corridor habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat, food availability, and overall salmonid fitness and survival.

Adults

Alternative 7 would slightly increase the proportion of San Joaquin River water in the Delta in September through December by 0.8 to 7.5% compared to NAA. The proportion of San Joaquin River water would be similar or slightly more than to NAA. Therefore migration conditions under Alternative 7 would be similar to slightly improved to those described for Alternative 1A. Alternative 7 would have no effect to a slight beneficial effect on the fall-run adult migration.

NEPA Effects: Upstream of the Delta, the results indicate that the effect of Alternative 7 on upstream flow conditions is not adverse because it does not have the potential to substantially interfere with the movement of fish. Reservoir storage volume, instream flows, and water temperatures under Alternative 7 in all rivers in which these parameters were predicted generally be similar to those under the NAA.

Near-field effects of Alternative 7 NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 13% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 7 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 7 on fall- and late fall-run Chinook salmon migration remains uncertain. Similarly, the impact on the fall-run Chinook salmon commercial fishery would be uncertain.

CEQA Conclusion: In general, Alternative 7 would not affect migration conditions for fall-/late fall-run Chinook salmon relative to Existing Conditions.

Upstream of the Delta

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants were evaluated during February through May under A7_LLT would generally be similar to or greater than those under Existing Conditions, except in wet years during May (18% lower), below normal water years during March, April, and May (9% to 11% lower), and dry years during April (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period except for wet years during May.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the adult fall-run Chinook salmon upstream migration period (September through October). Flows during September under A7_LLT would generally be lower than those under Existing Conditions by 16% to 19% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during October under A7_LLT would be similar to or greater than flows under Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 9% and 6% greater than those under Existing Conditions during September and October, respectively.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile late fall–run migrants (January through March). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal water years during March (11% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall–run Chinook salmon upstream migration period (December through February). Flows during January and February under A7_LLT would be similar to or greater than those under Existing Conditions.

Flows during December under A7_LLT would be mostly lower than under Existing Conditions (up to 6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

Clear Creek

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon upstream migration period (February through May) under A7_LLT would be similar to or greater than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A7_LLT would generally be similar to or greater than those under Existing Conditions except in critical years (38% lower) during September and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in Clear Creek.

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were evaluated during the fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during February through April, except in below normal years during February and March (12% and 8% lower, respectively) and in critical years during March and April (8% and 6% lower, respectively). Flows during May under A7_LLT were generally lower by up to 27% than flows under Existing Conditions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A7_LLT would generally be similar to or greater than flows under Existing Conditions except in below normal and dry water years during September (75 and 33% lower, respectively) and in wet years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration 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 Existing Conditions and Alternative 7 during October and generally during September except in dry and critical years.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during February and March would generally be similar to or greater than flows under Existing Conditions, except for critical years (24% and 20% lower in February and March, respectively). Flows under A7_LLT during April and May would generally be lower than flows under Existing Conditions by up to 33%.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% to 8% higher than under Existing Conditions in all month except April, in which there would be no difference.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during September would be 25% to 46% lower than flows under Existing Conditions. Flows under A7_LLT during October would be similar to or great than those under Existing Conditions in wet, below normal and critical water years and lower than those under Existing Conditions in above normal and dry years.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6% and 11% higher than those under Existing Conditions during September and October, respectively.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would predominantly be lower than flows under Existing Conditions by up to 36%.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*

Results utilized in the Fish Analysis). Mean monthly water temperatures under Alternative 7 would be up to 7% higher than those under Existing Conditions in every month of the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during September would generally be similar to flows under Existing Conditions, except during wet and above normal years (17% and 6% lower, respectively). Flows under A7_LLT during October would be 5% to 11% lower than flows under Existing Conditions.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6% higher than those under Existing Conditions during September but there would be no difference in mean monthly water temperatures between Alternative 7 and Existing Conditions during October except in wet and critical years.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would generally be similar to flows under Existing Conditions in all months. Wetter water years under Alternative 7 would have similar or greater flows than those under Existing Conditions, whereas drier years would have lower flows under H3.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 8% lower than those under Existing Conditions in September and similar in October.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be 12% greater than those under Existing Conditions during February, similar during March, and 8% and 12% lower during April and May, respectively.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be 27% lower than under Existing Conditions during September but would be similar during October.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the three intake structures. The predation effects would be the same as those described for Alternative 4 (Impact AQUA-78). Estimates of potential predation losses at the north Delta intakes range from about 0.25% to 13% of those migrating fall-run Chinook salmon juveniles that reach the Delta. This topic is further discussed in Impact AQUA-42 for Alternative 1A. The overall effect of the predation and habitat loss associated with the three intake structures is not considered substantial.

As described above, DPM results for Alternative 7 found a slight increase (1.4% more) in average through-Delta survival by emigrating juvenile fall-run Chinook salmon for the Mokelumne River (1.4% greater survival compared to Existing Conditions, or a 9% more in relative percentage) and decrease in the Sacramento (2.1 to 5.3% reduced average survival, or 8-15% less in relative percentage), compared to Existing Conditions.

Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions for fall- and late fall–run Chinook salmon (Table 11-7-49). Rio Vista flows under Alternative 7 would be similar or increased relative to Alternative 1A for nearly all months, except for October and November when flows would be reduced. Reduced flows in October and November, relative to Alternative 1A, would overlap with the migration timings for fall-run Chinook salmon. For late fall–run adults, flows at Rio Vista would be similar to Alternative 1A during the majority of their upstream migration period. Because the impact under Alternative 1A, Impact AQUA-78, was determined to be not substantial, the Alternative 7 impact on adult Chinook salmon upstream migration through the Delta would also not be substantial. Fall-run adults Chinook salmon would experience reduced flows at Rio Vista during their migration, but would also benefit from improved olfactory cues. San Joaquin River flows would not be substantially impacted (<10%) (Table 11-7-49) compared to Existing Conditions.

Table 11-7-49. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7

Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
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
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
	Shading indicates a difference of 10% or greater in flow proportion.				

Summary of CEQA Conclusion

In the Delta on the Sacramento River, Alternative 7 would not substantially reduce olfactory cues for Sacramento River Chinook salmon and Mokelumne River flows would be slightly increased. Alternative 7 also would not substantially increase predation and remove important instream habitat as the result of the presence of three NDD structures. Through-Delta survival of emigrating juveniles would not be expected to be reduced, compared to Existing Conditions. Therefore, it is concluded that the through-delta impact on the Sacramento River is less than significant and no mitigation is required.

In the Delta on the San Joaquin River, because of similar and olfactory attraction cues, Alternative 7 would be less than significant for fall-run Chinook salmon and no mitigation is required.

For upstream of the Delta, collectively, the results of the Impact AQUA-78 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce migration habitat. There would be substantial flow reductions under Alternative 7 in the Feather, American, and Stanislaus rivers during the fall-run juvenile and adult migration periods relative to CEQA Existing Conditions. Flow reductions during juvenile migration could reduce the downstream migratory ability of juveniles, which could delay smoltification and reduce survival. Flow reductions during adult migration could reduce olfactory cues from natal streams and increase straying. Further, water temperatures in the Feather and Stanislaus Rivers would be higher under Alternative 7 relative to CEQA Existing

Conditions, which would further increase stress and mortality of juvenile and adult fall-run migrants.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat conditions for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

The effects on construction of restoration measures on fall-/late-fall-run Chinook would be identical to those on winter-run Chinook; please refer to the discussion of Impact AQUA-43 above.

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

The effects of contaminants associated with restoration measures would be the same for all four ESUs. Accordingly, please refer to the discussion of Impact AQUA-44 for winter-run Chinook salmon.

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

The overall effects of construction of restored habitat conditions would be the same for all four ESUs. Accordingly, please refer to the discussion of Impact AQUA-45 for winter-run Chinook salmon. Under Alternative 7 more restored floodplain habitat may occur in the south Delta. If it does, there would be additional benefits expected for spring-run, fall-run, and late-fall run Chinook salmon since they occupy these areas while winter-run Chinook salmon do not.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on fall-late fall-run Chinook salmon are the same as those described under Alternative 1A (Impact AQUA-82 through 90). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-82 through 90), and no mitigation is required.

Steelhead

Construction and Maintenance of CM1

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

The potential effects of construction of the water conveyance facilities on steelhead would be similar to those described for Alternative 1A (Impact AQUA-91) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-91, the impact of the construction of water conveyance facilities on steelhead would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-92) except that only three intakes would be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Impact AQUA-92, the effect would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Water Exports from SWP/CVP South Delta Facilities

Alternative 7 would reduce overall entrainment of juvenile steelhead at the south Delta export facilities, estimated as salvage density, by about 82% (~7,200 fish; Table 11-7-50) across all years compared to NAA. Under Alternative 7, entrainment reduction of juvenile steelhead is anticipated to be lowest, approximately 76%, 79% and 80% (~4,800, 8,800 and 10,700 fish, respectively), during wet, below normal and above normal water years, respectively. The greatest relative reductions would occur in dry (~6,700 fish; decrease 97%) and critical water years (~5,500 fish; decrease 99%) compared to NAA (Table 11-7-50). Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

Table 11-7-50. Juvenile Steelhead Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-4,727 (-76%)	-4,820 (-76%)
Above Normal	-10,360 (-80%)	-10,704 (-80%)
Below Normal	-9,557 (-80%)	-8,827 (-79%)
Dry	-7,330 (-97%)	-6,739 (-97%)
Critical	-5,817 (-99%)	-5,466 (-99%)
All Years	-7,363 (-82%)	-7,222 (-82%)

[a] Estimated annual number of fish lost, based on non-normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact and conclusion is similar as for Alternative 1A, Impact AQUA-93 for steelhead. Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The impact and conclusion are the same as for Impact AQUA-93 for steelhead under Alternative 1A for NBA. Potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: Overall, under Alternative 7 potential entrainment of juvenile steelhead would be substantially reduced compared to Existing Conditions. This effect is not adverse and would provide a small incremental benefit to the species.

CEQA Conclusion: As described above, entrainment losses of juvenile steelhead would be less under Alternative 7 compared to Existing Conditions. Overall, impacts would be beneficial to steelhead because of the reduction in entrainment loss and no mitigation would be required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, Alternative 7 would have negligible effects on spawning and egg incubation habitat for steelhead relative to NAA. There would be beneficial effects on water temperatures in the Feather River based on increased cold-water pool availability from increased reservoir storage.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A7_LLT throughout the period would generally be similar to those under NAA except during January in dry and critical water years (7% and 11% lower, respectively) and during February during below normal and critical water years (11% and 9% higher, respectively).

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 7 in any month or water year type throughout the period at either location

SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-51). SacEFT predicts negligible (4%) differences between NAA and A7_LLT in the percentage of years with good (lower) redd scour risk and no (0%) difference in the percentage of years with good (lower) egg incubation conditions. These results indicate that there would be a low effect of Alternative 7 on spawning habitat quantity but no difference in redd scour risk or temperature-related egg incubation conditions.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in the Sacramento River would be negligible.

Table 11-7-51. Difference and Percent Difference in Percentage of Years with "Good" Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	-3 (-4%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	4 (10%)	0 (0%)
Juvenile Stranding Risk	-19 (-56%)	-5 (-25%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A7_LLT would generally be similar to flows under NAA throughout the period, except in critical years during January (6% higher) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between NAA and A7_LLT for all water year types (Table 11-7-52).

No water temperature modeling was conducted in Clear Creek.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in Clear Creek would be negligible.

Table 11-7-52. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	A7_LLT vs. EXISTING CONDITIONS	A7_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.

[a] 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.

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*). Steelhead spawning and egg incubation on the Feather River occurs primarily in Hatchery Ditch and the low-flow channel in the general vicinity of the Feather River Hatchery, but a small number can spawn downstream of Thermalito Afterbay. Instream flows affect physical habitat quality and availability through changes in wetted channel width, water depth, and water velocities. Results of IFIM studies (WUA versus flow relationships) provide information on the spawning habitat conditions in the low-flow channel. Results of CALSIM modeling show that instream flows in the Feather River low-flow channel were the same between NAA and Alternative 7, and range from 700 to 800 cfs under all conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A7_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). Therefore, Alternative 7 is not expected to affect physical habitat conditions for steelhead spawning and egg incubation within the Feather River low-flow channel.

Flows under A7_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in critical years during January and March (24% and 7% lower, respectively) and in dry water years during February (5% 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 A7_LLT would be up to 51% greater than storage under NAA depending on water year type (Table 11-7-25). May Oroville storage under A7_LLT would be similar to storage or up to 16% greater than storage under NAA (Table 11-7-28).

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 7 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 11-7-53). The percent of months exceeding the threshold under Alternative 7 would generally be similar to or lower (up to 9% lower on an absolute scale) than the percent under NAA depending on month and degrees above the threshold.

Table 11-7-53. Differences between Baseline and Alternative 7 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	7 (600%)	2 (NA)	1 (NA)	1 (NA)	1 (NA)
April	36 (414%)	19 (375%)	14 (NA)	5 (NA)	1 (NA)
NAA vs. A7_LLT					
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	-9 (-16%)	-9 (-27%)	-4 (-21%)	-1 (-20%)	0 (0%)

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-7-54). Total degree-months would be similar between NAA and Alternative 7 in January and February and higher in March and April (31% and 6%, respectively).

Table 11-7-54. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, January through April

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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	3 (NA)	1 (50%)
	Dry	4 (NA)	2 (100%)
	Critical	10 (1,000%)	2 (22%)
	All	16 (1,600%)	4 (31%)
April	Wet	5 (NA)	2 (67%)
	Above Normal	12 (600%)	1 (8%)
	Below Normal	17 (425%)	1 (5%)
	Dry	27 (540%)	1 (3%)
	Critical	23 (NA)	0 (0%)
	All	0 (NA)	5 (6%)

NA = could not be calculated because the denominator was 0.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in the Feather River would be negligible.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to flows under NAA during the period except in dry and critical years during March (6% and 17% lower, respectively) and during April (15% and 9% lower, respectively) and in critical years in February (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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 7 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-7-43). Steelhead spawn and eggs incubate in the American River between January and April. During this period, the percent of months exceeding the threshold under Alternative 7 would similar to or up to 22% lower (absolute scale) than the percent under NAA.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-7-44). During the January through April steelhead spawning and egg incubation period, total degree-months would be similar between NAA and Alternative 7.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in the American River would be negligible.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 throughout this period would generally be identical to flows under NAA.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 7 throughout 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*).

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 throughout this period would generally be identical to flows under NAA.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effects of Alternative 7 on flow would not be adverse because they would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg development. Changes in flow and water temperatures during steelhead spawning and egg incubation period in each waterway would be small and inconsistent.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of steelhead spawning habitat relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized* *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during January and February except for dry water years (10% and 8% lower, respectively), similar to Existing Conditions during March except in below normal years (20% lower) and lower than Existing Conditions in April (up to 14% lower). Upstream of Red Bluff Diversion Dam, flows under NAA and Alternative 7 would generally be similar to those at Keswick except there would be no lower flows during January and February.

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period at either location.

SacEFT predicts no changes (0% difference) in spawning habitat, egg incubation, and redd dewatering risk for Alternative 7 compared to Existing Conditions, and a small change (-7%) in redd scour risk (Table 11-7-51) that would not be considered significant.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in the Sacramento River would be small to negligible.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A7_LLT would be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between Existing Conditions and A7_LLT for all water year types except wet, in which the greatest reduction would be 38% lower (worse) under A7_LLT than under Existing Conditions (Table 11-7-52).

No water temperature modeling was conducted in Clear Creek.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg 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 A7_LLT would not differ from Existing Conditions 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 A7_LLT at Thermalito Afterbay would be variable depending on the specific month and water year type. There would be primarily decreases in mean monthly flows in January (-13% to -43%) for all but wet water years, which would increase by 16%. February and March would experience substantial decreases (-7% to -46%) in drier water year types that could significantly affect spawning conditions, and increases in wetter water year types (13% to 33%). April would experience primarily negligible effects (<5%) with the exception of a small decrease (-6%) in critical years and an increase (16%) in dry years.

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. Oroville Reservoir storage volume at the end of September would be 9% to 31% lower under A7_LLT relative to Existing Conditions depending on water year type except for dry years when it would be 12% higher (Table 11-7-25). May Oroville storage volume under A7_LLT would be lower than Existing Conditions by 2% to 9% depending on water year type (Table 11-7-28).

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*). In the low-flow channel, mean monthly water temperatures under Alternative 7 would be 5% to 7% greater than those under Existing Conditions during January through March and similar to temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water temperatures under Alternative 7 would be 5% to 7% greater than those under Existing Conditions during January through March and similar to temperatures under Existing Conditions during April.

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 11-7-53). The percent of months exceeding the threshold under Alternative 7 would generally be similar to the percent under Existing Conditions during January and February and similar to or up to 36% greater (absolute scale) than the percent under Existing Conditions depending on month and degrees above the threshold.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-7-54). Total degree-months would be similar between Existing Conditions and Alternative 7 during January, February and April, and 1,600% higher under Alternative 7 compared to Existing Conditions during March.

Overall, these results indicate that there would be negligible effects of Alternative 7 on mean monthly flows in the low-flow channel, but that flows in the high-flow channel would be substantially lower in some water year types and months. Alternative 7 would substantially increase exposure of spawning steelhead and their eggs to critical water temperatures, a result of reduced coldwater pools availability in Oroville Reservoir.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower than flows under Existing Conditions during January and April and greater than flows under Existing Conditions during February and March with some exceptions.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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). Mean monthly water temperature under Alternative 7 would be 5% to 6% lower than those under Existing Conditions during January through April.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-7-43). Steelhead spawn and eggs incubate in the American River between January and April. During January and February, the percent of month exceeding the threshold under Existing Conditions and Alternative 7 would be identical. During March and April, the percent of months exceeding the threshold under Alternative 7 would be up to 23% greater (absolute scale) than the percent under Existing Conditions.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-7-44). During January and February, there would be no difference in total degree-months above the threshold between Existing Conditions and Alternative 7. During March and April, total degree-months under Alternative 7 would be 389% and 97% greater than those under Existing Conditions, respectively.

Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg incubation habitat in the American River would be moderately negative.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT throughout this period would be up to 14% lower flows under Existing Conditions in all months with few exceptions.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was evaluated 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*). Mean monthly water temperatures under Alternative 7 would be 6% higher than those under Existing Conditions in all months.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to flows under Existing Conditions during January through March and up to 14% lower during April.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Alternative 7 would reduce steelhead spawning conditions through reduced flows and increased water temperatures in the Feather River, and through reduced flows in the American River, particularly during drier water years. This reduction in spawning conditions would reduce spawning success and increase egg mortality. Alternative 7 would not substantially affect steelhead spawning conditions in the Sacramento River and Clear Creek.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, Alternative 7 would not affect the quantity and quality of steelhead rearing habitat relative to NAA.

Sacramento River

Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would generally be similar to or greater (up to 11%) than flows under NAA during February through August and October, and lower than flows under NAA (up to 18% lower) during January, September and November.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing 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 7 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions under A7_LLT would be the same as under NAA (Table 11-7-51).The percentage of years with good (lower) juvenile stranding risk conditions under A7_LLT would 25% lower as under NAA, although this is only 5% lower on an absolute scale.

Overall in the Sacramento River, Alternative 7 would have negligible effects on juvenile steelhead rearing conditions based on negligible effects (<5%) on mean monthly flows with the exception of a moderate reduction (-15%) in wet years, a small decrease (5%) in the percent of years classified as "good" rearing habitat, and no effect on juvenile stranding risk, which collectively are not expected to contribute to biologically meaningful effects in the Sacramento River.

Clear Creek

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A7_LLT would generally be similar to or sometimes greater than flows under NAA, except for below normal years in March and critical years in September in which flows would be 6% 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 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 7 relative to NAA in all water years except in critical years when they would be 10% higher (Table 11-7-55).

Table 11-7-55. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	A7_LLT vs. EXISTING CONDITIONS	A7_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.

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.

Overall, these results indicate that Alternative 7 would not affect juvenile rearing conditions in Clear Creek

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 A7_LLT would not differ from those under NAA. In the high flow channel, flows under A7_LLT would be mostly lower (up to 32%) during April, July, August, September and December, mostly greater (up to 36%) than flows under NAA during January, February, March, June and October, and mixed in May and November.

May Oroville storage under A7_LLT would be similar to or up to 16% higher under NAA (Table 11-7-28). September Oroville storage volume would be 7% to 17% greater than under NAA depending on water year type (Table 11-7-25).Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing 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 7 in any month or water year type throughout the period at either location.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 7 would generally be similar to or lower (up to 20% lower on an absolute scale) than the percent under NAA (Table 11-7-29). At Gridley, the percent of months exceeding the threshold under Alternative 7 would similar to or up to 19% lower (absolute scale) than the percent under NAA (Table 11-7-40).

Total degree-months exceeding 56°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) and at Gridley during November through April. In the low-flow channel, total degree-months under Alternative 7 would be similar to or lower than those under NAA depending on the month (Table 11-7-30). At Gridley, total degree-months would be similar between NAA and Alternative 7 for all months except October, November, and December, in which degree-months would be 6% to 100% lower under Alternative 7 (Table 11-7-41).

Overall, despite some flow reductions in the high-flow channel during late summer, there would be no substantial effects of Alternative 7 on steelhead rearing conditions in the Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to flows under NAA during January, February, November and December, greater than flows under NAA during May, June and July, and lower than flows under NAA during March, and August through September, and with both higher and lower flows in October and November.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing 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 7 in any month or water year type throughout the period.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-7-56). Except for the 3, 4, and 5 degree categories in June and July, the other months and degree categories under Alternative 7 would be similar or lower (up to 69% on the absolute scale) under NAA. The periods with higher values range from 2% to 32% (absolute scale).

Table 11-7-56. Differences between Baseline and Alternative 7 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
May	22 (113%)	9 (58%)	2 (22%)	6 (100%)	0 (0%)
June	31 (48%)	37 (70%)	43 (106%)	42 (136%)	36 (171%)
July	0 (0%)	1 (1%)	37 (59%)	57 (159%)	70 (407%)
August	0 (0%)	0 (0%)	14 (17%)	42 (87%)	51 (164%)
September	-17 (-20%)	2 (5%)	10 (31%)	9 (54%)	9 (117%)
October	6 (125%)	6 (250%)	6 (NA)	1 (NA)	0 (NA)
NAA vs. A7_LLT					
May	-22 (-35%)	-26 (-53%)	-26 (-66%)	-20 (-62%)	-12 (-71%)
June	-4 (-4%)	-1 (-1%)	2 (3%)	7 (11%)	9 (18%)
July	0 (0%)	0 (0%)	2 (3%)	21 (29%)	32 (58%)
August	0 (0%)	-2 (-2%)	-5 (-5%)	-6 (-6%)	-9 (-10%)
September	-32 (-32%)	-42 (-43%)	-43 (-51%)	-49 (-67%)	-44 (-73%)
October	-69 (-86%)	-57 (-87%)	-40 (-86%)	-28 (-96%)	-11 (-100%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-7-57). During May, June, July and October, total degree-months would be similar between NAA and Alternative 7 or up to 8% lower under Alternative 7. During August and September, there would be a 1% to 3% increases in total degree-months exceeding the threshold.

Table 11-7-57. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in the Feather River at the Watt Avenue Bridge, May through October

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	21 (350%)	0 (0%)
	Above Normal	23 (NA)	-4 (-15%)
	Below Normal	22 (733%)	-1 (-4%)
	Dry	30 (136%)	-4 (-7%)
	Critical	29 (153%)	-3 (-6%)
	All	125 (250%)	-12 (-6%)
June	Wet	51 (300%)	-17 (-20%)
	Above Normal	21 (88%)	-11 (-20%)
	Below Normal	32 (110%)	-6 (-9%)
	Dry	44 (65%)	4 (4%)
	Critical	47 (94%)	-3 (-3%)
	All	195 (104%)	-33 (-8%)
July	Wet	52 (67%)	3 (2%)
	Above Normal	12 (44%)	6 (18%)
	Below Normal	19 (56%)	-2 (-4%)
	Dry	36 (58%)	-15 (-13%)
	Critical	37 (46%)	-9 (-7%)
	All	156 (55%)	-17 (-4%)
August	Wet	103 (130%)	-5 (-3%)
	Above Normal	33 (80%)	0 (0%)
	Below Normal	39 (70%)	2 (2%)
	Dry	85 (125%)	4 (3%)
	Critical	67 (85%)	3 (2%)
	All	328 (102%)	5 (1%)
September	Wet	79 (329%)	5 (5%)
	Above Normal	40 (250%)	4 (8%)
	Below Normal	53 (189%)	6 (8%)
	Dry	84 (200%)	-2 (-2%)
	Critical	55 (112%)	2 (2%)
	All	311 (196%)	15 (3%)
October	Wet	54 (5,400%)	0 (0%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	37 (NA)	-2 (-5%)
	Dry	36 (NA)	-1 (-3%)
	Critical	29 (580%)	-1 (-3%)
	All	183 (3,050%)	-3 (-2%)

NA = could not be calculated because the denominator was 0.

These results indicate that effects of Alternative 7 on flow and water temperatures would not reduce juvenile rearing conditions in the American River.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to flows under NAA throughout the period.

Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 7 throughout the year-round period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect of Alternative 7 is not adverse because it does not have the potential to substantially reduce rearing habitat. Effects of Alternative 7 on flows and water temperatures would be small and infrequent in the Sacramento, American, Stanislaus, San Joaquin, and Mokelumne Rivers, and Clear Creek. Flow reductions in the Feather River high-flow channel would be moderate in some months, but there would be no effect on flows in the low-flow channel or on water temperatures in the low-flow and high-flow channels.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of steelhead rearing habitat for steelhead relative to CEQA Existing Conditions.

Sacramento River

Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during January through March, June, July and October under A7_LLT would generally be similar to or greater than those under Existing Conditions. Flows during May and August would be mixed with some water years below and some water years above Existing Conditions. Flows during April, September, November and December would generally be lower under A7_LLT than under Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, mean monthly water temperatures under Alternative 7 would generally be similar to those under Existing Conditions, except during August through December, in which there would be 5% to 6% higher temperatures under Alternative 7.

SacEFT predicts that there would be a 10% increase in the percentage of years with good juvenile rearing habitat under Alternative 7 compared to Existing Conditions (Table 11-7-51). SacEFT predicts there would be a decrease of 56% in occurrence of years with "good" conditions for juvenile stranding risk (Table 11-7-51).This would contribute incrementally to decreased juvenile habitat conditions and would increase the potential for mortality due to stranding.

Based on the incremental effects of reductions in mean monthly flows (up to 21% lower) for some months during drier water year types, and increased risk of juvenile stranding (56%), effects of Alternative 7 on flows would have biologically meaningful effects on juvenile rearing conditions in the Sacramento River.

Clear Creek

Flows in Clear Creek during the year-round rearing period under A7_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years in August through October in which flows would be 6% to 38% lower and in below normal years in October when flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was conducted in Clear Creek.

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 11-7-55. Results indicate that Alternative 7 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to Existing Conditions in all water years except for that they would be 8% lower in critical water years.

Based on the infrequency and relatively small magnitude (single occurrences of -17% and -38%) of flow reductions under Alternative 7, and only small-scale effects on minimum instream flows (-8%), Alternative 7 would not have biologically meaningful effects on juvenile steelhead rearing conditions in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 7 relative to Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows under A7_LLT would be mostly lower (up to 46% lower) during January, May, November and December, mostly similar to or higher (up to 205% higher) in May, June, August, and October, and mixed with some water years higher and some lower in March, April and September.

As reported under Impact AQUA-59, May Oroville storage volume under A7_LLT would be similar to storage under Existing Conditions, except in above normal and dry water years (5% and 9% lower, respectively) (Table 11-7-28). Storage would not be different between Existing Conditions and A7_LLT in other water year types.

As reported in Impact AQUA-58, September Oroville storage volume would be 9% to 31% lower under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 7 would be similar to those under Existing Conditions between April and September, but would be 5% to 10% higher between October and March. In the high-flow channel, mean monthly water temperatures under Alternative 7 would be similar to those under Existing Conditions between March through July and in September, but would be 5% to 8% in the remaining six months.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 7 would generally be similar to the percent under Existing Conditions during May, and similar or up to 46% (absolute scale) higher than the percent under Existing Conditions during June through August (Table 11-7-29). At Gridley, the percent of months exceeding the threshold under Alternative 7 would similar to the percent under Existing Conditions during December through February, but similar to or up to 51% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months (Table 11-7-40).

Total degree-months exceeding 56°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) at Gridley during October through April. In the low-flow channel, total degree-months under Alternative 7 would be similar to those under Existing Conditions during May and 47% to 168% higher during June through August (Table 11-7-30). At Gridley, total degree-months under Alternative 7 would be similar to those under Existing Conditions during December through February and 101% to 2,400% greater than those under Existing Conditions in the remaining months of the period (Table 11-7-41).

These results indicate that the effects of Alternative 7 on water temperatures in the Feather River would have biologically meaningful effects on juvenile rearing success.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally lower than flows under Existing Conditions (up to 66% lower) in April through December (although there are individual water years with high flows in May and June, up to 32% higher), generally higher flows in February and March (up to 32% higher), and mixed higher and lower flows depending on water year in January.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing 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 Existing Conditions and Alternative 7 during June and July but Alternative 7 temperatures would be higher in all other months by 5% to 12%.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-7-54). During most months and degree categories Alternative 7 temperatures are higher by up to 70% on the absolute scale. Temperatures under Alternative 7 are similar to Existing Conditions in some degree categories during July, August, and October.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-7-57). During all months there would be increases in total-degree months under Alternative 7 compared to Existing Conditions. The increases range from 55% to 3,050%.

These results indicate that effects of Alternative 7 on flows would affect juvenile steelhead rearing conditions in the American River throughout most of the year, particularly during drier water years.

Stanislaus River

Flows in the Stanislaus River for Alternative 7 are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January, in wet years in March and June and in below normal years in December. Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternatives 7 would be 6% greater than those under Existing Conditions during all months except during June and July when they would be similar to those under Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing Conditions during January through May and October through December and lower during June through September. However, flows would be lower during majority of water year types within each month from February through May and during October.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Mean monthly flows in the Mokelumne River for Alternative 7 are generally lower than Existing Conditions during all months except during March, in which flows would be similar and during January, February and December, in which they would be up to 18% higher depending on water year type.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results Impact AQUA-95 CEQA analysis indicate that the impact would be significant because it has the potential to substantially reduce rearing habitat y. Juvenile rearing conditions in the Sacramento, Trinity, Feather and American rivers would be affected under Alternative 7. Degraded rearing conditions for juvenile steelhead would reduce their survival and growth in these waterways.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

In general, the effects of Alternative 7 on steelhead migration conditions relative to the NAA are uncertain.

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A7_LLT would be higher than NAA in some water years during February and May (up to 11% higher), similar to NAA during October through January, March, and April, and lower than NAA (up to 14% lower) during November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 7 in any month or water year type throughout the period.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be higher than NAA in some water years during February (up to 11% higher), similar to NAA during September through January, and March, and lower than NAA (up to 14% lower) during, November.

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 7 in any month or water year type throughout the period.

Kelt

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during these two months would be minimally different between NAA and A7_LLT.

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 7 in any month or water year type throughout the period.

Overall in the Sacramento River, these results indicate that Alternative 7 would not have biologically meaningful effects on steelhead kelt migration, but would have biologically meaningful effects on juvenile and adult steelhead migration.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period under A7_LLT would generally be similar to or greater than flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A7_LLT would generally be similar to or greater than flows under NAA except in critical years in September (13% lower) and below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A7_LLT would generally be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, these results indicate that effects of Alternative 7 on flows would not affect juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under NAA in all months and water years except during November in above normal years (8% lower) and dry years during December (17% lower) while flows during May would be mixed with similar flows, lower flows during below normal and critical years (7% and 16% lower, respectively) but higher in critical years (13% higher).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 7 in any month or water year type throughout the period.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under NAA in all months and water years except during November in above normal years (8% lower) and dry years during December (17% lower) while flows in September would generally be lower (13%, 25% and 17%, lower in wet, above normal, and below normal water years) and 15% higher in critical water years.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 7 in any month or water year type throughout the period.

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to those under NAA in March although 8% greater in below normal water years and similar to flows under NAA in April.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 7 in any month or water year type throughout the period.

Overall in the Feather River, the effects of Alternative 7 on flows would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period. Flows under A7_LLT would be lower than under NAA during October (12% lower in below normal years although 8% higher in dry years), March (up to 17% lower in critical years) and April (up to 15% lower in dry years), generally similar to flows under NAA during November, December, January and February, and higher than under NAA during May (20% higher in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 7 in any month or water year type throughout the period.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be variable in September (up to 15% lower in below normal years but up to 27% higher in critical years), lower than under NAA during October (12% lower in below normal years although 8% higher in dry years) and March (up to 17% lower in critical years), generally similar to flows under NAA during November, December, January and February.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 7 in any month or water year type throughout the period

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A7_LLT would generally be lower during March (up to 17% lower in critical years) and April (up to 15% lower in dry years and 9% lower in critical years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 7 in any month or water year type throughout the period.

Overall in the American River, the effects of Alternative 7 on flows would affect kelt migration in dry and critical years but would not affect juvenile and adult migration.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 7 are not different from flows under NAA for any month except for higher flows in below normal, dry and critical water years during June. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt migration in the Stanislaus River.

Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River for Alternative 7 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt migration in the Stanislaus River.

San Joaquin River

Flows in the San Joaquin River at Vernalis for Alternative 7 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt migration in the San Joaquin River.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta for Alternative 7 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt migration in the Mokelumne River.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

The methodology for assessing steelhead Delta migration habitat conditions is fully described in the analysis of Alternative 1A.

Sacramento River

Juveniles

DPM results for Alternative 7 for fall-run Chinook salmon from the Sacramento River (Impact AQUA-78 for Alternative 7) predict decreases in survival of less than 0.5%. Juvenile steelhead are not expected to be negatively affected by predation at the three NDD intakes because of their size and strong swimming ability.

Adults

The upstream adult steelhead migration occurs from September-March, peaking during December-February. The steelhead kelt downstream migration occurs from January-April. For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-origin steelhead apparently have not been examined in detail, for this analysis of effects, it was assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to straying have low importance under Existing Conditions for adult Sacramento River region steelhead.

The proportion of Sacramento River water in the Delta under Alternative 7 during the adult migration period would be increased 13% in September and slightly reduced (1% to 9% decrease) during October to March compared to NAA (Table 11-7-58). The proportion of Sacramento River flow would still comprise 62% to 78% of flows, which would maintain strong olfactory cues for migrating adults under Alternative 7.

Table 11-7-58. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Steelhead Migration Period for Alternative 7

Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
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
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
January	1.6	1.7	7.0	5.4	5.3
February	1.4	1.5	7.1	5.7	5.6
March	2.6	2.8	8.8	6.2	6.0
April	6.3	6.6	14.0	7.7	7.4
	Shading indicates a difference of 10% of greater in flow proportion.				

San Joaquin River

Juveniles

The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. As discussed for fall-run Chinook (Impact AQUA-78), there is a beneficial effect of Alternative 7 to all San Joaquin River basin fish due to positive Old and Middle River flows during migratory months resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under Alternative 7, entrainment and entrainment-related mortality at the South Delta Facilities would be reduced.

Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would alleviate one of the primary concerns related to potential Old and Middle River corridor habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat, food availability, and overall salmonid fitness and survival.

Adults

The proportion of San Joaquin River water in the Delta in September through December under Alternative 7 (1.1% to 7.9%) would increase appreciably by 1% to 6.9% compared to NAA (Table 11-7-58). Little information apparently currently exists as to the importance of Plan Area flows on the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon (Marston et al. 2012). It was assumed with moderate certainty that the attribute of Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult San Joaquin River region steelhead adults as well. Therefore migration conditions would be improved, and Alternative 7 would have a slight beneficial effect on the adult steelhead and kelt migration.

NEPA Effects: Upstream of the Delta, these results indicate that the effect is not adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Effects of Alternative 4 in all locations analyzed would consist primarily of negligible effects on mean monthly flow and water temperatures for the juvenile, adult, and kelt migration periods.

Near-field effects of Alternative 7 NDD on Sacramento River steelhead related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 7 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for steelhead. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 7 on steelhead migration remains uncertain.

For through Delta San Joaquin River flows there would be not any project-related flow changes at Vernalis for juvenile steelhead. For adult steelhead through Delta flow would be similar or slightly improved. The through-Delta effect for the San Joaquin River would not be adverse.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of migration habitat for steelhead relative to CEQA Existing Conditions.

Upstream of the Delta

Sacramento River

Juveniles

May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally similar during October, November, January and March with some higher and lower individual water years, generally lower during December (7% lower in below normal and dry water years) and April (9% lower in below normal years), greater flows than Existing Conditions in February, and mixed flows in May with both lower flows (17% and 11% lower in wet and below normal water years, respectively) and higher flows (8% and 14% higher in above normal and critical years, respectively).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 7 in all months but October, in which temperatures under Alternative 7 would be 5% greater than those under Existing Conditions.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally similar during October, November, January and March with some higher and lower individual water years, generally lower during December (7% lower in below normal and dry water years) and April (9% lower in below normal years), greater flows than Existing Conditions in February, and mixed higher and lower flows in September (up to 52% higher in above normal years and 16%, 18% and 19% lower in below normal, dry and critical years, respectively) and May (17% and 11% lower in wet and below normal water years, respectively; and 8% and 14% higher in above normal and critical years, respectively).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 7 in all months except September and October, in which temperatures under Alternative 7 would be 5% to 6% greater than those under Existing Conditions.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to those under Existing Conditions during March except in below normal water years (11% lower) and lower than under Existing Conditions in April (9% and 6% lower in below normal and dry water years, respectively).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period

Overall in the Sacramento River, the impacts of Alternative 7 on flows would not affect juvenile, adult, or kelt steelhead migration.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile steelhead migration period under A7_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54% greater) except in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A7_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in critical years during September (38% lower) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A7_LLT would generally be similar to or greater than flows under Existing Conditions (up to 8% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, the impacts of Alternative 7 on flows would not affect juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally lower than flows under Existing Conditions during November, December, January, and May (up to 34% lower) although May would have higher flows in critical water years (9% higher), higher flows during October (e.g., 13% higher in critical years), similar or greater flows in February (although 12% lower in below normal water years), and mixed flows during March with lower flows in below normal and critical water years (8% each) and greater in wet and above normal(10% and 13%, respectively).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 7 in all months except November and December, in which temperatures under Alternative 7 would be 5% greater than temperatures under Existing Conditions.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be generally lower than flows under Existing Conditions during November, December, January, and May (up to 34% lower) although May would have higher flows in critical water years (9% higher), higher flows during October (e.g., 13% higher in critical years), similar or greater flows in February (although 12% lower in below normal water years), and mixed flows during September (10%, 57%, and 10% higher in wet, above normal and critical water years, respectively; and 7%, 33% lower in below normal and dry water years, respectively) and March (8% lower flows in below normal and critical water years; and 10% and 13% greater in wet and above normal respectively).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 7 in all months except November and December, in which temperatures under Alternative 7 would be 5% greater than temperatures under Existing Conditions.

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be mixed during March (8% lower flows in below normal and critical water years; and 10% and 13% greater in wet and above normal respectively) and generally similar during April with slightly lower flows during critical years (6% lower).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

Overall in the Feather River, the impact of Alternative 7 on flows would affect juvenile, adult, and kelt migration conditions.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower during October, November, December, January, April and May (up to 33% lower in dry water years during November and above normal water years in May). Flows during February and March would generally be higher (up to 27%) except that they would be 24% and 20% lower, respectively, in critical water years for both months.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% to 11% higher than those under Existing Conditions in all months during the period except December and April, in which there would be no difference in water temperatures between Existing Conditions and Alternative 7.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower during September, October, November, December, and January (up to 46% lower in critical water years during September). Flows during February and March would generally be higher (up to 27%) except that they would be 24% and 20% lower, respectively, in critical water years for both months.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would be 5% to 11% higher than those under Existing Conditions in all months during the period except December, in which there would be no difference in water temperatures between Existing Conditions and Alternative 7.

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows during March would generally be higher (up to 15%)

than under Existing Conditions except that they would be 20% lower in critical water years. Flows during April would be lower (up to 15% lower in dry water years) than under Existing Conditions.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% higher than those under Existing Conditions in March but temperatures would be similar between Existing Conditions and Alternative 7 during April.

Overall in the American River, the impacts of Alternative 7 on flows would affect juvenile, adult and kelt steelhead migration in drier water years.

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 6% to 16% lower than flows under Existing Conditions depending on month except during January, in which there would be no difference.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May steelhead juvenile downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 7.

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7would be 6% to 16% lower than flows under Existing Conditions depending on month, except during January, in which there would be no differences.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 7.

Kelt

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 8% to 11% lower than flows under Existing Conditions during March and April, respectively.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6% higher than those under Existing Conditions during March and April.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Juveniles

Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would 6% greater than flows under Existing Conditions during January, and similar in the remaining 7 months of the period.

Adults

Flows in the San Joaquin River at Vernalis were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would 6% greater than flows under Existing Conditions during January, 8% lower during September, and similar in the remaining 5 months of the period.

Kelt

Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 similar to flows under Existing Conditions in both March and April.

Mokelumne River

Water temperature modeling was not conducted in the Mokelumne River.

Juveniles

Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing Conditions during October and March, 8% to 12% lower than flows under Existing Conditions during November, April, and May, and 12% to 14% higher than flows under Existing Conditions during December through February.

Adults

Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing Conditions during October and March, 9% to 27% lower than flows under Existing Conditions during September and November, and 12% to 14% higher than flows under Existing Conditions during December through February.

Kelt

Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing Conditions during March and 8% lower during April.

Through-Delta

Sacramento River

Based on DPM results for Chinook salmon (Impact AQUA-42), survival of migrating juvenile steelhead under Alternative 7, would be no lower than survival under NAA. Juvenile steelhead are not expected to be negatively impacted by predation at the three NDD intakes because of their size and strong swimming ability. Therefore the impact on juvenile steelhead migration through the Delta would be substantial.

Although straying rates for hatchery-origin steelhead apparently have not been examined in detail, for this analysis of effects, it was assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to straying have low importance under Existing Conditions for adult Sacramento River region steelhead. The proportion of January-March Sacramento River flows in the Delta under Alternative 7 would be slightly reduced compared to Existing Conditions (Table 11-7-49). The proportion of Sacramento River flows would still predominate the flow at Collinsville, thus providing strong olfactory cues during the entire migration period. Alternative 7 would not significantly affect adult migration.

San Joaquin River

Juveniles

There would be no impact on flows in the San Joaquin River at Vernalis under Alternative 7. As discussed for fall-run Chinook (Impact AQUA-78), there is a beneficial effect of Alternative 7 to all San Joaquin River basin fish due to positive Old and Middle River flows during migratory months resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under Alternative 7, entrainment and entrainment-related mortality at the South Delta Facilities would be reduced.

Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would alleviate one of the primary concerns related to potential Old and Middle River corridor habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat, food availability, and overall salmonid fitness and survival.

Adults

The proportion of San Joaquin River-origin water in the flows at Collinsville during the migration period would be 1.1% to 8.9% under Alternative7, compared to 0.2% to 2.6% under Existing

Conditions (Table 11-7-58). This change would substantially increase olfactory cues from San Joaquin River basin, and improve migration conditions.

Summary of CEQA Conclusion

The results of the Impact AQUA-96 analysis indicate generally similar impacts between Alternative 7 and Existing Conditions on locations upstream of the Delta, through Delta conditions on the Sacramento River and through Delta conditions on the San Joaquin River.

Through the Delta, Alternative 7 would result in some effects on flow conditions, during steelhead migration periods (juvenile, adult and kelt), although these effects would not be substantial in both the Sacramento River and San Joaquin River. Similarly, olfactory effects are not expected to be substantial in both locations. Consequently, the through the Delta impacts of Alternative 7 in the both the Sacramento River and the San Joaquin River would be less than significant and no mitigation is required.

Collectively, upstream of the Delta, the results of Impact AQUA-96 CEQA analysis indicate that the effect would be significant because it has the potential to substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, relative to CEQA Existing Conditions. Flows would be substantially lower in all upstream waterways except in Clear Creek and the San Joaquin River. Reduced migration conditions would delay or eliminate successful migration necessary to complete the steelhead life cycle. Flows and water temperature conditions would not affect migration conditions for steelhead.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration conditions for steelhead. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

NEPA Effects: The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-97). This would include potential effects of turbidity, mercury methylation, accidental spills, disturbance of contaminated sediments underwater noise, fish stranding, and predation elements. However, as concluded in Alternative 1A, Impact AQUA-97, restoration construction activities are not expected to adversely affect steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-97 for steelhead, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-98). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-98, contaminants associated with restoration measures are not expected to adversely affect steelhead with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-98 for steelhead, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-99). These would include *CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6 Channel Margin Enhancement, CM7 Riparian Natural Community Restoration*, and *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-99, restored habitat conditions are expected to be beneficial for steelhead and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-99 for steelhead, the potential impact of restored habitat conditions on steelhead is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on steelhead are the same as those described under Alternative 1A (Impact AQUA-100 through 108). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-100 through 108), and no mitigation is required.

Sacramento Splittail

Construction and Maintenance of CM1

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

The potential effects of construction of the water conveyance facilities on Sacramento splittail would be similar to those described for Alternative 1A (Impact AQUA-109) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-109, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-109, the impact of the construction of water conveyance facilities on Sacramento splittail would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-110) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance of water conveyance facilities on Sacramento splittail would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Water Exports from SWP/CVP South Delta Facilities

Total salvage of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass inundation) averaged across all water years is predicted to be 53% greater under Alternative 7 compared to NAA (Table 11-7-59). The greatest increase in total salvage would be in below normal (512-581%) and above normal (922–65% more) water years. However, this effect is related to the expected increase in overall juvenile splittail abundance resulting from additional floodplain habitat in wetter years. The per capita juvenile splittail salvage averaged across all years would be 69% lower under Alternative 7 compared to NAA (Table 11-7-60). Per capita juvenile salvage would be less for all water year types under Alternative 7. Potential adult entrainment (salvage density) would be 80-81% less for adults across all water year types (Table 11-7-61). The decrease in per capita salvage of splittail is due to strict reductions in south Delta exports, especially during the winter and spring months. The relative impact of entrainment on the splittail population would be less under Alternative 7 because the per capita entrainment risk would be lower compared to NAA.

Table 11-7-59. Juvenile Sacramento Splittail Entrainment Index[a] (Yolo Bypass Inundation Method) at the SWP and CVP Salvage Facilities Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	631,597 (66%)	444,938 (39%)
Above Normal	350,188 (765%)	358,793 (965%)
Below Normal	16,917 (495%)	17,349 (581%)
Dry	1,874 (65%)	2,219 (87%)
Critical	-181 (-12%)	270 (25%)
All Years	254,783 (82%)	197,073 (53%)

Shading indicates entrainment increased 10% or more.

[a] Average May-July salvage number, based on normalized data, estimated from Yolo Bypass Inundation Method.

Table 11-7-60. Juvenile Sacramento Splittail Entrainment Index[a] (per Capita Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-1,516,642 (-76%)	-1,192,323 (-71%)
Above Normal	-122,909 (-93%)	-105,077 (-91%)
Below Normal	-9,213 (-92%)	-8,895 (-92%)
Dry	-1,511 (-75%)	-1,020 (-67%)
Critical	-1,125 (-85%)	-868 (-81%)
All Years	-410,833 (-75%)	-309,285 (-69%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

Table 11-7-61. Adult Sacramento Splittail Entrainment Index[a] (Salvage Density Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 7

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-2,752 (-70%)	-2,900 (-71%)
Above Normal	-3,839 (-80%)	-3,838 (-79%)
Below Normal	-2,733 (-81%)	-2,541 (-82%)
Dry	-2,382 (-97%)	-2,220 (-97%)
Critical	-3,324 (-99%)	-3,103 (-99%)
All Years	-2,796 (-80%)	-2,732 (-80%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost, based on normalized data. Average (December–March).

Water Exports from SWP/CVP North Delta Intake Facilities

The impact and conclusion for entrainment of splittail to the proposed SWP/CVP north Delta intakes is the same as for Impact AQUA-111 for splittail under Alternative 1A. Splittail larvae would be vulnerable to entrainment to these intakes and there would be a risk of impingement for juvenile and adult splittail. Little is known about splittail densities around the vicinity of the proposed north Delta intakes, therefore monitoring will be implanted to study the potential effects of impingement and larval entrainment at the north Delta intakes

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effect of implementing dual conveyance for the NBA with an alternative Sacramento River intake would be the same as described under Alternative 1A (Impact AQUA-111).

Predation Associated with Entrainment

Splittail predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Per capita splittail entrainment would be reduced under Alternative 7 at the south Delta by 69% compared to NAA; predation losses would decrease a similar proportion.

Predation at the north Delta would be increased due to the construction of the proposed water export facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was not a factor currently limiting splittail abundance. ***NEPA Effects***: In conclusion, the impact from entrainment and predation loss would not be adverse, because the increase in predation losses at the north Delta under Alternative 7 would be offset by the substantial reduction in per capita south Delta entrainment losses and the increased production of juvenile splittail from *CM2 Yolo Bypass Fisheries Enhancement*.

CEQA Conclusion: Under Alternative 7 total juvenile salvage (based on Yolo Bypass inundation) would be 82% greater averaged across all years compared to Existing Conditions. However, operational activities associated with reduced south Delta water exports would result in an overall decrease in the proportion of splittail population entrained for all water year types. Estimated juvenile entrainment (Per Capita method) and hence pre-screen predation losses would be 75% lower and adult entrainment and pre-screen predation losses would be 80% lower than Existing Conditions. Entrainment of splittail would be reduced at the NBA. The impact and conclusion for predation associated with entrainment would be the same as described above.

In conclusion, the impact of entrainment and associated predation loss under Alternative 7 would be less than significant, because of improvements in overall entrainment and the increased production of juvenile splittail from CM2 actions. No mitigation would be required.

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

In general, Alternative 7 would have beneficial effects on splittail spawning habitat relative to NAA increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins

Slough and the Feather River, and negligible effects on water temperatures in the Feather River, relative to NAA.

Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning overwhelmingly dominates production in wet years. During low-flow years when floodplains are not inundated, spawning in side channels and channel margins would be much more critical.

Floodplain Habitat

Effects of Alternative 7 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow velocity was generally very low throughout the modeled area for most conditions, with generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo Bypass inundation events compared to NAA, especially for dry and critical year types; the changes are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of the analyses provided here. For wet year types, Alternative 7 results in a reduced frequency of shorter-duration events and an increased frequency of the longer-duration events (≥70 days) and an increased frequency in inundation events ≥50 days for above normal years (Figure 11-7-4). For the drier type years (below normal, dry, and critical), Alternative 7 results in no change or an increase in frequency for events greater than 30 days compared to NAA. For below normal years, Alternative 7 would result in occurrence of one inundation event ≥70 days, compared to 0 such events for NAA. For dry and critical years, project-related increases are for 30-49 day duration events as there are no events of longer duration for either scenario. These results indicate that overall project-related effects on occurrence of various duration inundation events would be beneficial for splittail spawning by creating better spawning habitat conditions.

There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 7 ranging from 5 to 832 acres relative to NAA. Areas under A7_LLT would be 49%, 56%, and 193% greater than areas under NAA in wet, above normal, and below normal water years, respectively (Table 11-7-64). There would be increases in area under A7_LLT for dry and critical years relative to NAA, but they would be minimal (7 and 5 acres, respectively. These results indicate that increases in inundated acreage in each water year type would result in increased habitat and have a beneficial effect on splittail spawning.

A potential adverse effect of Alternative 7 that is not included in the modeling is reduced inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the Yolo Bypass.

Channel Margin and Side-Channel Habitat

Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel habitat upstream of the Delta. These habitats are likely to be especially important during dry years, when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are affected by changes in flow because greater flows cause more flooding, thereby increasing availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are expected to be most important to the splittail population because in years of high-flows, when most production comes from floodplain habitats, the upstream side-channel habitats contribute relatively little production.

Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the Sacramento River for the time-frame February through June. These are the most important months for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from the side-channel habitats during May and June if conditions become unfavorable.

Differences between model scenarios for monthly average flows during February through June by water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) flows during February through June under A7_LLT would be similar to flows under NAA with the exception of isolated occurrences of flow increases for several months and water year types ranging from 7% to 15%. Therefore, the effect on spawning habitat for Sacramento splittail is not adverse. These results indicate that there would be some increases in flow (up to 15%) that would have beneficial effects on splittail rearing conditions in the Sacramento River.

For the Feather River at the confluence flows during February, March and April would be similar to or with small increased flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During May there would be flow reductions in dry (-7%) and critical (-16%) years while in June flows under A7_LLT would be up to 50% greater with the exception of a 19% decrease in dry years, resulting in an overall beneficial effect.

Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather River at the confluence with the Sacramento River, respectively were used to investigate the potential effects of Alternative 7 on the suitability of water temperatures for splittail spawning and egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and egg incubation.

There would be no biologically meaningful difference (>5% absolute scale) between NAA and Alternative 7 in the frequency of water temperatures in the Sacramento and Feather Rivers being within the suitable 45°F to 75°F regardless of water year type.

Table 11-7-62. Difference (Percent Difference) in Percent of Days or Months[a] during February to June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at Hamilton City and Feather River at the Confluence with the Sacramento River[b]

	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Hamilton City		
Temperatures below 45°F		
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%)
Temperatures above 75°F		
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 at Sacramento River Confluence		
Temperatures below 45°F		
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)
Temperatures above 75°F		
Wet	4 (NA)	-1 (-19%)
Above Normal	7 (NA)	-2 (-22%)
Below Normal	13 (NA)	2 (18%)
Dry	16 (360%)	2 (11%)
Critical	5 (300%)	-8 (-53%)
All	9 (729%)	-1 (-9%)

NA = could not be calculated because the denominator was 0.

[a] Days were used in the Sacramento River and months were used in the Feather River.

[b] Based on the modeling period of 1922 to 2003.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, the following provides a narrative summary of potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture, which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al. 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds. Actions under Alternative 7 to increase the frequency of Yolo Bypass inundation would increase the frequency of potential stranding events. For splittail, an increase in inundation frequency would also increase the production of Sacramento splittail in the bypass. While total stranding losses may be greater under Alternative 7 than under NAA, the total number of splittail would be expected to be greater under Alternative 7.

In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the potential improvements in habitat capacity outweighed the potential stranding problems that may exist in some years.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The effects of Alternative 7 on splittail spawning habitat are largely beneficial due to increased inundation in the Yolo Bypass. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River, and negligible effects on water temperatures in the Feather River, relative to NAA.

CEQA Conclusion: In general, Alternative 7 would have beneficial effects on splittail spawning habitat relative to CEQA Existing Conditions by increasing the quantity of spawning habitat in the Yolo Bypass. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River. There would be negative effects on water temperatures in the Feather River relative to CEQA Existing Conditions, but the benefits due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River as evidenced by the large amount of spawning activity when inundated.

Floodplain Habitat

Comparisons of splittail weighted habitat area for Alternative 7 and Existing Conditions show relatively little difference between the two scenarios, with no change or relatively small increases or decreases in longer-duration inundation events for Alternative 7 compared to Existing Conditions, except for wet year types (Figure 11-7-4, Table 11-7-63). During wet years there were four fewer inundation events of 30-49 days under Alternative 7, and five fewer inundation events of 50-69 days, but eight (50%) more events of >70 days, compared to Existing Conditions. Alternative 7 would result in increased acreage of suitable spawning habitat compared to Existing Conditions (Table 11-7-64), with increases of between 5 and 971 acres of suitable spawning habitat depending on water year type. Increased areas for wet, above normal, and below normal water years are predicted to be 63%, 57%, and 183%, respectively for Alternative 7. Comparisons for dry and critical water years indicate project-related increases of 7 and 5 acres of suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results indicate that Alternative 7 would have beneficial effects on splittail habitat through increasing spawning habitats by up to 183%.

Table 11-7-63. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February 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. A7_LLT	NAA vs. A7_LLT
30–49 Days		
Wet	-4	-2
Above Normal	-2	-2
Below Normal	3	3
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

Channel Margin and Side-Channel Habitat

Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate that Alternative 7 would have negligible effects (<5%) on channel margin and side-channel habitats through increased flows in February and March, negligible effects or small decreases (to -8%) in April, increases (to 13%) or decreases (to -16%) in May depending on water year type, and an increase for all water year types in June (9% to 24%). Therefore, the impact on spawning habitat for Sacramento splittail on the upper Sacramento River would be less than significant.

Flows in the Feather River at the confluence with the Sacramento River were evaluated during February through June. Flows during this period would generally be similar between Existing Conditions and A7_LLT during February, March and April with some exceptions and with substantial decreases in May and June but with higher flows in critical water years during both months

(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would generally be no biologically meaningful difference (>5% absolute scale) between Existing Conditions and Alternative 7 in the frequency of water temperatures in the Sacramento River being within the suitable 45°F to 75°F while the Feather River would exceed that value in all except wet water years (5% to 16% greater) for the 75°F threshold.

There would be no difference between Existing Conditions and A7_LLT in the number of years with water temperatures below 45°F (Table 11-7-62) because there are never any months with temperatures below 45°F under any scenario. Exceedances above 75°F under A7_LLT would occur more often than under Existing Conditions in dry and critical water years but not in other water years. These results indicate that Alternative 7 would have small negative temperature effects on splittail spawning in the Feather River

Stranding Potential

Because there would be little difference in flow conditions between Alternative 7 and Existing Conditions in Yolo Bypass, the project will not affect stranding potential.

Collectively, these results indicate that the impact would be less than significant and no mitigation would be necessary. The effects of Alternative 7 on splittail spawning habitat would be largely beneficial. Benefits due to increased inundation in the Yolo Bypass would outweigh increases in water temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River, as evidenced by the large amount of spawning activity when inundated.

Table 11-7-64. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass from Existing Biological Conditions to Alternative 7 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	971 (63%)	832 (49%)
Above Normal	652 (57%)	644 (56%)
Below Normal	240 (183%)	244 (193%)
Dry	7 (NA)	7 (NA)
Critical	5 (NA)	5 (NA)

NA = could not be calculated because the denominator was 0.

[a] 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).

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

As described above for spawning habitat, increased inundation of floodplains during wet years is expected to supplement splittail rearing habitat compared to baseline conditions (Table 11-7-64, Figure 11-7-4). Upstream channel flows under Alternative 7 are expected to be similar to baseline conditions.

NEPA Effects: Overall, rearing habitat would be increased under Alternative 7. The effect is not adverse because it would not substantially reduce suitable rearing habitat or substantially reduce the number of fish as a result of juvenile mortality.

CEQA Conclusion: As described above, upstream splittail rearing habitat under Alternative 7 is expected to be similar to Existing Conditions. Increased flows in the Yolo Bypass in wetter years are expected to increase floodplain habitat for rearing splittail. Overall, the impact on splittail rearing habitat would be less than significant because it would not substantially reduce suitable rearing habitat or substantially reduce the number of fish as a result of juvenile mortality. No mitigation would be required.

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

Upstream of the Delta

Effects of Alternative 7 on migration conditions for Sacramento splittail would be the same as described above for channel margin and side-channel environments (Impact AQUA-112). Effects of Alternative 7 on flow in the Sacramento River would consist primarily of negligible effects (<5%) or small increases in flow (to 15%) that would have beneficial effects. Effects of Alternative 7 on flows in the Feather River would consist primarily of negligible effects (<5%) or small increases or decreases in flow that would not have biologically meaningful effects on migration conditions.

Through-Delta

Alternative 7 would reduce OMR reverse flows during the period of juvenile splittail migration through the Delta, compared to NAA. OMR flows would be greater than NAA averaged across all water years and months under Alternative 7; therefore the effect on splittail migration survival would be beneficial.

NEPA Effects: In general, effects of Alternative 7 would be beneficial to splittail through-Delta migration survival, due to reduced OMR reverse flows during the migration period. However, negligible upstream effects would occur, relative to NAA, including in the Sacramento River which is the migration corridor to the most productive splittail spawning area, the Yolo Bypass. Therefore, the effect is not adverse.

CEQA Conclusion:

Upstream of the Delta

Project effects on splittail rearing habitat are the same as described for spawning habitat in the previous impact discussion, Impact AQUA-286. As concluded above, the impact would be less than significant relative to CEQA Existing Conditions and no mitigation would be necessary. The impacts of Alternative 7 on splittail migration conditions consist of negligible effects or small increases or decreases in mean monthly flow in the Sacramento and Feather Rivers. There would be adverse effects due to increased water temperatures in the Feather River but the impacts of this effect on splittail migration would be offset by substantial benefits to the population using the Sacramento River and the Yolo Bypass because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River, as evidenced by the large amount of spawning activity when inundated.

Through-Delta

As described above, average OMR flows would be greater under Alternative 7 than Existing Conditions during the juvenile splittail migration through the Delta. Therefore the impact on splittail migration survival would be beneficial under Alternative 7.

Summary of CEQA Conclusion

As described above, average OMR flows would be greater under Alternative 7 than Existing Conditions during the juvenile splittail migration through the Delta, providing beneficial effects. However, the impact would be less than significant in upstream areas, with negligible increases or decreases in mean monthly flows in the Sacramento and Feather rivers. Therefore, no mitigation is required.

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

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-115). This would include potential effects of turbidity, mercury methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation elements.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-115, restoration construction activities under Alternative 115 are not expected to adversely affect Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-115 for Sacramento splittail, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-116). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-116, contaminants associated with restoration measures are not expected to adversely affect Sacramento splittail with respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-116 for Sacramento splittail, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 22 additional miles of channel margin habitat).

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-117). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-117, restored habitat conditions are expected to be beneficial for Sacramento splittail and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-117 for Sacramento splittail, the potential impact of restored habitat conditions on Sacramento splittail is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: As described in Alternative 1A (Impact AQUA-118 through AQUA-125), the effects of these nine impact mechanisms would range from no effect, to not adverse, to beneficial for Sacramento splittail.

CEQA Conclusion: The nine impact mechanisms listed above would range from no impact, to less than significant to beneficial, and no mitigation is required.

Green Sturgeon

Construction and Maintenance of CM1

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

The potential effects of construction of the water conveyance facilities on green sturgeon would be similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-127, the impact of the construction of water conveyance facilities on green sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-128) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-128, the effect 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 would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

Alternative 7 would substantially reduce overall entrainment of juvenile green sturgeon at the south Delta export facilities, estimated as salvage density, by about 72–75%(~100 fish) as compared to NAA (Table 11-7-65). Unlike Alternative 1A (Impact AQUA-3 for green sturgeon), entrainment reductions would be greater in below normal, dry and critical years (99% decrease, ~50 fish) than in wet and above normal years (62–65% decrease, ~60–70 fish) compared to NAA. Alternative 7 would not have adverse effects on juvenile green sturgeon because of the substantial reductions in entrainment loss.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 7 and NAA (120 fish). The number of juvenile green sturgeon lost to predation at the south Delta facilities would change negligibly between Alternative 7 and NAA. The effects 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).

NEPA Effects: The effect on entrainment and entrainment-related predation under Alternative 7 would not be adverse.

CEQA Conclusion: As described above, annual entrainment losses of juvenile green sturgeon across all years would decrease 76% under Alternative 7 (A7_LLT) (41 fish) relative to Existing Conditions (166 fish) (Table 11-7-65). Overall, impacts of water operations on entrainment of green sturgeon would be beneficial due to the anticipated reduction in entrainment and no mitigation would be required.

Table 11-7-65. Juvenile Green Sturgeon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities for Alternative 7

	Entrainment Index			Absolute Difference (Percent Difference)	
Water Year[b]	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet and Above Normal	116	104	40	-77 (-66%)	-64 (-62%)
Below Normal, Dry, and Critical	50	42	1	-49 (-99%)	-41 (-99%)
All Years	166	146	41	-126 (-76%)	-120 (-75%)

[a] Estimated annual number of fish lost.
[b] Sacramento Valley water year-types.

Since few juvenile green sturgeon are entrained at the south Delta, reductions in entrainment (76% reduction compared to Existing Conditions, representing 126 fish) under Alternative 7 would have little effect on entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 7.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 7 would not affect spawning and egg incubation habitat for green sturgeon relative to NAA.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows can reduce the instream area available for spawning and egg incubation. Flows under A7_LLT would always be similar to or greater than flows under NAA upstream of Red Bluff and similar to or greater than flows under NAA at Keswick, except in below normal and critical years during April (7% and 6% lower, respectively) although flows can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be very few reductions in flows in the Sacramento River under Alternative 7.

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 7 in any month or water year type throughout the period.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees above the 63°F threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-66. There would be no difference in levels of concern between NAA and Alternative 7.

Table 11-7-66. Differences between Baseline and Alternative 7 Scenarios in the Number of Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Red	12 (300%)	3 (19%)
Orange	-1 (-100%)	-1 (NA)
Yellow	5 (250%)	2 (29%)
None	-16 (-21%)	-4 (-7%)

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-7-67). Total degree-days under Alternative 7 would be 4% and 39% lower than under NAA during May and June, respectively, and 14% to 17% higher during July through September.

Table 11-7-67. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	9 (NA)	6 (200%)
	Above Normal	6 (NA)	1 (20%)
	Below Normal	0 (NA)	0 (NA)
	Dry	14 (NA)	13 (1,300%)
	Critical	0 (NA)	0 (NA)
	All	60 (462%)	-3 (-4%)
June	Wet	539 (6,738%)	89 (19%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	59 (NA)	52 (743%)
	Critical	48 (NA)	41 (586%)
	All	11 (NA)	-7 (-39%)
July	Wet	4 (NA)	4 (NA)
	Above Normal	1,600 (1,019%)	225 (15%)
	Below Normal	1,629 (524%)	-5 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	10 (NA)	-1 (-9.1%)
	All	718 (8,975%)	88 (14%)
August	Wet	0 (NA)	0 (NA)
	Above Normal	63 (NA)	25 (66%)
	Below Normal	445 (1,435%)	175 (58%)
	Dry	40 (308%)	-3 (-5%)
	Critical	322 (NA)	70 (28%)
	All	1,947 (969%)	318 (17%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	0 (NA)	0 (NA)
	All	2,055 (690%)	296 (14%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. Flows under A7_LLT would be similar to or greater than flows under NAA with few exceptions of flows up to 26% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be a low level of reductions in flows in the Feather River under Alternative 7 independent of climate change.

Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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 7 in any month or water year type throughout the period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-7-68). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In both May and June, the percent of months exceeding the threshold under Alternative 7 would be similar to or lower (up to 15% lower on an absolute scale) than the percent under NAA.

Table 11-7-68. Differences between Baseline and Alternative 7 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 64°F Threshold, May through September

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
May	33 (104%)	23 (127%)	14 (138%)	10 (267%)	10 (400%)
June	6 (7%)	6 (7%)	11 (14%)	20 (31%)	25 (51%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	23 (34%)
August	0 (0%)	0 (0%)	6 (7%)	15 (18%)	28 (46%)
September	11 (16%)	14 (25%)	27 (96%)	35 (467%)	22 (900%)
NAA vs. A7_LLT					
May	-6 (-9%)	-15 (-26%)	-9 (-27%)	-5 (-27%)	0 (0%)
June	0 (0%)	-2 (-3%)	-5 (-5%)	-9 (-9%)	-15 (-17%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-5 (-5%)
August	0 (0%)	0 (0%)	-2 (-2%)	-5 (-5%)	-6 (-6%)
September	12 (18%)	9 (15%)	6 (13%)	-1 (-3%)	-4 (-13%)

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-7-69). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 7 would be 1% to 6% lower than those under NAA during May and June.

Table 11-7-69. Differences between Baseline and Alternative 7 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 CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	23 (383%)	-1 (-3%)
	Above Normal	12 (109%)	-2 (-8%)
	Below Normal	24 (300%)	0 (0%)
	Dry	32 (229%)	3 (7%)
	Critical	19 (112%)	-1 (-3%)
	All	110 (196%)	-1 (-1%)
June	Wet	53 (71%)	-14 (-10%)
	Above Normal	16 (31%)	-13 (-16%)
	Below Normal	30 (46%)	-2 (-2%)
	Dry	61 (65%)	8 (5%)
	Critical	23 (41%)	-16 (-17%)
	All	184 (54%)	-36 (-6%)
July	Wet	29 (17%)	13 (7%)
	Above Normal	19 (36%)	2 (3%)
	Below Normal	34 (50%)	2 (2%)
	Dry	81 (94%)	37 (28%)
	Critical	71 (90%)	17 (13%)
	All	234 (51%)	71 (11%)
August	Wet	36 (20%)	19 (10%)
	Above Normal	32 (71%)	10 (15%)
	Below Normal	32 (46%)	0 (0%)
	Dry	105 (154%)	27 (18%)
	Critical	38 (45%)	-12 (-9%)
	All	243 (54%)	44 (7%)
September	Wet	-5 (-13%)	22 (183%)
	Above Normal	10 (63%)	19 (271%)
	Below Normal	40 (143%)	0 (0%)
	Dry	39 (139%)	-13 (-16%)
	Critical	59 (295%)	5 (7%)
	All	143 (109%)	33 (14%)

San Joaquin River

Flows in the San Joaquin River under Alternative 7 would be the same as those under NAA throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. No water temperatures modeling was conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable green sturgeon spawning and egg incubation habitat. Flows and water temperatures under Alternative 7 in all rivers examined would be similar to those under the NEPA point of comparison.

CEQA Conclusion: In general, Alternative 7 would not affect spawning and egg incubation habitat for green sturgeon relative to CEQA Existing Conditions.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under A7_LLT would generally be similar to or greater than those under Existing Conditions, except in April at Keswick, during which flows under A7_LLT would be mostly lower (up to 14%) than under Existing Conditions and at Keswick and upstream of Red Bluff during July in critical years (8% and 7% lower, respectively) although flows can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be few reductions in flows in the Sacramento River under Alternative 7 relative to Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-7-12). The combination of number of days and degrees above the 63°F threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-66. The number of "red" years would be 300% higher under Alternative 7 relative to Existing Conditions.

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-7-67). Water temperatures under Alternative 7 would exceed the threshold 60 degree-days (462%) and 11 degree-days (no relative change calculation possible due to division by 0) more than those under Existing Conditions during May and June, respectively.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. At Thermalito, flows under A7_LLT would generally be similar to or greater than those under Existing Conditions, except during February in below normal and dry years (46% and 13% lower, respectively) and during March, in which flows under A7_LLT would be up to 24% lower than under Existing Conditions. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence with the Sacramento River, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions, except during May, in which flows under A7_LLT would be up to 27% lower than under Existing Conditions. These results indicate that there would be reductions in flows in the Feather River under Alternative 7 relative to Existing Conditions.

Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would generally be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 7 in any month or water year type throughout the period, except during February, in which mean monthly temperatures under Alternative 7 would be 6% higher than those under Existing Conditions.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-7-68). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. During the period, the percent of months exceeding the threshold under Alternative 7 would be similar to or higher (up to 33% higher on an absolute scale) than the percent under Existing Conditions.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-7-69). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 7 would be 196% and 54% higher than those under Existing Conditions during May and June, respectively.

San Joaquin River

Flows in the San Joaquin River under Alternative 7 similar to those under Existing Conditions throughout the March through June spawning and egg incubation period for green sturgeon, except during June, in which there would be a 30% flow reduction under Alternative 7 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis).* Flows under Alternative 7 in drier water years during March through May would be up to 16% lower than those under Existing Conditions, however.

No water temperatures modeling was conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce spawning and egg incubation habitat conditions, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7. Although there are high similarities in flows between Existing Conditions and Alternative 7, water temperature conditions would be substantially degraded in the Sacramento and Feather Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in

the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat conditions for green sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

In general, Alternative 7 would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to NAA.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing 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 7 in any month or water year type throughout the period.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 7 in any month or water year type throughout the period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-7-68). The percent of months exceeding the threshold under Alternative 7 would be similar to or lower (up to 15% lower on an absolute scale) than the percent under NAA in all months except September, in which the percent of months under Alternative 7 would be 6% to 12% (absolute scale) lower in the lower three degree categories than the percent under NAA.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-7-69). Total degree-months exceeding the threshold under Alternative 7 would be 1% to 6% lower than those under NAA during May and June and 7% to 14% greater than those under NAA during July through September.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect of Alternative 7 would not be adverse because it does not substantially affect green sturgeon rearing conditions in upstream rivers.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to CEQA Existing Conditions.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature under Alternative 7 would be similar to those under Existing Conditions during May, June and July, but 5% to 7% lower than those under Existing Conditions during August through October and in critical years during July.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 Existing Conditions and Alternative 7 in any month although dry and critical years during July and dry years during August would be 7% to 9% greater under Alternative 7 than those under Existing Conditions.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-7-68). The percent of months exceeding the threshold under Alternative 7 would be similar to or greater (up to 35% higher on an absolute scale) than the percent under Existing Conditions in all months during the period.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-7-69). Total degree-months exceeding the threshold under Alternative 7 would be 51% to 196% greater than those under Existing Conditions depending on month.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce rearing habitat conditions, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 7. Results indicate that water temperature conditions would be substantially degraded in the Sacramento and Feather Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to the alternative does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and the alternative indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and the alternative. This indicates that the differences between Existing Conditions and the alternative found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat conditions for green sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

In general, Alternative 7 would reduce green sturgeon migration conditions relative to NAA.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows under A7_LLT would generally be similar to or greater than flows under NAA in all months except for November and December (at Keswick only) during which flows would be up to 17% lower depending on location, month, and water year type.

Feather River flows under A7_LLT would generally be lower by up to 38% than those under NAA during July through September and December. Flows during other months under A7_LLT would generally be similar to or greater than flows under NAA with some exceptions.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved green sturgeon larval transport that results in improved year class strength. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be lower under Alternative 7 than those under NAA (up to 33% lower).

NEPA Effects: Collectively, these results indicate that the effect is adverse because it has the potential to substantially interfere with the movement of green sturgeon. Reductions in flows under Alternative 7 relative to NAA in the Sacramento River would affect the migratory abilities of juveniles and adults by slowing or inhibiting downstream migration of larvae and juveniles and reducing the ability to sense upstream migration cues and pass impediments by adults and flow reduction in the Feather River would affect the migratory abilities of all three green sturgeon life stages. 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. Even so, proposed mitigation (Mitigation Measure AQUA-132a through AQUA-132c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 7 would reduce green sturgeon migration conditions relative to CEQA Existing Conditions.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows at Keswick under A7_LLT would generally be lower than flows under Existing Conditions during April, September, and December by up to 23% depending on location, month, and water year type. Flows during other months would generally be similar to or greater than flows under Existing Conditions with some exceptions.

For Delta outflow, the percent of months exceeding flow thresholds under A7_LLT would generally be lower than those under Existing Conditions (up to 50% lower) with few exceptions (see Table 11-7-75 below).

Flows in the Feather River at Thermalito under A7_LLT would generally be up to 53% lower than flows under Existing Conditions during January, March, May, July, November, and December. Flows during other months under A7_LLT would generally be similar to or greater than flows under Existing Conditions with some exceptions.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially interfere with the movement of fish. The reduction in flows in the Sacramento and Feather rivers would reduce the migration periods of larval, juvenile, and adult migration, which would substantially slow or inhibit their downstream migration.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 7 would have significant and unavoidable adverse effects on migration, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 7.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 7 operations only. Development of mitigation actions for the incremental impact on migration attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 7.

Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts on Green Sturgeon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration under Alternative 7. 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).

Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-132a.

If feasible means are identified to reduce impacts on migration consistent with the overall operational framework of Alternative 7 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on green sturgeon habitat is not feasible under Alternative 7 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on green sturgeon would remain significant and unavoidable.

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

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-133). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: However, as concluded in Alternative 1A, Impact AQUA-133, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and restoration construction activities are not expected to adversely affect green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-133 for green sturgeon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-134). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-134, contaminants associated with restoration measures are not expected to adversely affect green sturgeon with respect to copper, ammonia and pesticides. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-134 for green sturgeon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-135). These would include *CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration,* and *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-135, restored habitat conditions are expected to be beneficial for green sturgeon and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-135 for green sturgeon, the potential impact of restored habitat conditions on green sturgeon is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on green sturgeon are the same as those described under Alternative 1A (Impact AQUA-136 through 144). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

White Sturgeon

Construction and Maintenance of CM1

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

The potential effects of construction of the water conveyance facilities on white sturgeon would be similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-145, the impact of the construction of water conveyance facilities on white sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than under Alternative 1A because only three intakes would be constructed rather than five. 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 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-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-146) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance of water conveyance facilities on white sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Water Exports

Alternative 7 would substantially reduce overall entrainment of juvenile white sturgeon at the south Delta export facilities, estimated as salvage density, by about 92% across all years as compared to NAA (Table 11-7-70). As discussed for Alternative 1A (Impact AQUA-3 for white sturgeon), entrainment is highest in wet and above normal water years. Under Alternative 7, entrainment in wet and above normal water years would be reduced 96%, compared to NAA. Therefore, Alternative 7 would not have adverse effects on juvenile white sturgeon because of the reductions in entrainment loss.

Predation Associated with Entrainment

Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile white sturgeon entrainment, and hence predation loss, would change minimally between Alternative 7 and NAA (254 fish). 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-147).

NEPA Effects: The overall effect on entrainment and entrainment-related predation under Alternative 7 would not be adverse.

CEQA Conclusion: As described above, operational activities associated with water exports from SWP/CVP south Delta facilities would result in an overall reduction in entrainment for juvenile white sturgeon under Alternative 7, compared to Existing Conditions (Table 11-7-70). Overall, impacts of water operations on entrainment of white sturgeon would be beneficial due to a reduction in entrainment and no mitigation would be required.

The impact and conclusion for predation associated with entrainment would be the same as described. Since few juvenile white sturgeon are entrained at the south Delta, reductions in entrainment (92% reduction compared to Existing Conditions, representing 254 fish) under Alternative 7 would have little effect in affecting entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 7.

Table 11-7-70. Juvenile White Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between Model Scenarios

	Absolute Difference (Percent Difference)	
Water Year[b]	NAA vs. A7_LLT	EXISTING CONDITIONS vs. A7_LLT
Wet and Above Normal	-256 (-96%)	-232 (-96%)
Below Normal, Dry, and Critical	-26 (-69%)	-22 (-66%)
All Years	-282 (-93%)	-254 (-92%)

[a] Estimated annual number of fish lost.
[b] Sacramento Valley water year-types.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 7 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 at Wilkins Slough under A7_LLT during March would be lower than flows under NAA in all water year types (5% to 7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during February, April, and May would be similar to or greater than those under NAA, except in below normal years during February (6% lower) and in dry years during February and May (6% and 5% lower, respectively). These results indicate that there would be mostly small (<10%) reductions in flows in the Sacramento River under Alternative 7.

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 7 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 11-7-10). The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-71. For the 61°F threshold, there would be 2 fewer (4% fewer) "red" years under Alternative 7 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 7.

Table 11-7-71. Differences between Baselines and Alternative 7 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. A7_LLT	NAA vs. A7_LLT
61°F threshold		
Red	47 (588%)	-2 (-4%)
Orange	-3 (-20%)	0 (0%)
Yellow	-20 (-65%)	1 (9%)
None	-24 (-86%)	1 (25%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	2 (NA)	-1 (-50%)
None	-2 (-2%)	1 (1%)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-7-72, Table 11-7-73). Total degree-days exceeding the 61°F threshold under Alternative 7 would be 31% higher than those under NAA during March, although this is an increase of only 5 degree-days, which would not cause biologically meaningful effect to white sturgeon. During April the total degree-days exceeding the 61°F threshold under Alternative 7 would be 8% higher than those under NAA. During May through June, total degree days exceeding the threshold would be 2% to 6% lower than those under NAA. Total degree-days exceeding the 68°F threshold would not differ between NAA and Alternative 7 during March and April, but would be 100% to 38% lower under Alternative 7 than under NAA during May and June.

Table 11-7-72. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	8 (NA)	4 (100%)
	Dry	12 (NA)	1 (9%)
	Critical	1 (NA)	0 (0%)
	All	21 (NA)	5 (31%)
April	Wet	64 (533%)	-2 (-3%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	80 (1,333%)	18 (26%)
	Dry	168 (329%)	24 (12%)
	Critical	17 (1,700%)	3 (20%)
	All	389 (486%)	35 (8%)
May	Wet	1,035 (311%)	-80 (-6%)
	Above Normal	311 (143%)	-40 (-7%)
	Below Normal	502 (273%)	53 (8%)
	Dry	462 (229%)	29 (5%)
	Critical	320 (158%)	-30 (-5%)
	All	2,630 (231%)	-68 (-2%)
June	Wet	605 (105%)	-353 (-23%)
	Above Normal	322 (106%)	-44 (-7%)
	Below Normal	532 (252%)	30 (4%)
	Dry	780 (233%)	78 (8%)
	Critical	566 (151%)	20 (2%)
	All	2,805 (156%)	-269 (-6%)

NA = could not be calculated because the denominator was 0.

Table 11-7-73. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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	33 (471%)	-3 (-7%)
	Above Normal	21 (NA)	1 (5%)
	Below Normal	1 (NA)	1 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	0 (NA)	-1 (-100%)
	All	57 (814%)	-2 (-3%)
June	Wet	6 (NA)	-2 (-25%)
	Above Normal	4 (400%)	0 (0%)
	Below Normal	0 (NA)	-2 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	15 (NA)	-12 (-44%)
	All	25 (2,500%)	-16 (-38%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to or greater than flows under NAA during February to May, except for March of below normal water years (8%). Flows under A7_LLT at the confluence with the Sacramento River would generally be similar to or greater than flows under NAA, except in below normal and dry years during May (7% and 16% lower, respectively). These results indicate that there would generally be few low magnitude reductions in flows in the Feather River during the white sturgeon spawning and egg incubation period under Alternative 7.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ between NAA and Alternative 7 at either location throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 7 during February through May would not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperature modeling was not conducted for the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 7 are generally similar to flows under NAA. In addition, exceedances above key water temperature thresholds for spawning adults and egg incubation under Alternative 7 would generally be similar to or lower than exceedances under NAA.

CEQA Conclusion: In general, under Alternative 7 water operations, the quantity and quality of spawning and egg incubation habitat for white sturgeon would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 7 (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either overstate the effects of Alternative 7 or suggest significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 7.

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 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Wilkins Slough, flows under A7_LLT would generally be similar to or greater than those under Existing Conditions, except in wet years during May (16% lower), below normal years during March, April, and May (5% to 10% lower depending on month), and in dry years during April (6% lower). At Verona, flows under A7_LLT during February would generally be similar to flows under Existing Conditions. Flows under A7_LLT during March through May would generally be lower (6% to 11%) than those under Existing Conditions,. These results indicate that there would be small reductions in flows in the Sacramento River under Alternative 7 relative to Existing Conditions.

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 Existing Conditions and Alternative 7 in any month or water year type throughout the period except for wet years during May (5% greater).

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 11-7-10). The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-7-71. For the 61°F threshold, there would be 47 more (588% increase) "red" years under Alternative 7 than under Existing Conditions. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between Existing Conditions and Alternative 7.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-7-72, Table 11-7-73). Total degree-days exceeding the 61°F threshold under Alternative 7 compared to Existing Conditions would be 21 degree-days (percent change unable to be calculated due to division by 0) to 2,805 degree-days (156%) higher depending on month. Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and Alternative 7 during March and April. During May and June, total degree-days would be 57 (814%) and 25 (2,500%) degree-days higher under Alternative 7, although these small absolute differences would not cause a biologically meaningful effect on white sturgeon.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito Afterbay during February, April and May under A7_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal and dry water years during February (46% and 13% lower, respectively), in critical years during April (6% lower), and in wet years during May (35% lower). Flows during March would generally be similar to or up to 24% lower than flows under Existing Conditions. Flows at the confluence with the Sacramento River under A7_LLT would generally be similar to or greater than flows under Existing Conditions, except in below normal years during February and March (12% and 8% lower, respectively) and critical years during March and April (8% and 6% lower, respectively), and in all but critical years during May (11% to 27% lower depending on water year type). These results indicate that there would be mostly small reductions in flows in the Feather River under Alternative 7 relative to Existing Conditions.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would not differ between Existing Conditions and Alternative 7 at either location throughout the period, except below Thermalito Afterbay during February and March, in which temperatures under Alternative 7 would be 6% higher than temperatures under Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 7 during February through May would not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperature modeling was not conducted for the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above. Water temperature exceedances above NMFS thresholds in the Feather River under Alternative 7 would be more frequent than under Existing Conditions. Elevated water temperatures can lead to reduced green sturgeon spawning success and higher egg mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for white sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

In general, Alternative 7 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to NAA.

Water temperature was used to determine the potential effects of Alternative 7 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing 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 7 in any month or water year type throughout the period.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing 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 7 in any month or water year type throughout the period

Water temperatures were not modeled in the San Joaquin River.

NEPA Effects: These results indicate that the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be no differences in water temperatures in the Sacramento and Feather Rivers.

CEQA Conclusion: In general, Alternative 7 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to CEQA Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 7 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing 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 Existing Conditions and Alternative 7 in any month or water year type throughout the period, except for a 5% to 6% higher mean monthly temperature during August through October, in critical years during January, in wet years during May, in critical years during July, and in below normal years during November under Alternative 7.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing 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 Existing Conditions and Alternative 7 during April through June, and August and September (except for an individual water year in each). During January through March and October through December mean monthly water temperatures under Alternative 7 would be 5% to 7% greater than under Existing Conditions.

Water temperatures were not modeled in the San Joaquin River.

Summary of CEQA Conclusion

Considering the mostly small increase in temperature exceedance under Alternative 7, it is concluded that this impact is less than significant because it does not have the potential to substantially reduce the amount of suitable habitat. No mitigation is necessary.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, the effects of Alternative 7 on white sturgeon migration conditions relative to the NAA are uncertain.

Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins Slough and Verona). Larval transport flows were represented by the average number of months per year during the February through May larval transport period that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-7-74). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A7_LLT were similar to those under NAA, except in above normal water years (6% higher). The number of months per year above 31,000 cfs at Verona would be similar to or lower than the number under NAA in all water year types. On an absolute scale, all these changes would be negligible (up to 0.3 months).

Table 11-7-74. Difference and Percent Difference in Number of Months in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona

	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wilkins Slough, 17,700 cfs[a]		
Wet	0 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (6%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs[b]		
Wet	-0.1 (-2%)	0.1 (1%)
Above Normal	-0.4 (-6%)	-0.1 (-1%)
Below Normal	0 (0%)	0.3 (6%)
Dry	0.2 (4%)	-0.1 (-1%)
Critical	0.3 (7%)	0.2 (5%)
Verona, 31,000 cfs[a]		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-42%)	-0.1 (-33%)
Dry	-0.2 (-61%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.
[a] Months analyzed: February through May.
[b] Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percent of months exceeding flow thresholds under A7_LLT would generally be lower than those under NAA (up to 33%) (Table 11-7-75). These results suggest that, using the positive correlation between Delta outflow and year class strength, year class strength would be lower under Alternative 7.

Table 11-7-75. Difference and Percent Difference in Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April and May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-8 (-11%)	0 (0%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-4 (-4%)	4 (5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-31 (-36%)	-8 (-13%)
	Above Normal	-17 (-40%)	-8 (-25%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-17 (-17%)	-8 (-9%)
20,000 cfs	Wet	-12 (-13%)	-8 (-9%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-8 (-17%)	-8 (-17%)

For juveniles, year-round migration flows at Verona would be more than 5% lower under A7_LLT relative to NAA throughout much of the year under each water year, although differences would rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-7-74). The average number of months exceeding 5,300 cfs under A7_LLT would generally be similar to the number of months under NAA, except in below normal (6% higher) and critical (5% higher) water year types (Table 11-7-74). These increases in exceedances are considered small (<15%) and would not affect white sturgeon adult migration.

NEPA Effects: Upstream flows (above north Delta intakes) are similar between Alternative 7 and NAA (Table 11-7-74). However, due to the removal of water at the North Delta intakes, there are substantial differences in through-Delta flows between Alternative 7 and NAA (Table 11-7-75). Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 7 would be deemed Not Adverse due to the similarities in upstream flow conditions between Alternative 7 and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 7 would be deemed Adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 7 as compared to NAA.

CEQA Conclusion: In general, under Alternative 7 water operations, white sturgeon migration conditions would not be affectedrelative to the CEQA baseline.

The number of months per year with exceedances above the 17,700 cfs threshold at Wilkins Slough under A7_LLT would generally be similar to or lower than those under Existing Conditions, except in above normal years (18% higher) (Table 11-7-74). The number of months per year above 31,000 cfs at Verona would be similar to or lower than those under Existing Conditions in all water years.

For Delta outflow, the percent of months exceeding flow thresholds under A7_LLT would generally be lower than those under Existing Conditions (up to 50% lower) with few exceptions (Table 11-7-75).

For juveniles, average migration flows during were more than 5% lower under A7_LLT relative to Existing Conditions throughout much of the year under each water year type, although differences would rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For adult migration, the average number of months exceeding 5,300 cfs under A7_LLT would generally be similar to or lower than the number of months under Existing Conditions, except in critical water years (7% increase) (Table 11-7-74).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above. As discussed above, the Delta outflow-white sturgeon year class strength correlation has high uncertainty such that it is not possible to determine whether reduced outflow would result in a significant impact. However, flows at Verona would generally not meet the 31,000 cfs threshold under Alternative 7 as frequently as under Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the

alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-151). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-151, restoration construction activities are not expected to adversely affect white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-151 for white sturgeon, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-152). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-152, contaminants associated with restoration measures are not expected to adversely affect white sturgeon with respect to copper, ammonia and pesticides. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-152 for white sturgeon, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-153). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7. Under Alternative 7 more restored floodplain habitat may occur in the south Delta. If it does, there would be additional benefits expected for white sturgeon since they occupy these areas.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-153, restored habitat conditions are expected to be beneficial for white sturgeon and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-153 for white sturgeon, the potential impact of restored habitat conditions on white sturgeon is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on white sturgeon are the same as those described under Alternative 1A (Impact AQUA-154 through 162). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is required.

Pacific Lamprey

Construction and Maintenance of CM1

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

The potential effects of construction of the water conveyance facilities on Pacific lamprey would be similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-163, the impact of the construction of water conveyance facilities on Pacific lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than under Alternative 1A because only three intakes would be constructed rather than five. 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 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-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-164) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Water Exports

The potential entrainment impacts of Alternative 7 on Pacific lamprey would be the same as described above for Alternative 1A (Impact AQUA-165). These actions would avoid or reduce potential entrainment and the effect is not adverse.

Under Alternative 7, average annual entrainment of lamprey at the south Delta export facilities, as estimated by salvage density, would be substantially reduced by about 82% (~2,800 fish) (Table 11-7-76) across all years compared to NAA. Therefore, Alternative 7 would not have adverse effects on lamprey.

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 82% compared to NAA and predation losses would 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 entrainment-related predation on lamprey is considered not adverse.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be reduced under Alternative 7 relative to Existing Conditions. Impacts of water operations on entrainment of Pacific lamprey are considered less than significant, and no mitigation would be required.

Table 11-7-76. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for Alternative 7[a]

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
All Years	-2,751 (-82%)	-2,779 (-82%)

[a] Number of fish lost, based on non-normalized data, for all months.

The impact and conclusion for predation associated with entrainment would be 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 since there is little available knowledge on their distribution and abundance in the Delta. The impact is considered to 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 7 would not affect the quality and quantity of spawning and egg incubation habitat for Pacific lamprey relative to NAA.

Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of flow alterations on egg exposure, called redd dewatering risk, and effects on water temperature. Rapid reductions in flow can dewater redds leading to mortality. Locations for each river used in the dewatering risk analysis were based on available literature, personal conversations with agency experts, and spatial limitations of the CALSIM II model, and include the Sacramento River at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the Sacramento River. Pacific lamprey spawn in these rivers between January and August 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). Water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under all model scenarios in the upper Sacramento, Trinity, Feather, American, and Stanislaus Rivers.

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%. 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, January to August.

Results indicate an increase in redd cohorts exposed to month-over-month flow reductions for Alternative 7 indicates effects would only occur in the Feather River, with a relatively small increase in flow reduction exposures (6%) that would not constitute an adverse effect, and a small reduction in flow reduction exposure (-8%) in the Stanislaus River that would be beneficial (Table 11-7-77).

Table 11-7-77. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts[a]

Location	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
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%)
Stanislaus River at Sacramento River confluence	-3 (-5%)	-5 (-8%)

[a] 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 Alternative 7 than in the baseline.

Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual day or month starts a new "egg cohort" such that there are 19,928 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from January 1 through August 31, and 648 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Exact spawning locations of Pacific lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

In most locations, egg cohort exposure would not differ between NAA and Alternative 7 (Table 11-7-78). However, the number of cohorts exposed under Alternative 7 would be 100% lower than those under NAA in the Sacramento River at Keswick. Also, the number of cohorts exposed under Alternative 7 would be 53% greater than those under NAA in the Feather River at Thermalito Afterbay. The increases and decreases in egg cohort exposure under NAA would not have a biologically meaningful effect due to their small absolute values relative to total egg cohort sizes.

Table 11-7-78. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg Cohort Temperature Exposure[a]

Location	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Keswick	0 (NA)	-51 (-100%)
Sacramento River at Hamilton City	1,106 (NA)	38 (4%)
Trinity River at Lewiston	8 (NA)	3 (60%)
Trinity River at North Fork	14 (NA)	-3 (-18%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	116 (483%)	48 (52%)
American River at Nimbus	74 (673%)	0 (0%)
American River at Sacramento River Confluence	155 (277%)	-5 (-2%)
Stanislaus River at Knights Ferry	3 (NA)	1 (50%)
Stanislaus River at Riverbank	83 (4,150%)	-4 (-4%)

NA = could not be calculated because the denominator was 0.

[a] 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.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because Alternative 7 would not have substantial effects on spawning and egg incubation habitat for Pacific lamprey. Flows and temperatures under Alternative 7 would generally be similar to or better than those under NAA during the periods of Pacific lamprey presence.

CEQA Conclusion: In general, Alternative 7 would not affect the quality and quantity of spawning and egg incubation habitat for Pacific lamprey relative to CEQA Existing Conditions. Comparison of the month-over-month flow reductions for Alternative 7 to Existing Conditions (Table 11-7-77) indicate there would be increased exposures to flow reduction in the Sacramento River at Keswick and Red Bluff (36% and 37%, respectively) and in the American River at Nimbus Dam and the confluence (38% and 36%, respectively). There would be negligible effects (<5%) on flow reduction exposures in the Trinity River, a substantial decrease for the Feather River (-24%), and a small decrease for the Stanislaus River (-5%).

The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 7 would be greater than that under Existing Conditions in all rivers (Table 11-7-78).

Collectively, the results of Impact AQUA-166 CEQA analysis indicate that the impact would be significant because it has the potential to substantially reduce rearing habitat. Both redd dewatering risk and exposure to high temperatures would increase due to Alternative 7 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the

alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, the effect of Alternative 7 would not reduce the quantity or quality of Pacific lamprey rearing habitat relative to NAA based on negligible effects on month-over-month flow reductions and negligible effects on critical water temperatures. There would be small to moderate beneficial effects under Alternative 7 relative to NAA based on decreased occurrence of flow reductions in the Feather River and the American River.

Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete exposure, called ammocoete stranding risk. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of effects were made for ammocoete cohorts 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, and Stanislaus River. An ammocoete remains relatively immobile in the sediment in the same location for 5 to 7 years, after which it migrates downstream. During the upstream rearing period there is potential for ammocoete stranding from rapid reductions in flow.

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 of ammocoetes was assumed to be born every month during their spawning period (January through August) and spend 7 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.

For the Sacramento River at Keswick (Table 11-7-79), Flow reductions under Alternative 7 would be similar to (<5% difference) or less frequent (-12.3%) than under NAA, with a single small increase (6%) for 65% flow reductions. These results indicate that there would be no project-related effects on flow reductions in the Sacramento River at Keswick.

Table 11-7-79. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0.2
-65%	0	6
-70%	4	4
-75%	0.7	0.4
-80%	8	-6
-85%	3	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-7-80) provide slightly more variability in results (Table 11-7-80). Alternative 7 compared to NAA indicates similar conditions (<5% difference) or small decreases (-8% for the 75% flow reduction category) attributable to the project. These results indicate that there would be no project-related effects on flow reductions in the Sacramento River at Red Bluff.

Table 11-7-80. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	4	0.2
-60%	6	4
-65%	2	0.4
-70%	9	-2
-75%	0.2	-8
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the Trinity River for Alternative 7 indicate no effect (0%) or negligible effect (<5% difference) attributable to the project (Table 11-7-81). These results indicate are that there will be no project-related effects on flow reductions in the Trinity River.

Table 11-7-81. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

In the Feather River, comparisons of Alternative 7 to NAA indicate reductions in project-related month-over-month flow effects ranging from -8% to -48% (Table 11-7-82). These results indicate that there will be no project-related effects on flow reductions in the Feather River.

Table 11-7-82. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-9	-8
-85%	-32	-48
-90%	-64	-28

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the American River at Nimbus Dam (Table 11-7-83) and at the confluence with the Sacramento River (Table 11-7-84) indicate no effect (0%), negligible effects (<5%), or substantial decreases (to -22%) attributable to the project for both locations (Table 11-7-83). These results indicate that there will be no project-related effects on flow reductions in the American River.

Table 11-7-83. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	37	-2
-75%	92	0
-80%	227	-14
-85%	296	-22
-90%	200	0

NA = could not be calculated because the denominator was 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Table 11-7-84. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	34	-2
-80%	207	4
-85%	218	-9
-90%	232	-21

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the Stanislaus River (Table 11-7-85) indicate negligible project-related effects on flow reduction in the Stanislaus River. These results indicate that there will be no project-related effects on flow reductions in the Stanislaus River.

Table 11-7-85. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the Sacramento River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	2.5	-6
-75%	52	0.5
-80%	0	0
-85%	0	0
-90%	0	0

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

To evaluate water temperature-related effects of Alternative 7 on Pacific lamprey ammocoetes, we examined the predicted number of ammocoete "cohorts" that experience water temperatures greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each individual day or month starts a new "cohort" such that there are 18,244 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

In general, there would be no differences in the number of ammocoete cohorts exposed to temperatures greater than 71.6°F in each river (Table 11-7-86).There would be 79 more cohorts (70% increase) exposed under Alternative 7 in the Trinity River at Lewiston, but there would be 23 fewer cohorts (8% decrease) exposed at North Fork. In addition, there would be 72 more cohorts (14% increase) exposed under Alternative 7 in the Feather River below Thermalito Afterbay, but there would be River at Fish Barrier Dam, but there would be 0% fewer cohorts (0% decrease) exposed at the Feather River Fish Barrier Dam. Overall, the small to moderate increases and decreases will balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

Table 11-7-86. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month[a]

Location	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Keswick[b]	0 (NA)	-1,705 (-100%)
Sacramento River at Hamilton City[b]	10,569 (NA)	-686 (-6%)
Trinity River at Lewiston	192 (NA)	79 (70%)
Trinity River at North Fork	282 (NA)	-23 (-8%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	297 (153%)	-70 (-12%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	57 (NA)	1 (2%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.
[a] Positive values indicate a higher value in Alternative 7 than in EXISTING CONDITIONS or NAA.
[b] Based on daily data; all other locations use monthly data; 1922–2003.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. In each river, there are no project-related effects on flow reductions or high temperatures during the upstream rearing period that would affect Pacific lamprey ammocoetes.

CEQA Conclusion: In general, under Alternative 7 water operations, the quantity and quality of rearing habitat for Pacific lamprey would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 7 (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either overstate the effects of Alternative 7 or suggest significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 7.

In the Feather River, no effect (0%) or decreased occurrence (-9% to -64%) of flow reductions that may cause Pacific lamprey ammocoete stranding are predicted from the project (Table 11-7-82). Comparisons for the American River at Nimbus Dam (Table 11-7-83) and at the confluence with the Sacramento River (Table 11-7-84) indicate increased chance of occurrence of flow reductions between 70% and 90% for Alternative 7 compared to Existing Conditions; predicted increases ranged from 37% to 296% for Nimbus Dam and from 7% to 232% for the confluence, which were derived from numeric increases on the order of 112 to 336 and 56 to 168 (Nimbus Dam) and 145 to 445 and 112 to 356 (confluence). Comparisons for the Stanislaus River (Table 11-7-85) indicate a small decrease (65% flow reduction), two increases (3% and 52% for the 70% and 75% flow reduction categories) and no change for the other flow reduction categories from 50% to 90%.

The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under Alternative 7 would be higher than those under Existing Conditions in at least one location in all rivers (Table 11-1A-80).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Flow-related effects on ammocoete stranding risk would increase in the Sacramento River at Red Bluff (increases in higher flow reduction categories from 9% to 100%), Trinity River (increases from 18% to 41%), and in the American River at Nimbus Dam (increases from 37% to 296%) and at the confluence with the Sacramento (7% to 232%). Large flow reductions would increase the risk of ammocoete stranding and desiccation in these rivers. Further, ammocoetes would be exposed to increased water temperatures exposure in all rivers examined under Alternative 7 relative to Existing Conditions. Increased exposure to higher water temperatures would increase stress and mortality of ammocoetes.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

In general, the effect of Alternative 7 would not reduce the quality of migration habitats for Pacific lamprey relative to NAA due to moderate flow reductions during portions of the juvenile and/or adult migration periods in the Sacramento River at Rio Vista, Feather River, and American River, including in drier water year types. There would be beneficial effects during specific months for some locations due to small to moderate increases in flow, including the Feather River at the confluence with the Sacramento River, the American River, and the Stanislaus River; some of these would occur in drier water year types but would not be of sufficient magnitude or duration to offset the negative effects of flow reductions predicted during the remainder of the migration periods.

After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macropthalmia (juveniles) once they reach the Delta. Migration generally is associated with large flow pulses in winter months (December through March) (USFWS unpublished data) meaning alterations in flow have the potential to affect downstream migration conditions. The effects of Alternative 7 water operations on seasonal migration flows for Pacific lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of Pacific lamprey during the likely migration period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, and the American River at the confluence with the Sacramento River.

Sacramento River

Macropthalmia

The difference in mean monthly flow rate for the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 7 compared to NAA indicates reductions in flow for most months during most water year types, with isolated exceptions where Alternative 7 would have negligible effects (<5%). Flow reductions range from -6% to -44% with the highest values occurring in May. There would also be small increases in flow (6%) during January and February in wet years. There would be flow reductions ranging from -6% to -25% with the highest and most consistent (across water year types) reductions occurring in March, April and May. Project-related decreases in flow in the Sacramento River at Rio Vista (to -25%) would affect Pacific lamprey macropthalmia migration conditions.

For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), the difference in mean monthly flow rate for Alternative 7 compared to NAA for December to May indicate primarily negligible project-related effect. There are several isolated occurrences of small decreases attributable to the project, ranging from -5% (December, above normal years) to -11% (January, critical years), and several occurrences of small increases for some water year types in February and May, ranging from 6% to 11%. Overall in the Sacramento River, these results indicate that the effect of Alternative 7 on flows would generally be negligible (<5%) and would not affect migration conditions.

Adults

Analysis For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for the time-frame January to June, indicates primarily negligible (<5%) project-related effects or increases in flow depending on the specific month and water year type, with increases ranging from 6% to 11%, with the exception of small decreases in mean monthly flow in January during dry (-7%) and critical water years (-11%). These results indicate that project-related effects are primarily negligible (<5%) with small increases or decreases (to -11%) for a few months that would not cause biologically meaningful effects.

Feather River

Juveniles

Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate decreases in mean monthly flow for December and May range from -6% to -18%, and most of the remaining months have negligible project-related effects on flow with the exception of a small decrease (-10%) in January during critical water years, and increases ranging from 6% to 12% for some water year types in January, February, and March. Overall in the Feather River, these results indicate that the effect of Alternative 7 on flows would generally be negligible with the exception of moderate reductions in flow for December and May (to -18%) that could affect outmigrating macropthalmia during these months.

Adults

For the Feather River at the confluence with the Sacramento River, January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), mean monthly flows under Alternative 7 indicate negligible effects (<5%), and a reversal of some of the water year type effects in June from decreases to small increases. There would be a small increase in mean monthly flow during January in above normal years (9%) and a decrease in critical years (-10%). There would be increases in flow during February in wet, above normal, and critical years ranging from 6% to 12%. There would be negligible effects during March and April for all water year types with the exception of a small increase in flow during March in below normal years (8%). Results for May and June show variable project-related effects depending on the water year type, with decreases in mean monthly flow during May in below normal and dry years (-7%, -16%) and during June in dry years (-19%), and increases in flow during May in critical years (13%) and June in wet (5%), above normal (24%), and critical (50%) water years. These results indicate that project-related effects would include primarily negligible effects or small increases in flow except for mixed effects by water year type in May and June. Decreases in mean monthly flow during dry water years in May (-16%) and June (-19%) would affect migration; however there would be increases in flow during these two months in critical years (13%, 50%) that would have beneficial effects on migration.

American River

Juveniles

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate that Alternative 7 would have negligible (<5%) project-related effects on flows in December and January for all water year types, negligible effects for February through April during all but dry and/or critical water years with decreases ranging from -6% to -17%, and increases ranging from 8% to 20% for all but wet water years in May. Overall in the American River, these results indicate that the effect of Alternative 7 on flows would generally be negligible, with the exception of moderate reductions during February through April in dry and critical years (to –17%) that could affect outmigrating macropthalmia during this time-frame.

Adults

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June primarily negligible (<5%) project-related effects for January to April, with exceptions consisting of small decreases for some months during drier water year types (February during critical years, -7%; and March and April during dry and critical years, -6% to -17%). In contrast, project-related effects for May and June consist of increases in mean monthly flow for almost all water year types, ranging from 8% to 20%, with negligible effects (<5%) in May during wet years and June during dry years. These results indicate the project-related effects on flow would be negligible except during March and April in dry and critical years, when flows would be reduced up to -17%. Project-related increases in flow during May and June (to 20%) would have a beneficial effect on migration.

Stanislaus River

Juveniles

Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate that effects of Alternative 7 on mean monthly flows compared to NAA for the months of December through May are negligible (<5%) for December through May for all water year types. Overall in the Stanislaus River, these results indicate that the effect of Alternative 7 on flows would generally be negligible.

Adults

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January through June negligible (<5%) project-related effects for January through May, and during June in wet and above normal years; there would be project-related increases in flow for the three drier water year types in June ranging from 7% to 25% that would be beneficial for migration.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it would not substantially reduce or degrade migration habitat or substantially reduce the number of fish as a result of mortality. Effects of Alternative 7 on mean monthly flow for the macropthalmia and adult migration periods consist primarily of negligible effects (<5%) in all locations analyzed, with infrequent and small decreases in flow for some months/water years that would not have biologically meaningful effects on migration conditions, with the exception of small to moderate flow reductions for some months and water year types during the migration periods in the Sacramento River at Rio Vista. The negative effect on migration conditions for this location would be offset by beneficial effects from increases in mean monthly flow for some months and water year types during the migration periods for the other locations analyzed, including the Feather, American, and Stanislaus rivers.

CEQA Conclusion: In general, the effect of Alternative 7 would not reduce the quality of suitable migration habitat relative to CEQA Existing Conditions.

Sacramento River

Macropthalmia

Comparing Alternative 7 to Existing Conditions, the difference in mean monthly flow rate for the Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicates reductions in flow ranging from -6% to -44% that vary by month and water year type, with the most substantial flow reductions in December and April through May, and smaller reductions as well as negligible effects (<5%) for during January and February in some water year types. Conclusions are that Alternative 7 would result in decreases in mean monthly flows (to -44%) during all months for macropthalmia migration, with less severe effects in January and February.

Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable effects of Alternative 7 relative to Existing Conditions by month and water year type, with small decreases (maximum of -6%) for some water year types in December, primarily negligible effects in January except for an increase (11%) during wet years, increases in February during most water year types (5% to 11%), primarily negligible effects in March and April with small increases (5%) or decreases (-6% to -11%) for some water year types, and mixed result in May with increases in flow during above normal and critical years (8%, 14%), and decreases during wet and below normal years (-18%, -11%). Overall, the effects would primarily consist of negligible effects (<5%), and small increases or decreases that would not be biologically meaningful to Pacific lamprey migration.

Adults

Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January through June for Alternative 7 relative to Existing Conditions indicate negligible (<5%) effects of Alternative 7 on mean monthly flow or increases ranging from 6% to 14%, depending on the specific month and water year type. Isolated occurrences of decreases in mean monthly flow are predicted during March in below normal years (-11%), April in below normal (-9%) and dry (-6%) years, and May in wet (-18%) and below normal (-11%) years. These results indicate that Alternative 7 would have primarily negligible effects on flow, with relatively small increases or isolated decreases in mean monthly flow that would not have biologically meaningful effects on migration conditions.

Feather River

Juveniles

Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate decreased flow for Alternative 7 compared to Existing Conditions for the three drier water year types during December (-13% to -34%) and January (-5% to -13%), during February in below normal years (-12%), during March in below normal and critical years (-8%, -8%), during April in critical years (-6), and during May in all but critical water years (-11% to -27%). There would be a small increases in flow that would be beneficial for migration during December in above normal years (9%), January in wet years (16%), February in wet and above normal years (21%, 10%), and May in critical years (9%). Effects would be negligible (<5%) in April during all water year types except critical years. These results indicate that there are substantial flow reductions (to -34%) that would occur during December and January in drier water year types that would affect Pacific lamprey migration.

Adults

Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate variable effects of Alternative 7 relative to Existing Conditions depending on the month and water year type, with meaningful changes in flow (>5%) consisting of increases up to 36% (June, critical years) and decreases to -29% (June, dry years). Effects in January through March vary by water year type with generally increases in mean monthly flow in wetter water year types and decreases or negligible effects during drier water year types. Effects during April are negligible, with the exception of a small decrease (-6%) in critical years. Effects during May consist primarily of reductions in mean monthly flow ranging from -11% to -27%, with the exception of an increase in mean monthly flow in critical years (9%). Effects during June vary by water year type, with decreases in wet (-26%) and dry (-29%) years, and increases in above normal (8%) and critical (36%) years. These results indicate that there would be decreases in flows in drier water year types (to -29%) that would affect migration conditions.

American River

Juveniles

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate decreases in flow for Alternative 7 compared to Existing Conditions for most water year types in December (-6% to -24%),April (-9% to -15%), and May (-7% to -33%); as well as in January during below normal, dry, and critical years (-15% to -31%), and in February and March during critical years (-24%, -20%). There would be increases in flow in January, February, and March during wetter water year types, ranging from 7% to 27%. These results indicate that there would be decreases in mean monthly flow for much of the migration period (to -33%), including in drier water years, that would affect Pacific lamprey migration conditions.

Adults

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate variable effects of Alternative 7 depending on the month and water year type. The effect of Alternative 7 on mean monthly flow in January varies by water year type, with increased flow in wet (26%) and above normal years (20%) and decreased flow in the drier water year types (-15% to -31%). Effects of Alternative 7 in February and March consist primarily of increases in mean monthly flow ranging from 7% to 27%, with the exception of decreased flow during critical years for each month (-24%, -20%). In contrast, effects of Alternative 7 in May and June consist primarily of reductions in mean monthly flow ranging from -7% to -44%, with the exception of an increase in June during below normal years (18%) and some water years with negligible effects. These results indicate that there would be decreases in flows in drier water year types (to -44%) that would affect migration conditions.

Stanislaus River

Juveniles

Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate primarily reductions in flow attributable to Alternative 7 compared to Existing Conditions, ranging from -6% to -36%, with isolated occurrences of negligible effects (<5%) or small increases in flow (in January during above normal years, 14%; and in March during wet years, 7%). These results indicate that there would be decreases in flow predicted for much of the migration period (to -36%), including in drier water years, that would affect Pacific lamprey migration conditions.

Adults

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June indicate that flows under Alternative 7 would generally be lower than those under Existing Conditions during February through May (8% to 14% lower) but similar during January and June.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially interfere with the movement of fish. Alternative 7 would causes decreases in mean monthly flow in all locations analyzed except for the Sacramento River during the macropthalmia and adult life stages of Pacific lamprey migration. Flow reductions during the macropthalmia life stage would increase migration delays to the ocean life stage and straying and increase the risk of mortality. Flow reductions during the adult life stage would reduce the ability for adult lamprey to sense olfactory cues from natal spawning grounds if they use these cues for migration.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-169). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-169, restoration construction activities are not expected to adversely affect Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-169 for Pacific lamprey, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-170). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-170, contaminants associated with restoration measures are not expected to adversely affect Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-170 for Pacific lamprey, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-171). These would include *CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration,* and *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-171, restored habitat conditions are expected to be beneficial for Pacific lamprey and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-171 for Pacific lamprey, the potential impact of restored habitat conditions on Pacific lamprey is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on Pacific lamprey are the same as those described under Alternative 1A (Impact AQUA-172 through 180). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-172 through 180), and no mitigation is required.

River Lamprey

Construction and Maintenance of CM1

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

The potential effects of construction of the water conveyance facilities on river lamprey would be similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-181, the impact of the construction of water conveyance facilities on river lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-182) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A,Impact AQUA-182, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Water Exports

The potential entrainment impacts of Alternative 7 on Pacific lamprey would be the same as described for Impact AQUA-183 for river lamprey under Alternative 1A. These actions would avoid or reduce potential entrainment and the effect is not adverse.

Under Alternative 7, average annual entrainment of lamprey at the south Delta export facilities, as estimated by salvage density, would be substantially reduced by about 82% (~2,800 fish) (Table 11-7-87) across all years compared to NAA.

NEPA Effects: Alternative 7 would not have adverse effects on lamprey.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be decreased under Alternative 7 relative to Existing Conditions. Impacts of water operations on entrainment of river lamprey are expected to be less than significant, and no mitigation would be required.

Table 11-7-87. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for Alternative 7[a]

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
All Years	-2,751 (-82%)	-2,779 (-82%)

[a] Number of fish lost, based on non-normalized data, for all months.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, the effect of Alternative 7 would not affect the quantity and quality of spawning habitat for river lamprey relative to NAA.

Flow-related effects on 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, American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River 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, 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.

Flows in all rivers evaluated for the river lamprey spawning period from February to June indicated small project-related increases would occur in the Sacramento River at Keswick (6%) and in the Feather River (7%) (Table 11-7-88). All other locations would experience negligible effects (<5%) attributable to the project.

Table 11-7-88. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Keswick	Difference	5	2
	Percent Difference	16%	6%
Sacramento River at Red Bluff	Difference	3	1
	Percent Difference	8%	3%
Trinity River downstream of Lewiston	Difference	-3	-1
	Percent Difference	-4%	-1%
Feather River Below Thermalito Afterbay	Difference	-6	4
	Percent Difference	-9%	7%
American River at Nimbus	Difference	8	-1
	Percent Difference	15%	-2%
American River at Sacramento River confluence	Difference	10	-7
	Percent Difference	17%	-9%
Stanislaus River at Sacramento River confluence	Difference	-11	-6
	Percent Difference	-20%	-12%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 7 than in existing biological conditions (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 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey "adults need… temperatures [that] do not exceed 25°C," although there is no mention of thermal requirements for eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs, significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs. The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data from the Bureau's temperature model. Each individual day or month starts a new "egg cohort" such that there are 12,320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from February 1 through June 30, and 405 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Spawning locations of river lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

For both thresholds, there would be few differences in egg cohort exposure between NAA and Alternative 7 among all sites (Table 11-7-89). Differences of 21 to 22 cohorts in the Sacramento River at Hamilton City are negligible to the population considering the total number of cohorts is 12,320. In the Feather River below Thermalito Afterbay, there would be 15 more cohorts (39% increase) exposed to the 71.6°F threshold under Alternative 7 relative to NAA, although differences at the 77°F threshold would be negligible. In addition, there would be no differences between NAA and Alternative 7 in egg exposure at the Fish Barrier Dam in the Feather River. Overall, except at one location in the Feather River for the more conservative threshold temperature (71.6°F), these results indicate that there would be no differences in egg exposure to elevated temperatures under Alternative 7.

Table 11-7-89. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg Cohort Temperature Exposure[a]

Location	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	344 (NA)	21 (7%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	3 (NA)	-2 (-40%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	44 (489%)	15 (39%)
American River at Nimbus	26 (520%)	1 (3%)
American River at Sacramento River Confluence	48 (171%)	-6 (-7%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	31 (3,100%)	-3 (-9%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	58 (NA)	22 (61%)
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	9 (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.

[a] 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.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it does not have the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. The effect of Alternative 7 on redd dewatering risk would be negligible at all locations. Further, the effect of Alternative 7 on egg exposure to elevated temperatures would be negligible all locations except the Feather River at Thermalito Afterbay at the more conservative temperature threshold, although there is no effect at the higher threshold, or at Fish Barrier Dam for either temperature threshold.

CEQA Conclusion: In general, the effect of Alternative 7 would not affect the quantity and quality of suitable spawning habitat for river lamprey relative to CEQA Existing Conditions.

Comparisons of Alternative 7 to Existing Conditions indicate increased flow reductions would occur at all locations analyzed in the Sacramento River and the American River; the maximum increase would occur in the American River at the confluence, 17% (Table 11-7-88). Results for the Trinity River, Feather River and Stanislaus River indicate reduced occurrence of flow reductions for Alternative 7 relative to Existing Conditions. These results indicate that there would be negligible effects on flow from Alternative 7 in the Trinity River, Feather River, and Stanislaus River. Decreased occurrence of flow reductions in the Feather (-9%) and Stanislaus Rivers (-20%) would have beneficial effects on redd dewatering. There would be increased risk of redd dewatering from month-over-month flow reductions from Alternative 7 in the Sacramento River (up to 16%) and the American River (up to 17%).

In the Sacramento River at Hamilton City, there would be 344 more cohorts (could not calculate relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 7 relative to Existing Conditions, although this represents a very small proportion of the total number of cohorts evaluated (12,320 cohorts)(Table 11-7-89). Therefore, would not be biologically meaningful. There would be no differences between Existing Conditions and Alternative 7 at either location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 44 more cohorts (489% higher) exposed to the 71.6°F threshold under Alternative 7 relative to Existing Conditions, although there would be no difference at the Fish Barrier Dam. At both locations in the American River, there would be 26 to 48 more cohorts (520% to 171% higher) exposed to the 71.6°F threshold under Alternative 7 relative to Existing Conditions. In the Stanislaus River at Riverbank, there would be 31 more cohorts (3,100% higher) exposed to the 71.6°F threshold under Alternative 7 relative to Existing Conditions, although there would be no difference at the Knights Ferry. There would be no or minimal differences between Existing Conditions and Alternative 7 at any location examined in exposure of egg cohorts to the 77°F threshold except for the Sacramento River at Hamilton City (58 additional cohorts).

Summary of CEQA Conclusion

The results of the Impact AQUA-184 CEQA analysis indicate that that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce the quality and quantity of spawning and egg incubation habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Both redd dewatering risk and exposure to high temperatures would increase due to Alternative 7 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and

Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

In general, the effect of Alternative 7 would be negligible relative to NAA.

Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of effects were made for ammocoete cohorts, as described for Pacific lamprey, in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River 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 Alternative 7 to NAA for the Sacramento River at Keswick (Table 11-7-90) indicate either no effect (0%), negligible effects (<5%), or a small increase (9%) in one category (65% flow reductions) attributable solely to the project (Table 11-7-90).

Table 11-7-90. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	2	0
-60%	6	3
-65%	10	9
-70%	3	4
-75%	-2	4
-80%	13	1
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-7-91) indicate indicates no change (0%), negligible effects (<5%), or very small effects (±5%) attributable to the project

Table 11-7-91. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	6	3
-60%	12	5
-65%	4	3
-70%	10	1
-75%	16	-5
-80%	10	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the Trinity River indicate no effect (0%) or negligible effects (<5%) attributable to the project for all flow reduction categories (Table 11-7-92).

Table 11-7-92. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	26	-4.7
-80%	39	0
-85%	31	0
-90%	62	6

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

In the Feather River, all comparisons show no difference (0%) or reductions in the occurrence of flow reductions between 50–90% (Table 11-7-93).

Table 11-7-93. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0.0
-75%	-2	-2
-80%	-21	-16
-85%	-41	-56
-90%	-62	-32

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the American River at Nimbus Dam (Table 11-7-94) and at the confluence with the Sacramento River (Table 11-7-95) indicated no effect (0%), negligible effects (<5%), or substantial decreases (maximum of -29%) attributable to the project.

Table 11-7-94. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	4	-3
-70%	52	-4
-75%	126	0
-80%	296	-17
-85%	300 [25 to 100]	-29
-90%	200 [25 to 75]	0

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Table 11-7-95. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	4	-3
-75%	2	-2
-80%	27	4
-85%	10	-11
-90%	248	-27

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Comparisons for the Stanislaus River at the confluence with the Sacramento River (Table 11-7-96) indicate that under Alternative 7 there would be no effect (0%) or negligible effect (<5%) for all flow reduction categories.

Table 11-7-96. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the Sacramento River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	-2
-70%	-6	0
-75%	-4	0
-80%	-120	0
-85%	-31	0
-90%	0	0

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day or month starts a new "cohort" such that there are 18,730 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 380 cohorts for the other rivers using monthly data over the same period.

In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 7 would be similar to or lower than those under NAA (Table 11-7-97). Biologically meaningful exceptions includes the Trinity River at Lewiston and Feather River below Thermalito Afterbay for the 71.6°F threshold and the Sacramento River at Hamilton City and the Feather River below Thermalito Afterbay confluence for the 77°F threshold. In all cases, there would be another location within the river that would have similar or lower exceedances under Alternative 7.

Table 11-7-97. 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[a]

Location	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
71.6°F Threshold		
Sacramento River at Keswick[b]	0 (NA)	-1,218 (-100%)
Sacramento River at Hamilton City[b]	8,781 (NA)	-714 (-8%)
Trinity River at Lewiston	90 (NA)	40 (80%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	185 (97%)	55 (17%)
American River at Nimbus	210 (233%)	-35 (-10%)
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%)
77°F Threshold		
Sacramento River at Keswick[b]	0 (NA)	0 (NA)
Sacramento River at Hamilton City[b]	1,502 (NA)	1,352 (90%)
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	190 (NA)	-30 (-14%)
American River at Sacramento River Confluence	240 (NA)	10 (4%)
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.

[a] Positive values indicate a higher value in the preliminary proposal than in EXISTING CONDITIONS or NAA.

[b] Based on daily data; all other locations use monthly data; 1922–2003.

NEPA Effects: These results indicate the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish through ammocoete mortality. Project-related effects on flow reductions and effects on water temperatures in all locations analyzed would be negligible and would not affect river lamprey ammocoete stranding risk and rearing success.

CEQA Conclusion: In general, under Alternative 7 water operations, the quantity and quality of rearing habitat for river lamprey would not be affected relative to the CEQA baseline.

Comparisons of Alternative 7 to Existing Conditions for the Sacramento River at Keswick indicate no effect (0%) and negligible effect (<5%) in occurrence of flow reductions for the lower flow reduction categories as well as 90% (all values are 0), small increases (6% to 13%) in the occurrence of flow reductions for 60%, 65%, and 80%, and a larger increase (44%) in flow reductions of 85% (Table 11-7-90). Comparisons for the Sacramento River at Red Bluff indicate slightly more variable results with small increases in the occurrence of flow reductions in the 55%, 60% and 70% through 80% flow reduction categories ranging from 6% to 16%, and a 100% increase (from 25 to 50 occurrences) in the 85% flow reduction category (Table 11-7-91). Based on the prevalence of negligible effects (<5%), or relatively small increased occurrence of flow reductions for most of the flow reduction categories, the effects of a more substantial increase in flow reductions in a single flow reduction category would not be considered biologically meaningful to river lamprey in the Sacramento River.

Comparisons for the Trinity River indicated no effect (0%) for the lower flow reduction categories, up to 70%, and increases in occurrence ranging from 26% to 62% for the 75% through 90% flow reduction categories (Table 11-7-92). The prevalence of increased occurrence of higher-magnitude flow reductions would affect river lamprey ammocoete stranding in the Trinity River.

Comparisons for the Feather River indicated no effect (0%) or negligible effect (<5%) for all flow reduction categories through 75% flow reductions; for the higher flow reduction categories, there would be a decrease in the occurrence of flow reduction events, ranging from -21% to -62% (Table 11-7-93). Decreased occurrences of flow reductions would have a beneficial effect.

Comparisons for the American River at Nimbus Dam (Table 11-7-94) and at the confluence with the Sacramento River (Table 11-7-95) for Alternative 7 compared to Existing Conditions indicated no effect (0%) or negligible effect (<5%) for the lower flow reduction categories, and increased occurrence of flow reductions between 70% and 90% ranging from 52% to 300% (actual increase from 25 to 100) for Nimbus Dam and from 10% to 248% (actual increase from 25 to 85) for the confluence. The prevalence of increased occurrence of higher-magnitude flow reductions would constitute a biologically meaningful effect on river lamprey ammocoete stranding in the American River.

Comparisons for the Stanislaus River at the confluence with the Sacramento River (Table 11-7-96) indicate no effect (0%), negligible effects (<5%), and flow reductions ranging from -31% to -120%. Decreased occurrences of flow reductions would have a beneficial effect.

The number of ammocoete cohorts exposed to 71.6°F under Alternative 7 would be higher than those under Existing Conditions in most locations examined (Table 11-7-97). The number of ammocoete cohorts exposed to 77°F under Alternative 7 would be higher at the Sacramento River at Hamilton City, the Trinity river at North Fork, the Feather River below Thermalito Afterbay, and both locations on the American River. The other locations would have 0 additional cohorts affected.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. There would be increases in occurrence of flow reduction events for Alternative 7 with respect to Existing Conditions for the Trinity River and the American River at Nimbus Dam and at the confluence with the Sacramento that would be considered a significant impact on river lamprey ammocoete stranding risk for these locations. Alternative 7 would not affect flow reductions in the Sacramento River, Feather River and Stanislaus River. There would also be increases under Alternative 7 on ammocoete cohort exposure to critical water temperatures in the Feather River below Thermalito Afterbay, based on an increase from 0 to 190 cohorts exposed to 71.6°F, and an increase from 0 to 65 cohorts exposed to 77°F, that would have a significant impact on rearing success through ammocoete mortality.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

In general, the effect of Alternative 7 would have negligible effects on river lamprey migration conditions relative to NAA based on negligible effects on flow. There would be beneficial effects from project-related increases in flow in the Feather River and the American River including in drier water year types.

Macropthalmia

After 3 to 5 years river lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. River lamprey migration generally occurs September through November (USFWS unpublished data). The effects of water operations on seasonal migration flows for river lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of river lamprey during the likely migration period (September through November) were examined to predict how Alternative 7 may affect migration flows for outmigrating macropthalmia. Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, American River at the confluence with the Sacramento River, and Stanislaus River at the confluence with the Sacramento River.

Sacramento River

Mean monthly flow rates for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for the river lamprey outmigrating period, September to November, indicate variable project-related effects in September and October ranging from negligible effects (<5%), increases to 7%, and decreases to -18% for above normal and below normal water years. Drier water years would experience negligible effects or small increases in flow. Project-related effects in November would be limited to negligible effects (<5%) and decreases in flow during wetter water year types, ranging from -9% to -14%.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River indicate (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) predominantly decreases in mean monthly flow in September and November with a substantial portion of the September flow reductions (-13% to -25% for wetter water year types) directly attributable to the project; however, project-related effects in September during critical years would increase mean monthly flow by 15%. Project-related effects in October consist of increases in mean monthly flow for the drier water year types ranging from 10% to 29%. Project-related effects would be negligible (<5%) in November for all water year types with the exception of a small decrease in mean monthly flow (-8%) during above normal years. Conclusions are that project-related effects would decrease mean monthly flows in September (to -25%) except in critical years; effects in October and November would be negligible (<5%), small decreases, or increases (October) that would have a beneficial effect. There would be a decrease in flows during September.

American River

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable results, with decreases in mean monthly flow in September during wetter water years (-9% to -15%) and increases during dry (15%) and critical (27%) years; negligible effects (<5%) in October during wet and critical years, decreases in mean monthly flow during above normal (-13%) and below normal (-12%) years, and a small increase (8%) during below normal years. Project-related effects in November would be negligible (<5%) or consist of a small increase (6%) or decrease (-6%) in mean monthly flow depending on water year type. These results indicate that project-related effects during drier water year types in September would be beneficial for migration, with negligible (<5%) or small increases or decreases in October and November depending on water year type.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) negligible project-related effects for all three months during all water year types. These results indicate that Alternative 7 would not affect flows in the Stanislaus River.

Adults

Consideration of effects of flow on adult migration from September through November would be the same as described for the macropthalmia migration period, September through November, above for all rivers evaluated. Alternative 7 would primarily have negligible effects (<5%), small increases or decreases in flow, or decreases in wetter water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Project-related increases in flow in the Feather River during October and in the American River during September in drier water years would have a beneficial effect on adult river lamprey migration.

NEPA Effects: Collectively, these results indicate that the effect is not adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Alternative 7 would primarily have negligible effects (<5%), small increases or decreases in flow, or decreases in wetter water year types. Project-related increases in flow in the Feather River during October and in the American River during September in drier water years would have a beneficial effect on river lamprey macropthalmia migration.

CEQA Conclusion: In general, under Alternative 7 water operations, the quantity and quality of river lamprey migration habitat would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 7 (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either overstate the effects of Alternative 7 or suggest effects that are largely attributable to sea level rise and climate change, and not to Alternative 7.

Macropthalmia

For the Sacramento River at Red Bluff, comparisons of mean monthly flow rate for Alternative 7 to Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate increases in mean monthly flow in September during wetter water years (39%, 52%), and decreases during drier water years ranging from -16% to -19%. Effects of Alternative 7 in October and November consist primarily of negligible (<5%) effects with the exception of an increase in mean monthly flow in October during dry years (11%) and a decrease in November during dry years (-7%). These results indicate that Alternative 7 has the potential for significant effects on river lamprey macropthalmia migration due to flow reductions during a portion of the migration period (decreases during September to -19%).

Comparisons for the Feather River at the confluence with the Sacramento River indicate (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable effects of Alternative 7 relative to Existing Conditions based on month and water year type. There would be increases in mean monthly flow in September during wetter water year types (106%, 57%) and critical years (10%) and decreases during below normal (-7%) and dry (-33%) years. There would be negligible effects (<5%) or increases (10% to 17%) in mean monthly flow in October during all water year types except for a small decrease in mean monthly flow during wet years (-6%). There would be negligible effects (<5%) or decreases (-18% and -9% for wet and below normal years, respectively) in November. Decreases during wetter water year types would not affect migration. However, decreases in flow during September in drier water years (to -33%) would affect migration during this portion of the migration period.

Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate primarily decreases in mean monthly flow rate for September through November, ranging from -5% to -46% depending on the specific month and water year type. Exceptions include negligible effects (<5%) in October during wet and below normal years and an increase in October during critical years (8%). These results indicate that overall effects of Alternative 7 on flows consist of decreases (to -46%) that would affect river lamprey macropthalmia migration.

Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate primarily negligible effects (<5%) and reductions in flow ranging from -5% to -17% depending on the specific month and water year type. Decreases during drier water year types would be small (negligible to -11%) and would have less-than-significant impacts on migration. These results indicate that Alternative 7 effects on flows in the Stanislaus River would affect macropthalmia migration.

Adults

Consideration of effects of flow on adult migration from September through November would be the same as described for the macropthalmia migration period, September through November, above.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. There would be reductions in flows in the Sacramento River during September (to -19%), in the Feather River during September of drier years (to -33%), and in the American River for the entire migration period (decreases to -46%). These flow reductions would affect juvenile migration success, increase straying, and delay access to the ocean. These flow reductions would also affect adult migration success, including a reduction in the ability for adults to sense olfactory cues if they use these cues to find natal spawning grounds.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 7 indicates that flows in the locations and during the

months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

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

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

The potential effects of restoration construction activities under Alternative 7 would be greater than that described for Alternative 1A due to the increased floodplain and channel margin habitat enhancement (see Impact AQUA-187). This would include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish stranding, and predation.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-187, restoration construction activities are not expected to adversely affect river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-187 for river lamprey, the potential impact of restoration construction activities is considered less than significant, and no mitigation would be required.

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

The potential effects of contaminants associated with restoration measures under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-188). This would include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects would be the same as described under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-188, contaminants associated with restoration measures are not expected to adversely affect river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-188 for river lamprey, the potential impact of contaminants associated with restoration measures is considered less than significant, and no mitigation would be required. The same conclusion applies to the additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat).

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

The potential effects of restored habitat conditions under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-189). These would include CM2 Yolo Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-189, restored habitat conditions are expected to be beneficial for river lamprey and the additional restoration included in Alternative 7 provides proportionally more benefit.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-189 for river lamprey, the potential impact of restored habitat conditions on river lamprey is considered to be beneficial. The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: Detailed discussions regarding the potential effects of these impact mechanisms on river lamprey are the same as those described under Alternative 1A (Impact AQUA-190 through 198). The effects range from no effect, to not adverse, to beneficial.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-190 through 198), and no mitigation is required.

Non-Covered Aquatic Species of Primary Management Concern

Construction and Maintenance of CM1

The effects of construction and maintenance of CM1 under Alternative 7would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-1) except that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. Additionally, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities on non-covered species of primary management concern would not be significant except potentially 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.

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-200). Also, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-2, the effects would not be adverse.

CEQA Conclusion: As described above, these impacts would be less than significant.

Water Operations of CM1

The effects of water operations of CM1 under Alternative 7 include a detailed analysis of the following species:

- Striped Bass
- American Shad
- Threadfin Shad
- Largemouth Bass
- Sacramento tule perch
- Sacramento-San Joaquin roach – California species of special concern
- Hardhead – California species of special concern
- California bay shrimp

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Striped bass spawn mostly upstream of the Delta in the Sacramento River, between Colusa and the Feather River confluence; however spawning can take place as far downstream as Isleton (Moyle 2002). Limited spawning occurs in the south Delta and lower San Joaquin River. Striped bass eggs could be transported downstream from spawning grounds towards the proposed north Delta intakes. Although these intakes would be screened to exclude fish larger than 15mm, striped bass eggs or larvae in the vicinity of the screens would have the potential to be entrained. The screens of the alternate NBA intake would be similarly screened.

At the south Delta facilities, entrainment peaks during the summer months, based on historical salvage. Entrainment losses under Alternative 7 would be expected to decrease compared to baseline conditions since exports from the south Delta facilities would be substantially reduced in the summer, especially in June. This result is based on the assumption that striped bass entrainment is proportional to south Delta exports.

Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile striped bass (Nobriga et al. 2004). These diversions are typically small and located on-shore, which may reduce the vulnerability of striped bass to entrainment to these diversions due to their pelagic nature. Reduction or consolidation of diversions from the ROAs (approximately 4–12% of diversions) would not increase entrainment risk and may provide a minor benefit. Also, restoration activities as part of the conservation measures should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that these habitat changes would result in at least a minor improvement in production of juvenile striped bass.

NEPA Effects: In summation, potential entrainment would increase in the Sacramento River for eggs and larvae exposed to the north Delta intakes and the NBA alternative intake compared to baseline (no intake facilities), while entrainment of striped bass older than young of year (YOY) at the south Delta facilities would potentially decrease. Although egg and larval survival is correlated with striped bass YOY production, the variability in egg and larval survival is dampened by a population bottleneck between YOY abundance and recruitment at three years of age (Kimmerer et al. 2000). Hence variations in striped bass survival rates during the first few months of life are moderated by this bottleneck (Kimmerer et al. 2000). Therefore it would be expected that reductions in entrainment of juveniles and adults at the south Delta intakes would have a greater population impact than increases in entrainment at the proposed SWP/CVP north Delta intakes and the NBA intake. Furthermore, reductions/consolidations in agricultural diversions may also reduce entrainment of striped bass.

Overall, the effect on striped bass entrainment would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of striped bass would be the same as described immediately above. The changes in entrainment under Alternative 7 would not substantially reduce the striped bass population when other conservation measures are taken into consideration. The impact would be less than significant and no mitigation would be required.

American Shad

The majority of American shad spawning occurs upstream of the Delta but some spawning is believed to occur in the Delta along the Sacramento River (Stevens 1966). American shad eggs stay suspended in the water column and may gradually drift downstream towards the proposed north Delta intakes. The north Delta is also used as nursery habitat for American shad. The intakes of the proposed north Delta diversions and the NBA intake would be screened, but small life stages (eggs and larvae) would have the potential to be entrained. Some larval American shad would be in the north Delta, but only a small fraction of the total larval population would encounter the proposed North Delta intakes when they are still vulnerable to entrainment.

At the SWP/CVP south Delta facilities, historical salvage of American shad was highest in the summer months but continued to be elevated through the fall months. American shad entrainment losses under Alternative 7 would decrease compared to NAA due to reduced south Delta exports for all months. Reduced south Delta entrainment would also be expected to reduce predation loss associated with these facilities, especially within Clifton Court Forebay. Reduction or consolidation of agricultural diversions in ROAs would not increase entrainment.

NEPA Effects: Overall, the effect on American shad would not be adverse, and would be slightly beneficial.

CEQA Conclusion: The impact of water operations on entrainment of American shad would be the same as described immediately above. The changes in entrainment under Alternative 7 would not substantially reduce the American shad population. The impact would be less than significant and no mitigation would be required.

Threadfin Shad

Threadfin shad are widely distributed throughout the Delta, however they are most abundant in the southeastern region of the Delta where areas of dense SAV in shallow water serve as important spawning and rearing habitat (Feyrer et al. 2009). The proposed SWP/CVP north Delta intakes and alternate NBA intake would be located well upstream of this region, which would limit potential entrainment of shad eggs and larvae, and the intakes would be screened to avoid entrainment of juveniles and adults.

At the SWP/CVP south Delta facilities, historical salvage of threadfin shad peaks sharply in the summer months, with smaller peaks occurring in late fall and early winter. Threadfin shad entrainment losses would decrease due to reduced south Delta exports under Alternative 7. Additionally, reduced south delta entrainment is expected to reduce predation loss associated with these entrainment at these facilities, especially within Clifton Court Forebay.

Agricultural diversions may be sources of entrainment for threadfin shad. Reduction or consolidation of these agricultural diversions under the Plan would decrease or have no impact on threadfin shad entrainment.

NEPA Effects: Overall, entrainment would be reduced, which would benefit threadfin shad. The effect on threadfin shad would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of threadfin shad would be the same as described immediately above. The changes in entrainment under Alternative 7 would not substantially reduce and may benefit the threadfin shad population. The impact would be less than significant and no mitigation would be required.

Largemouth Bass

Historically, entrainment of largemouth bass to the south Delta export facilities peaks during the summer months. At the SWP/CVP south Delta facilities, entrainment losses under Alternative 7 would be expected to decrease compared to NAA, assuming largemouth bass entrainment is proportional to south Delta exports. Water exports from the south Delta would decrease in all months under Alternative 7 compared to NAA.

Largemouth bass are predominantly distributed in the central and south Delta in areas of dense SAV, and thus would have minimal overlap with propose north Delta intake facilities and alternate NBA intake on the Sacramento River. The proposed intakes would be screened to exclude fish larger than 15 mm. Largemouth bass lay demersal eggs in a nest guarded by the male and newly hatched largemouth bass hold around their nests until they begin feeding. Parental male bass protect newly hatched young bass for several weeks at which time, they would be effectively screened. These behaviors minimize the potential for larval largemouth bass to encounter and be entrained into the proposed north Delta intakes and NBA intake.

Agricultural diversions may be sources of entrainment for largemouth bass. Agricultural diversions are typically located nearshore, which is the habitat mainly used by largemouth bass. Reduction or consolidation of these agricultural diversions under the Plan would not be expected to increase entrainment of largemouth bass and would likely reduce overall entrainment attributable to these diversions.

NEPA Effects: Overall, entrainment of largemouth bass would decrease compared to baseline conditions. The effect from Alternative 7 would not be adverse and would likely provide minor benefits.

CEQA Conclusion: The impact of water operation on largemouth bass would be as described immediately above. The changes in entrainment under Alternative 7 would likely benefit the largemouth bass population. The impact would be less than significant and no mitigation would be required.

Sacramento Tule Perch

At the SWP/CVP south Delta facilities, entrainment losses under Alternative 7 would be expected to decrease compared to baseline conditions, because Sacramento tule perch entrainment is assumed to be proportional to south Delta exports. Because water would be exported from the proposed north Delta facilities under Alternative 7, less water would be exported from the south Delta, leading to presumed reductions in Sacramento tule perch south Delta entrainment. Additionally, reduced south Delta entrainment would be expected to reduce the amount of entrainment-related predation loss associated with these facilities, especially within Clifton Court Forebay.

The proposed SWP/CVP north Delta intakes would be screened with state-of-the-art fish screens for fish less than 15 mm in size. Because Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively screened at the proposed north delta facilities.

Agricultural diversions may be sources of entrainment for Sacramento tule perch. Agricultural diversions are typically located nearshore, which is the habitat mainly used by juvenile and adult Sacramento tule perch. Reduction or consolidation of these agricultural diversions under the Plan would decrease entrainment of Sacramento tule perch into these agricultural intakes.

NEPA Effects: In summation, entrainment of Sacramento tule perch would decrease compared to Existing Conditions. Overall, the effect on entrainment from Alternative 7 would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The changes in entrainment under Alternative 7 would be beneficial to the Sacramento tule perch. The impact would be less than significant and no mitigation would be required.

Sacramento-San Joaquin Roach

The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201).

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento-San Joaquin roach would be the same as described immediately above. The impacts would be less than significant.

Hardhead

The effect of water operations on entrainment of hardhead under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201).

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of hardhead would be the same as described immediately above. The impacts would be less than significant.

California Bay Shrimp

NEPA Effects: California bay shrimp do not occur in the vicinity of the intakes and there would be effect.

CEQA Conclusion: The impact of water operations on entrainment of California bay shrimp would be the same as described immediately above. There would be no impact.

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June except in below normal years during April (6% lower) and wet and below normal years during May (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June except in wet years during May and June (35% and 10% lower, respectively), and critical years during April (7% lower), below normal and dry years during May (19% and 26% lower, respectively), and dry years during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA throughout the period except in dry and critical years during April (13% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the range would be lower than the percentage under NAA in all water year types except in critical years (8% higher) (Table 11-7-98).

Table 11-7-98. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (0%)	-5 (-12%)
Above Normal	-9 (-20%)	-6 (-17%)
Below Normal	-5 (-11%)	-7 (-19%)
Dry	0 (0%)	4 (8%)
Critical	8 (21%)	-6 (-12%)
All	-1 (-2%)	-3.7 (-9%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 7 would generally be similar to or greater than flows under NAA, with infrequent, small-magnitude flow reductions that would not have biologically meaningful effects. The percentage of months outside the 59°F to 68°F water temperature range would generally be lower under Alternative 7 than under NAA.

CEQA Conclusion: In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for striped bass relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal and dry years during April (9% and 6% lower, respectively) and wet and below normal years during May (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during April (6% lower), wet years during May (35% lower), and in wet and dry years during June (9% and 14% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or lower than flows under Existing Conditions during April through June (up to 38% lower) except in above and below normal years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Despite several moderate flow reductions for specific months and water year types, reductions would not be consistent for all three months for any one water year type and therefore would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be similar to or lower than flows under Existing Conditions during April through June (to 27% lower) except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be moderate flow reductions in drier water year types for two of the three months of the period; they would not be substantial enough to have biologically meaningful effects.

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June would be similar to or lower than the percentage under Existing Conditions in all water years except critical years (21% higher) (Table 11-7-98). This is a small-magnitude increase that would not have biologically meaningful effects.

Collectively, these results indicate that the impact would not be significant because Alternative 7 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of striped bass relative to Existing Conditions. Flows under Alternative 7 during the April through June spawning, incubation, or initial rearing period would generally be similar to or lower than flows under Existing Conditions, with isolated and small-magnitude occurrence of flow reductions that would not have biologically meaningful effects on the striped bass population. The percentage of months outside the 59°F to 68°F water temperature range would generally be similar to or lower under Alternative 7 compared to Existing Conditions.

American Shad

In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June except above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through June except in below normal and dry years during May (19% and 26% lower, respectively), and dry years during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA throughout the period except in dry and critical years during April (13% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the 60°F to 70°F water temperature range would generally be similar to or lower than the percentage under NAA, except in below normal years (11% greater) (Table 11-7-99). These are small-magnitude increases that would not have biologically meaningful effects.

Table 11-7-99. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-5 (-11%)	0 (0%)
Above Normal	-3 (-8%)	-12 (-36%)
Below Normal	12 (38%)	5 (11%)
Dry	6 (14%)	0 (0%)
Critical	-3 (-8%)	-8 (-25%)
All	1 (2%)	-2 (-5%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in American shad spawning or adult migration. Flows in all rivers examined during the April through June adult migration and spawning period under Alternative 7 would generally be similar to or greater than flows under NAA, with infrequent, small-magnitude flow reductions that would not have biologically meaningful effects.

The percentage of months outside the 60°F to 70°F water temperature range would generally be similar to or lower under Alternative 7 than under NAA.

CEQA Conclusion: In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for American shad relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal and dry years during April (9% and 6% lower, respectively) and wet and below normal years during May (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during April (6% lower), wet years during May (35% lower), and in wet and dry years during June (9% and 14% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or lower than flows under Existing Conditions during April through June (up to 38% lower) except in above and below normal years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Despite several moderate flow reductions for specific months and water year types, reductions would not be consistent for all three months for any one water year type and therefore would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be similar to or lower than flows under Existing Conditions during April through June (to 27% lower) except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be moderate flow reductions in drier water year types for two of the three months of the period; they would not be substantial enough to have biologically meaningful effects.

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of the 60°F to 70°F water temperature range would be similar to or lower than the percentage under Existing Conditions in all water years except below normal and dry years (38% and 14% higher, respectively) (Table 11-7-99). These increases correspond to relatively small absolute increases, 12% and 6%, respectively, and would not have biologically meaningful effects.

Collectively, these results indicate that the impact would not be significant because Alternative 7 would not cause a substantial reduction in American shad adult migration and spawning habitat. Flows under Alternative 7 would generally be similar to or lower than flows under Existing Conditions, with isolated and small-magnitude occurrence of flow reductions that would not have biologically meaningful effects. The percentages of months outside the 60°F to 70°F water temperature range would generally be similar to or lower under Alternative 7 than under Existing Conditions.

Threadfin Shad

In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August threadfin shad spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT during April and May would always be similar to or greater than flows relative to NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April and critical years during August (11% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would nearly always be similar to or greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be lower than those under NAA during July and August (up to 32% lower), greater during June (up to 53%

greater), and similar during the rest of the period, with some exceptions (up to 26% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions that occur in drier water years would generally be offset by increases in adjoining months and would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under NAA throughout the period, with relatively infrequent and small-magnitude exceptions and a single, substantial flow reduction in critical years during August (41% lower) that would be isolated and not have biologically meaningful effects.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would no differences in flows relative to the NAA.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT below 68°F would similar to or greater than those under NAA in all water years (to 7% greater) except in dry years (18% lower) (Table 11-7-100). The increases are of small magnitude and would not have biologically meaningful effects.

Table 11-7-100. Difference and Percent Difference in the Percentage of Months during April–August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F Water Temperature Threshold for Threadfin Shad Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-9 (-15%)	4 (7%)
Above Normal	-25 (-33%)	4 (7%)
Below Normal	-21 (-31%)	3 (6%)
Dry	-37 (-49%)	-7 (-18%)
Critical	-28 (-44%)	0 (0%)
All	-22 (-33%)	1 (2%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in spawning habitat. Flows in all rivers examined during the April through August spawning period under Alternative 7 would generally be similar to or greater than flows under NAA, except during summer months in the Sacramento, Feather, and American rivers. Lower flows during these months in these rivers are not of sufficient magnitude or frequency to have a biologically meaningful effect on threadfin shad. The percentage of months below the spawning temperature threshold would be similar to or slightly higher under Alternative 7 relative to NAA, and is not expected to have a biologically meaningful effect on the threadfin shad population. Additionally, there are no temperature-related effects in any other rivers.

CEQA Conclusion: In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT during April, May, and August would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during June and July would generally be greater than flows under Existing Conditions by up to 11%.

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during May and August (6% and 33% lower, respectively) and wet years during July (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would nearly always be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than flows under Existing Conditions during April through June, and August (up to 63% greater) with some exceptions, and similar to or lower than flows under Existing Conditions during July (to 47% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions in dry water years during June through August that would have a localized effect during that specific water year; other flow reductions would be of small magnitude and would generally be offset by increases in flow in adjoining months.

In the American River at Nimbus Dam, flows under A7_LLT would generally be lower than flows under Existing Conditions during April through August (up to 56% lower) with some exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be of relatively small magnitude and/or would be inconsistent month to month and would not have biologically meaningful negative effects.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions by up to 27% during April, May and July, but similar to or greater than flows under Existing Conditions during the June and August with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water temperature threshold for threadfin shad spawning under A7_LLT would be 15% to 49% lower than the percentage under Existing Conditions, depending on water year type (Table 11-7-100).

Collectively, these results indicate that the impact would not be significant because Alternative 7 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers examined during the April through August spawning period under Alternative 7 would generally be similar to or greater than flows under Existing Conditions, except during summer months in the Sacramento, Feather, and American rivers. Lower flows during these months in these rivers would not be of sufficient magnitude or frequency to cause a biologically meaningful effect on threadfin shad. The percentage of months outside all temperature thresholds are lower under Alternative 7 than under Existing Conditions, indicating that there would be a net temperature-related benefit of Alternative 7 to threadfin shad.

Largemouth Bass

In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would be similar to or greater than flows under NAA during March through June, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June, except in critical years during April (7% lower), below normal and dry years during May (19% and 26% lower, respectively), and dry years during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under NAA during March, April, and June, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under A7_LLT would generally greater by up to 16% relative to NAA.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the 59°F to 75°F water temperature range would be lower than the percentage under NAA in all water years (Table 11-7-101).

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat. Similarly, water temperatures in all rivers would not negatively affect largemouth bass. The effects would not be adverse.

Table 11-7-101. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-16 (-32%)	-2 (-7%)
Below Normal	-14 (-32%)	-4 (-12%)
Dry	-18 (-38%)	0 (0%)
Critical	-15 (-33%)	-4 (-14%)
All	-14 (-28%)	-2 (-4%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March through May (9% to 11% lower), dry years during April (6% lower), and wet years during May (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March (6% lower), critical years during May (6% lower), and wet years during July (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would be lower than flows under Existing Conditions in drier water year types during March (up to 24% lower), and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 25% lower) but no consistent, substantial flow reductions from month to month in any specific water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March and June, except in critical years during March and June (16% and 38% lower, respectively) and wet years during June (28% lower). Flows under A7_LLT during April and May would generally be lower (up to 30% lower) than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would not be consistent month to month in any specific water year type.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would be lower than flows under Existing Conditions by up to 28% during March through May in all water year types except wet years, and similar to or greater than flows under Existing Conditions during June, except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions during March through May would follow flow reductions during December through February as well and would result in a localized effect on spawning conditions.

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of the 59°F to 75°F water temperature range for largemouth bass spawning would be lower than the percentage under Existing Conditions in all water years (16% to 38% lower) (Table 11-7-101).

Sacramento Tule Perch

The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-202, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The impacts would be less than significant.

Sacramento-San Joaquin Roach – California Species of Special Concern

In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would be similar to or greater than flows under NAA during March through June, except in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during March through June, except in critical years during April (7% lower), below normal and dry years during May (19% and 26% lower, respectively), and dry years during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under NAA during March, April, and June, with some exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under A7_LLT would generally be greater by up to 16%.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A7_LLT would be similar to or lower than the percentage under NAA in all water years (Table 11-7-102).

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat. Similarly, water temperatures in all rivers would not negatively affect Sacramento-San Joaquin roach. The effects would not be adverse.

Table 11-7-102. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-5 (-11%)	0 (0%)
Dry	-13 (-23%)	-1 (-3%)
Critical	-17 (-30%)	-2 (-5%)
All	-11 (-19%)	-1 (-1%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

CEQA Conclusion: In general, Alternative 7 would affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March through May (9% to 11% lower), dry years during April (6% lower), and wet years during May (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March (6% lower), critical years during May (6% lower), and wet years during July (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would be lower than flows under Existing Conditions in drier water year types during March (up to 24% lower), and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 25% lower), but with no consistent, substantial flow reductions from month to month in any specific water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during March and June, except in critical years during March and June (16% and 38% lower, respectively) and wet years during June (28% lower). Flows under A7_LLT during April and May would generally be lower (up to 30% lower) than those under Existing

Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would not be consistent month to month in any specific water year type.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would be lower than flows under Existing Conditions by up to 28% during March through May in all water year types except wet years, and similar to or greater than flows under Existing Conditions during June, except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions during March through May would follow flow reductions during December through February as well and would result in a localized effect on spawning conditions.

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A7_LLT would be lower than the percentage under Existing Conditions in all water years (from 11% to 30% lower) (Table 11-7-102).

Hardhead – California Species of Special Concern

In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during April and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during April and May, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always to be similar to flows under NAA during April and May regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during April and May, except in critical years during April (7% lower), and below normal and dry years during May (19% and 26% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA throughout the period except in dry and critical years during April (13% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the range would be similar to or lower than the percentage under NAA in all water years (Table 11-7-103).

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat. Similarly, water temperatures in all rivers would not negatively affect hardhead. The effects would not be adverse.

Table 11-7-103. Difference and Percent Difference in the Percentage of Months during April–May in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 64°F Water Temperature Range for Hardhead Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	2 (3%)	0 (0%)
Above Normal	-18 (-29%)	-9 (-20%)
Below Normal	14 (33%)	-7 (-13%)
Dry	-6 (-10%)	0 (0%)
Critical	-4 (-8%)	-4 (-8%)
All	-1 (-2%)	-3 (-6%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream spawning habitat conditions for hardhead relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April and May, except in below normal and dry years during April (9% and 6% lower, respectively) and wet and below normal years during May (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April and May, except in critical years during April (6% lower) and wet years during May (35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would be lower than flows under Existing Conditions throughout the period (up to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would not be consistent from April to May for any specific water year type except above and below water years, with small reductions during April (7% and 9% lower, respectively) followed by moderate reductions during May (30% and 28%, respectively). These would have a small, localized effect on conditions for those specific water years but would not have biologically meaningful negative effects on spawning success.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower relative to Existing Conditions by up to 27% during April through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to moderate flow reductions in drier water year types for both months that would have a localized effect on spawning conditions but would not have biologically meaningful effects for the region.

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower than the percentage under Existing Conditions in all water years (<5% difference to 29% lower) except in below normal years (33% greater) (Table 11-7-103). This moderate increase for a single water year type would not have biologically meaningful effects.

California Bay Shrimp

NEPA Effects: The effect of water operations on spawning habitat of California bay shrimp under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on spawning habitat of California bay shrimp would be the same as described immediately above. The impacts would be less than significant.

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

The discussion under Alternative 7, Impact AQUA-202 for striped bass also addresses the embryo incubation and initial rearing period. That analysis indicates that there is no adverse effect on striped bass rearing during that period.

NEPA Effects: Other effects of water operations on rearing habitat for striped bass under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on striped bass rearing habitat would be less than significant.

American Shad

The effects of water operations on rearing habitat for American shad under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on American shad rearing habitat would be less than significant.

Threadfin Shad

The effects of water operations on rearing habitat for threadfin shad under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on threadfin shad rearing habitat would be less than significant.

Largemouth Bass

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through November except in above normal and below normal years during September (7% and 18% lower, respectively), below normal years during October (6% lower), and wetter water years during November (to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA during April through November except for infrequent, small-magnitude reductions in flow (to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT generally be similar to or greater than NAA throughout the year, except in critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under NAA during April, June, October, and November, with isolated exceptions, and would be similar to or lower than flows under NAA during May, July, August, and September, (up to 32% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be most critical for habitat conditions, would persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year types.

In the American River at Nimbus Dam, flows under A7_LLT would generally be lower than flows under NAA during September (up to 14% lower), greater during May and June (up to 18% greater), and similar during the rest of the period, with some exceptions (up to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA during April through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under NAA or A7_LLT (Table 11-7-104). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 7 and NAA.

Table 11-7-104. Difference and Percent Difference in the Percentage of Months during April–November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would during November would be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT generally be similar to or greater than flows under NAA throughout the year, with some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than flows under NAA during February, March, June, and October (up to 35% greater), similar during May and November, with some exceptions (up to 26% lower), and lower during July through September and December (up to 32% lower). Flow reductions in drier water years, when effects would be most critical for habitat conditions, would persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA during May and June, lower during September (up to 14% lower), and similar during the remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA and A7_LLT (Table 11-7-105). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 7 and NAA.

Table 11-7-105. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 7 are generally similar to or greater than flows under NAA in most months. In the Feather River there would be persistent, moderate flow reductions in drier water years from May through August, and inconsistent and/or small-magnitude flow reductions from month to month in the other drier water year types; these flow reductions would not have biologically meaningful effects. The percentage of months outside all temperature thresholds examined in the Feather River under Alternative 7 are similar to or lower than under NAA. Also, there are no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to CEQA Existing Conditions.

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions in all months but September (up to 19% lower) with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT during April through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to flows under Existing Conditions during August and September except in critical years (33% and 49% lower, respectively), and would generally be lower than flows under Existing Conditions during October and November (to 25% lower) in most water year types. Moderate to substantial flow reductions in critical years during August through November would have a localized effect on rearing conditions for that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the April through November period, except in critical years during August and September (17% to 38% lower) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during April through June and August through October, with some exceptions, and similar to or lower than flows under Existing Conditions (up to 47% lower) during July and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more critical, include moderate to substantial reductions in dry years during June through September (to 50% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This is a relatively isolated occurrence for a specific water year type and would not have biologically meaningful negative effects on rearing conditions.

In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during June and October with some exceptions (up to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during April, May, July through September, and November would be lower by up to 56% and flows during October would be similar between Existing Conditions and A7_LLT. Flow reductions in drier water years, when effects on habitat conditions would be more critical, would be most persistent from August through September (to 41% lower in below normal years, to 36% lower in dry years, and to 56% lower in critical years); in other months, flow reductions in any specific water year type would be less persistent, of smaller magnitude, and/or would be offset by increases in adjoining months.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions during April, May, July, and October (to 27% lower, including small to moderate reductions in drier water year types), and would be similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower, primarily in wetter water years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F water temperature threshold for year-round juvenile largemouth bass occurrence under Existing Conditions or A7_LLT (Table 11-7-104). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 7 and Existing Conditions.

Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during all months but September and December (up to 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with some exceptions (up to 49% lower), except during October and November when it would generally be lower (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during

August and September (17% and 38% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under Existing Conditions during March through June and August, through October (up to 205% greater), lower during January, March, November, and December (up to 43% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more critical, include moderate to substantial reductions in below normal years during December through March (to 46% lower), moderate to substantial reductions in dry years during June through September (to 50% lower), and reductions in dry and critical years during December through January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under Existing Conditions during February and March (up to 28% greater), lower during April, May, July through September, and November through January (up to 56% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would occur in below normal years during July through September (6% to 41% lower), dry years during July through January (6% to 31% lower), and critical years during August through March (16% to 56% lower) except during October (6% greater). These are fairly persistent flow reductions that would affect rearing conditions for a good part of the year in each of these specific water year types, and would have a localized effect on rearing conditions.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions by up to 36% during December through May and July, but similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F water temperature range for year-round adult largemouth bass occurrence under Existing Conditions or A7_LLT (Table 11-7-105). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 7 and Existing Conditions.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because Alternative 7 would cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects on the largemouth bass population. Reduced flows in other rivers would not have biologically meaningful effects on largemouth bass. The percentages of years outside all temperature thresholds are generally be similar under Alternative 7 and under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to both the alternative and future climate change.

Sacramento Tule Perch

In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would during November would be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA throughout the year, with some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under NAA during February, March, June, and October (up to 35% greater), similar during May and November, with some exceptions (up to 26% lower), and lower during July through September and December (up to 32% lower). Flow reductions in drier water years, when effects would be most critical for habitat conditions, would persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA during May, and June (up to 18% greater), lower during September (up to 14% lower), and similar during the remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT exceeding the 72°F threshold would be higher than the percentage under NAA by 19% to 75% depending on water year type. Although relative differences in all years are large due to small values, the absolute differences in percent exceedance are only 2% to 7% relative to NAA, and do not represent biologically meaningful effects to Sacramento tule perch (Table 11-7-106).

The percentage of months under A7_LLT exceeding the 75°F threshold would be similar to or greater than the percentage under NAA (9% to 100% higher). The large relative differences are large due to small values, the absolute differences in percent exceedance are only from 0.3% to 1%, and would not have biologically meaningful effects on Sacramento tule perch (Table 11-7-106).

Table 11-7-106. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F Water Temperature Thresholds for Sacramento Tule Perch Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
72°F Threshold		
Wet	4 (157%)	4 (67%)
Above Normal	3 (NA)	2 (75%)
Below Normal	5 (NA)	2 (38%)
Dry	12 (NA)	7 (58%)
Critical	14 (333%)	3 (19%)
All	7 (531%)	4 (46%)
75°F Threshold		
Wet	0 (NA)	0.32 (100%)
Above Normal	0 (NA)	0 (NA)
Below Normal	1 (NA)	1 (100%)
Dry	2 (NA)	1 (60%)
Critical	7 (1,000%)	1 (9%)
All	2 (1,700%)	1 (33%)

NA = could not be calculated because the denominator was 0.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined during the year under Alternative 7 are generally similar to or greater than flows under NAA in most months. In the Feather River there would be persistent, moderate flow reductions in drier water years from May through August, and inconsistent and/or small-magnitude flow reductions from month to month in the other drier water year types; these flow reductions would not have biologically meaningful effects on Sacramento tule perch. The percentages of years outside all temperature thresholds under Alternative 7 are generally similar to or slightly greater than the percentages under NAA.

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to CEQA Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during all months but September and December (up to 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with some exceptions (up to 49% lower), except during October and November when it would generally be lower (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 38% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under Existing Conditions during March through June and August, through October (up to 205% greater), lower during January, March, November, and December (up to 43% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more critical, include moderate to substantial reductions in below normal years during December through March (to 46% lower), moderate to substantial reductions in dry years during June through September (to 50% lower), and reductions in dry and critical years during December through January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under Existing Conditions during February and March (up to 28% greater), lower during April, May, July through September, and November through January (up to 56% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would occur in below normal years during July through September (6% to 41% lower), dry years during July through January (6% to 31% lower), and critical years during August through March (16% to 56% lower) except during October (6% greater). These are fairly persistent flow reductions that would affect rearing conditions for a good part of the year in each of these specific water year types, and would have a localized effect on rearing conditions.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions by up to 36% during December through May and July, but similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in Clear Creek or the San Joaquin River.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT exceeding 72°F would be similar to or higher than the percentage under Existing Conditions, by up to 333% (Table 11-7-106).

The percentage of months under A7_LLT exceeding 75°F would be similar to the percentage under Existing Conditions in all water years except critical years (1,000% higher) (Table 11-7-106). In both cases the high relative percentages are due to low values being compared, with absolute differences corresponding to a maximum of 14% for the lower threshold and 7% for the higher threshold. These effects would not have biologically meaningful negative effects on Sacramento tule perch.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 7 would cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American and Feather rivers, which would have biologically meaningful negative effects on the Sacramento tule perch population. Reduced flows in other rivers would not have biologically meaningful effects on Sacramento tule perch. The percentages of years outside both temperature thresholds are generally lower or slightly greater under Alternative 7 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to both the alternative and future climate change.

Sacramento-San Joaquin Roach

In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to NAA.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA throughout the year, with some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under NAA during February, March, June, and October (up to 35% greater), similar during May and November, with some exceptions (up to 26% lower), and lower during July through September and December (up to 32% lower). Flow reductions in drier water years, when effects would be most critical for habitat conditions, would persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA during May and June, lower during September (up to 14% lower), and similar during the remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA and A7_LLT (Table 11-7-107). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 7 and NAA.

Table 11-7-107. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Range for Sacramento-San Joaquin Roach Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in spawning and juvenile and adult Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under Alternative 7 are generally similar to or greater than flows under NAA in most months. In the Feather River there would be persistent, moderate flow reductions in drier water years from May through August, and inconsistent and/or small-magnitude flow reductions from month to month in the other drier water year types; these flow reductions would not have biologically meaningful effects. The percentages of years outside all temperature thresholds examined in the Feather River are generally similar to or lower under Alternative 7 than under NAA. Also, there are no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during all months but September and December (up to

19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with some exceptions (up to 49% lower), except during October and November when it would generally be lower (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 38% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under Existing Conditions during March through June and August, through October (up to 205% greater), lower during January, March, November, and December (up to 43% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more critical, include moderate to substantial reductions in below normal years during December through March (to 46% lower), moderate to substantial reductions in dry years during June through September (to 50% lower), and reductions in dry and critical years during December through January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under Existing Conditions during February and March (up to 28% greater), lower during April, May, July through September, and November through January (up to 56% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would occur in below normal years during July through September (6% to 41% lower), dry years during July through January (6% to 31% lower), and critical years during August through March (16% to 56% lower) except during October (6% greater). These are fairly persistent flow reductions that would affect rearing conditions for a good part of the year in each of these specific water year types, and would have a localized effect on rearing conditions.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions by up to 36% during December through May and July, but similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or A7_LLT (Table 11-7-107). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 7 and Existing Conditions.

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 7 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects on the roach population. Reduced flows in other rivers would not have biologically meaningful effects on roach. The percentages of years outside both temperature thresholds are generally lower under Alternative 7 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to both the alternative and future climate change.

Hardhead

In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat conditions for hardhead relative to NAA.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.

Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under NAA throughout the year, with some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under NAA during February, March, June, and October (up to 35% greater), similar during May and November, with some exceptions (up to 26% lower), and lower during July through September and December (up to 32% lower). Flow reductions in drier water years, when effects would be most critical for habitat conditions, would persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under NAA during May, and June, lower during September (up to 14% lower), and similar during the remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to NAA and no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the range would lower than the percentage under NAA in all water years except below normal years (6% lower) (Table 11-7-108).

Table 11-7-108. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-4 (-5%)	-1 (-1%)
Above Normal	-8 (-11%)	-4 (-6%)
Below Normal	-7 (-10%)	4 (6%)
Dry	-6 (-9%)	1 (2%)
Critical	-9 (-13%)	-2 (-3%)
All	-6 (-9%)	0 (0%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 7 would not cause a substantial reduction in spawning and juvenile and adult hardhead rearing. Flows in all rivers examined during the year under Alternative 7 are generally similar to or greater than flows under NAA in most months. In the Feather River there would be persistent, moderate flow reductions in drier water years from May through August, and inconsistent and/or small-magnitude flow reductions from month to month in the other drier water year types; these flow reductions would not have biologically meaningful effects on hardhead. The percentages of years outside all temperature thresholds are generally lower under Alternative 7 than under NAA.

CEQA Conclusion: In general, Alternative 7 would reduce the quality and quantity of upstream habitat conditions for hardhead relative to CEQA Existing Conditions.

Juvenile and Adult Rearing

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions during all months but September and December (up to 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with some exceptions (up to 49% lower), except during October and November when it would generally be lower (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 38% lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than those under Existing Conditions during March through June and August, through October (up to 205% greater), lower during January, March, November, and December (up to 43% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more critical, include moderate to substantial reductions in below normal years during December through March (to 46% lower), moderate to substantial reductions in dry years during June through September (to 50% lower), and reductions in dry and critical years during December through January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows under Existing Conditions during February and March (up to 28% greater), lower during April, May, July through September, and November through January (up to 56% lower), and similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would occur in below normal years during July through September (6% to 41% lower), dry years during July through January (6% to 31% lower), and critical years during August through March (16% to 56% lower) except during October (6% greater). These are fairly persistent flow reductions that would affect rearing conditions for a good part of the year in each of these specific water year types, and would have a localized effect on rearing conditions.

In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would generally be lower than Existing Conditions by up to 36% during December through May and July, but similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months in which year-round in-stream temperatures would be outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be similar to or lower than the percentage under Existing Conditions in all water years (Table 11-7-108).

Summary of CEQA Conclusions

Collectively, these results indicate that the impact would be significant because Alternative 7 would cause a substantial reduction in hardhead habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects on hardhead. Reduced flows in other rivers would not have biologically meaningful effects on hardhead. The percentages of years outside both temperature thresholds are generally lower under Alternative 7 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the NEPA point of comparison is assumed to occur during the late long-term implementation period whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to both the alternative and future climate change.

California Bay Shrimp

The effect of water operations on rearing habitat of California bay shrimp under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on California bay shrimp rearing habitat would be less than significant.

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Adult striped bass migrate up the Delta via the Sacramento River to reach suitable spawning habitat upstream. It is assumed that this migration period occurs around the same timing as spawning, from April through June.

Flows in the Sacramento River below the north Delta diversion facilities would be lower than baseline conditions during the April through June period. Monthly flows on average would be 17-20% lower compared to NAA. Sacramento River flows are highly variable interannually, and striped bass are still able to migrate upstream the Sacramento River during lower flow years.

NEPA Effects: The effect of reduced Sacramento flows under Alternative 7 would not be adverse.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (22–30% lower compared to Existing Conditions) would not interfere substantially with movement of spawning striped bass through the Delta. No mitigation would be required.

American Shad

Adult American shad migrate up the Delta to reach suitable spawning habitat upstream around March–May. American shad migrate up the Sacramento River while some shad spawn in the San Joaquin River basin. Flows in the Sacramento River below the north Delta diversion facilities would be 18–21% less than NAA. Flows from the San Joaquin River at Vernalis would be unchanged. Sacramento River flows are highly variable interannually, and American shad are still able to migrate upstream the Sacramento River during lower flow years.

NEPA Effects: Overall, the impact to American shad migration habitat conditions would not be adverse under Alternative 7.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (20–30% lower compared to Existing Conditions) would not interfere substantially with movement of American shad from the Delta to upstream spawning habitat. No mitigation would be required.

Threadfin Shad

NEPA Effects: Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats. Threadfin shad found in the Delta to not actively migrate upstream to spawn. Therefore there is no effect on migration habitat conditions.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because flow changes in the Delta under Alternative 7 would not alter movement patterns for threadfin shad. No mitigation would be required.

Largemouth Bass

NEPA Effects: Largemouth bass are non-migratory fish within the Delta. Therefore they do not use the Delta as migration habitat corridor. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes under Alternative 7 would not affect largemouth movements within the Delta. No mitigation would be required.

Sacramento Tule Perch

NEPA Effects: Similar with largemouth bass, Sacramento tule perch are a non-migratory species and do not use the Delta as a migration corridor as they are a resident Delta species. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes would not affect Sacramento tule perch movements within the Delta. No mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 7, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

Hardhead

NEPA Effects: For hardhead the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 7, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for hardhead would not be significant and no mitigation is required.

California Bay Shrimp

NEPA Effects: The effect of water operations on migration conditions of California bay shrimp under Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on migration conditions of California bay shrimp would be less than significant.

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

The effects of restoration measures under Alternative 7would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of construction of restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of restoration measures under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-7).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-7, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of the construction of restoration measures would be less than significant.

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-8 under delta smelt for a discussion of the effects of contaminants associated with restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of contaminants associated with restoration measures under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-8, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of contaminants associated with restoration measures would be less than significant.

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: Refer to Impact AQUA-9 under delta smelt for a discussion of the effects of restored habitat conditions on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. Although there are minor differences the effects are similar. The potential effects of restored habitat conditions under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). For a detailed discussion, please see Alternative 1A, Impact AQUA-8. In addition, see Alternative 1A, Impact AQUA-207 for a discussion of the different effects on non-covered species of primary management concern. Alternative 7 would also include an additional 10,000 acres of seasonally inundated floodplain and an additional 20 miles of channel margin habitat. In general these would provide proportionally more habitat for non-covered species of management concern particularly with respect to food production and export which would be beneficial to downstream species (striped bass, American shad, threadfin shad, largemouth bass and Sacramento tule perch). Sacramento-San Joaquin roach and hardhead would generally occur upstream of these restored areas and would receive minimal benefit from them. Predatory species (striped bass and largemouth bass) and Sacramento tule perch would benefit from the additional cover provided by the additional 20 miles of enhanced channel margin.

CEQA Conclusion: As described immediately above, the impacts of restored habitat conditions would range from slightly beneficial to beneficial.

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of methylmercury management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of methylmercury management under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-10).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-10, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of methylmercury management would be less than significant.

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

NEPA Effects: Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic vegetation management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of invasive aquatic vegetation management under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. The effect on them will not be adverse. Control of invasive aquatic vegetation would not occur within California bay shrimp habitat and there would be no effect on them.

CEQA Conclusion: Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic vegetation management on non-covered species of primary management concern. There are minor differences and the effects are similar except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Control of invasive aquatic vegetation would not occur within California bay shrimp habitat and there would be no effect on them. Sacramento tule perch use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on them will not be significant and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

The effects of other conservation measures under Alternative 7 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved oxygen management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of dissolved oxygen management under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-12).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-12 these effects would be beneficial; however, California bay shrimp do not occur in this habitat and there would be no effect on them.

CEQA Conclusion: As described immediately above, the impacts of oxygen level management would be beneficial.

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of predatory fish (striped bass and largemouth bass) and predator management on non-predatory fish. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive.

NEPA Effects: The effects of this management will not be adverse; however, California bay shrimp do not occur in this habitat and there would be no effect on them.

CEQA Conclusion: Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of predatory fish and predator management on non-predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive.

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

NEPA Effects: Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of nonphysical fish barriers on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of nonphysical fish barriers under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-14). For a detailed discussion, please see Alternative 1A, Impact AQUA-14. The effects would be similar except for Sacramento-San Joaquin roach and hardhead which are unlikely to be present in their vicinity. California bay shrimp do not occur in this habitat and there would be no effect on them. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of nonphysical fish barriers would be less than significant.

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

Refer to Impact AQUA-15 under delta smelt for a discussion of the effects of illegal harvest reduction on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of illegal harvest reduction under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-15).

NEPA Effects: As concluded for 1A, Impact AQUA-15, the effect would not be adverse. California bay shrimp do not occur in this habitat and there would be no effect on them.

CEQA Conclusion: As described immediately above, the impacts of illegal harvest reduction would be less than significant.

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

Refer to Impact AQUA-16 under delta smelt for a discussion of the effects of conservation hatcheries on non-covered species of primary management concern. The potential effects of conservation hatcheries under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-16).

NEPA Effects: For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be no effect.

CEQA Conclusion: As described immediately above, conservation hatcheries would have not impact.

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

Refer to Impact AQUA-17 under delta smelt for a discussion of the effects of stormwater treatment on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of stormwater treatment under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-17).

NEPA Effects: For a detailed discussion, please see Alternative 1A, Impact AQUA-17. These effects would be beneficial.

CEQA Conclusion: As described immediately above, the impacts of stormwater management would be beneficial.

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

Refer to Impact AQUA-18 under delta smelt for a discussion of the effects of removal/relocation of nonproject diversions on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of removal/relocation of nonproject diversions under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-18).

NEPA Effects: For a detailed discussion, please see Alternative 1A, Impact AQUA-18. The effects would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which are unlikely to be present near these diversions. California bay shrimp do not occur in this habitat and there would be no effect on them. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of removal/relocation of nonproject diversions would be less than significant.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 7 would not be substantially reduced when compared to NAA.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 7 would reduce the quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5 and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

Alternative 8 is the same as Alternative 1A except that it involves Intakes 2, 3, and 5 instead of Intakes 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would divert up to 15,000 cfs and uses Operational Scenario A, Alternative 8 would divert up to 9,000 cfs and uses Operational Scenario F. The dimensions of the intakes are in Table 11-5. Alternative 8 has the same six barge facilities as Alternative 1A.

Delta Smelt

Construction and Maintenance of CM1

Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June during construction of intake facilities. Small numbers of delta smelt eggs, larvae could also be present in June or July during construction of the barge landings in the east Delta and south Delta (see Table 11-6). Very low delta smelt abundance would be expected in the south Delta near the southern barge landings during the in-water construction period. These construction areas also occur entirely within designated delta smelt critical habitat.

Construction impacts on delta smelt or critical habitat would be as described for Alternative 1A, Impact AQUA-1, except that Alternative 8 would include only Intakes 2, 3, and 5. No impacts would occur at the locations of Intakes 1 and 4 that are proposed under Alternative 1A.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of construction of the water conveyance facilities on delta smelt or critical habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or their critical habitat.

CEQA Conclusion: As described for Alternative 1A, Impact AQUA-1, the impact of the construction of water conveyance facilities on delta smelt or their critical habitat would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 Impact AQUA-1 in the discussion of 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-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-2, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt.

CEQA Conclusion: As described for Alternative 1A, Impact AQUA-2, the impact of the maintenance of water conveyance facilities on delta smelt would be less than significant and no mitigation would be required.

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Water Exports from SWP/CVP South Delta Facilities

Overall, operational activities under Alternative 8 would benefit delta smelt by substantially reducing proportional entrainment losses at the south Delta facilities for the combined population by 0.123 (approximately 12% of the population), a 55% relative reduction compared to the NAA.

Average larval/juvenile proportional entrainment (March–June) would be 0.06 (i.e., 6% of the juvenile population) under Alternative 8, compared to 0.15 for the NAA (a 58% relative reduction) (Figure 11-8-1). Average adult proportional entrainment (December–March) under Alternative 8 (about 0.035, or 3.5% of the adult population) would be 0.04 less (51% relative reduction) compared to the NAA, with little difference attributable to climate change (Figure 11-8-2, Table 11-8-1).

This improvement is due to reductions in OMR reverse flows under Alternative 8 operations. South Delta exports would substantially decline compared to the NAA and increase Delta outflow, with no exports in April–May and October–November, thus substantially increasing OMR flows. In all months of the year except during the summer (July, August, September), monthly OMR flows averaged across water year types would be net positive (flowing towards San Francisco Bay).

Table 11-8-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities for Alternative 8

Water Year	Proportional Entrainment[a] Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Total Population		
Wet	-0.068 (-64%)	-0.094 (-71%)
Above Normal	-0.103 (-64%)	-0.130 (-69%)
Below Normal	-0.123 (-56%)	-0.152 (-61%)
Dry	-0.126 (-48%)	-0.145 (-51%)
Critical	-0.109 (-34%)	-0.109 (-34%)
All Years	-0.101 (-51%)	-0.123 (-55%)
Juvenile Delta Smelt (March–June)		
Wet	-0.028 (-74%)	-0.054 (-85%)
Above Normal	-0.060 (-74%)	-0.089 (-81%)
Below Normal	-0.081 (-59%)	-0.113 (-66%)
Dry	-0.086 (-47%)	-0.106 (-52%)
Critical	-0.076 (-31%)	-0.081 (-32%)
All Years	-0.061 (-50%)	-0.084 (-58%)
Adult Delta Smelt[b] (December–March)		
Wet	-0.040 (-58%)	-0.040 (-58%)
Above Normal	-0.043 (-53%)	-0.042 (-53%)
Below Normal	-0.042 (-51%)	-0.040 (-50%)
Dry	-0.041 (-50%)	-0.039 (-49%)
Critical	-0.034 (-44%)	-0.028 (-40%)
All Years	-0.040 (-52%)	-0.038 (-51%)

Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.

[a] Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).

[b] Adult proportional entrainment adjusted according to Kimmerer (2011)

Water Exports from SWP/CVP North Delta Intake Facilities

The effects would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes because potential entrainment and impingement risks at the proposed north Delta facilities would be limited because delta smelt rarely occur in the vicinity of the proposed intake site. Alternative 8 would have only three intakes, compared to five intakes for Alternative 1A, and therefore potential entrainment and impingement risk would be relatively reduced compared to Alternative 1A. The effect under Alternative 1A was determined to be not adverse.

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 models, was low, averaging 1.4% under Alternative 8 compared to 2.0% under NAA, a 30% relative reduction (Table 11-8-2).

Table 11-8-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 8 and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A8_LLT	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
2.1	2.0	1.4	-0.71 (-34%)	-0.61 (-30%)

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 predation losses of delta smelt at the SWP/CVP facilities are believed to be high. Because proportional entrainment of combined juvenile and adult delta smelt would be substantially reduced under Alternative 8 (55% compared to NAA), there would be less predation loss at the south Delta. Predation loss at the proposed north Delta intakes and the alternate NBA intake would be limited because few delta smelt occur that far upstream. The effect would be beneficial because fewer delta smelt would be lost to predation.

NEPA Effects: In conclusion, under Alternative 8 overall potential entrainment of delta smelt would be reduced at the south Delta SWP/CVP facilities and the NBA. 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. The overall effect on delta smelt would be beneficial because of the reduction in entrainment loss and mortality.

CEQA Conclusion: Alternative 8 would result in an overall reduction of entrainment as a whole compared to Existing Conditions. At the south Delta facilities, proportional entrainment of juvenile and adult delta smelt would be substantially reduced (Table 11-8-1, Figures 11-8-1 and 11-8-2) due to substantial reductions in water exports from the south Delta. Proportional entrainment averaged across water year types would be reduced by 0.04 for adults (i.e., 4% of population, a 52% relative reduction) and reduced by 0.061 for juveniles (a 50% relative reduction) compared to Existing Conditions (Table 11-8-1). In addition, pre-screen predation loss would also be substantially reduced at the south Delta facilities under Alternative 8. The risk of entrainment and impingement at the proposed north Delta intake facilities is low due to low abundances of delta smelt in the vicinity, and would be minimized by state-of-the-art screens. At the NBA potential entrainment of larvae is low under Existing Conditions and would be slightly reduced (~1%) under Alternative 8 (Table 11-8-2). Overall, Alternative 8 would benefit delta smelt due to a substantial reduction in entrainment and associated predation losses at the south Delta facilities and minimizing entrainment at the north Delta facilities and NBA intakes. This impact is considered to be beneficial. No mitigation would be required.

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

NEPA Effects: The effects of operations under Alternative 8 on abiotic spawning habitat would be the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning timing, would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect of Alternative 8 operations on spawning would not be adverse, because there would be little change in abiotic spawning conditions for delta smelt.

CEQA Conclusion: As described above, operations under Alternative 8 would not reduce abiotic spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

NEPA Effects: As described for other alternatives, Impact AQUA-5, rearing habitat conditions for juvenile delta smelt are considered with respect to the abiotic habitat index (Feyrer et al. 2011) with and without the assumption that BDCP habitat benefits are realized. The abiotic habitat index under Alternative 8 across all water years would be similar (<5% change) to NAA without restoration (Figure 11-8-3, Table 11-8-3). Alternative 8 has the potential to further benefit delta smelt by habitat restoration (CMs 2 and 4), particularly in the Suisun Marsh, West Delta, and Cache Slough ROAs which are closer to delta smelt's main range. Habitat restoration would increase spawning and rearing habitat and supplement food production and export. With habitat restoration, Alternative 8 flows may result in a 30% increase in the average abiotic habitat index compared to the NAA. The greatest increase would be in below normal and dry years (34–37% more). These overall effects would be due to the inundation of new areas of the Delta resulting from habitat restoration effects; it is assumed that 100% of the newly restored habitat would be utilized by delta smelt.

CEQA Conclusion: Without BDCP habitat restoration efforts, the average fall abiotic habitat index would increase by 25% when compared to Existing Conditions, which do not include Fall X2 criteria. The abiotic habitat index would be increased in all water year types under Alternative 8 flows, even without habitat restoration. Habitat restoration under Alternative 8 would further increase the fall abiotic habitat index by 58% when averaged for all water years, with about 85% more in above normal and wet years (Figure 11-8-3, Table 11-8-3). The impact on delta smelt rearing habitat would be beneficial because the abiotic habitat index would be increased under Alternative 8 even without habitat restoration actions.

Table 11-8-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 8 and Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type

	Without Restoration		With Restoration	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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 the proposed scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: The effects of operations under Alternative 8 on migration conditions would be the same as described for Alternative 1A (Impact AQUA-6). Alternative 8 would not affect the first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta water temperatures would not change across alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes under BDCP operations.

As described for other alternatives, Alternative 8 may decrease sediment supply to the estuary by 8 to 9 percent, with the potential for decreased habitat suitability for delta smelt in some locations.

CEQA Conclusion: As described above, operations under Alternative 8 would not substantially alter the turbidity cues associated with winter flush events that may initiate migration, nor would there be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt migration conditions would be less than significant, and no mitigation would be required.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through AQUA-9) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on delta smelt are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: All three of the impact mechanisms listed above would be beneficial or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for delta smelt under Alternative 1A (Impact AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on delta smelt for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on delta smelt, for the reasons identified for Alternative 1A, and no mitigation is required.

Longfin Smelt

Construction and Maintenance of CM1

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

NEPA Effects: The potential effects of construction of the water conveyance facilities on longfin smelt would be similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-19, the impact of the construction of water conveyance facilities on longfin smelt would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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 8 would be the same as those described for Alternative 1A Impact AQUA-20, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. 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 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

Potential entrainment risk for larval longfin smelt, as simulated by mean percent particles entrained at the south Delta diversions, was 0% under Alternative 8, compared to 2.2 for NAA (Table 11-8-4). Entrainment risk of larval longfin smelt to the south Delta facilities is expected to be minimal under Alternative 8.

Table 11-8-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 8 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Starting Distribution	EXISTING CONDITIONS	NAA	A8_LLT	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wetter	1.9	1.6	0.0	-1.88 (-100%)	-1.70 (-100%)
Drier	2.5	2.2	0.0	-2.51 (-100%)	-2.24 (-100%)

For juvenile longfin smelt, entrainment at the south Delta facilities (salvage index, averaged across all water year types) would be effectively eliminated (99.9% reduction). For adult longfin smelt, entrainment at the south Delta facilities averaged across all water year types would be substantially reduced by 81% compared to the NAA (Table 11-8-5) because of increases in OMR flows.

Table 11-8-5. Longfin Smelt Entrainment Index at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 8

		Absolute Difference (Percent Difference)	
Life Stage	Water Year Types	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Juvenile (March–June)	Wet	-63,749 (-100%)	-69,191 (-100%)
	Above Normal	-4,522 (-100%)	-4,811 (-100%)
	Below Normal	-3,040 (-99%)	-3,249 (-99%)
	Dry	-529,625 (-100%)	-587,932 (-100%)
	Critical	-567,468 (-100%)	-493,597 (-100%)
	All Years	-267,492 (-100%)	-292,504 (-100%)
Adult (December–March)	Wet	-91 (-71%)	-95 (-72%)
	Above Normal	-534 (-82%)	-574 (-83%)
	Below Normal	-1,723 (-89%)	-1,646 (-88%)
	Dry	-1,170 (-97%)	-1,105 (-97%)
	Critical	-24,331 (-100%)	-22,198 (-100%)
	All Years	-2,943 (-82%)	-2,908 (-81%)
	Shading indicates >5% increase in entrainment index.		

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed north Delta intakes could increase entrainment potential and locally attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species occur only rarely this far upstream.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Particle tracking modeling of larval entrainment found that under NAA on average less than 1% of particles were entrained at the NBA. Entrainment to the NBA under Alternative 8 would be very similar to NAA (Table 11-8-6). Overall, larval entrainment to the NBA would be minor under this Alternative.

Table 11-8-6. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct under Alternative 8 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Distribution	EXISTING CONDITIONS	NAA	A8_LLT	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wetter	0.20	0.08	0.09	-0.12 (-58.1%)	0.01 (6.2%)
Drier	0.25	0.11	0.11	-0.14 (-57.3%)	0.00 (-0.7%)

In summation, at the SWP/CVP south Delta facilities juvenile and adult longfin smelt entrainment would be reduced substantially under Alternative 8 compared to the NAA. Longfin smelt entrainment to the NBA would be unchanged compared to the NAA. Entrainment loss of longfin smelt at the proposed north Delta intakes would be rare since longfin smelt are not expected to occur in that area of the Sacramento River.

Predation Associated with Entrainment

Pre-screen predation losses of longfin smelt at the SWP/CVP facilities are believed to be high and proportional to entrainment. It is assumed that pre-screen predation losses of longfin smelt would be similar to delta smelt based on their similar size, shape, and pelagic nature. Predation loss of juvenile longfin smelt would be effectively eliminated under Alternative 8, and predation loss of adults would also be substantially reduced (81–82% reduction). Predation loss at the proposed north Delta intakes would be limited because few longfin smelt occur that far upstream. The impact and conclusion for the risk of predation associated with the NPB structures would be the same as described for Alternative 1A, Impact AQUA-21.

NEPA Effects: In conclusion, the effect on entrainment and entrainment-related predation loss under Alternative 8 would be beneficial because of the substantial reductions in entrainment at the south Delta facilities.

CEQA Conclusion: The results of the PTM model indicate reduced larval entrainment to agricultural diversions relative to Existing Conditions, while larval entrainment would be unchanged at the NBA. Based on PTM analysis and salvage density results, there would be substantial reductions in entrainment of all life stages of longfin smelt at the south Delta facilities under Alternative 8. At the south Delta facilities, juvenile entrainment would be effectively eliminated (99.9% reduction compared to Existing Conditions) and adult entrainment would be substantially reduced by 82%

compared to Existing Conditions. Entrainment to the north Delta intakes would be low since longfin smelt would not occur in the vicinity of the intakes.

Predation loss of juveniles would be effectively eliminated while predation loss of adult would be reduced by 82% compared to Existing Conditions. Little predation loss would occur at the SWP/CVP north Delta intakes because longfin smelt rarely occur in that vicinity.

In conclusion, the impact under Alternative 8 would less than significant because of the substantial reductions in entrainment and predation loss, which would benefit longfin smelt. No mitigation would be required.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

NEPA Effects: Predicted average relative longfin smelt abundance would be increased 46% (based on Fall Midwater Trawl index estimates) to 57% (based on Bay Otter Trawl index estimates) under Alternative 8 compared to NAA conditions. Relative abundances would increase particularly in below normal (58–73% more), dry (78–100% more) and critical (70–89% more) water year types (Table 11-8-7).

Table 11-8-7. Estimated Differences Between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl

	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All	204 (4%)	1,680 (46%)	679 (5%)	5,435 (57%)
Wet	-3,779 (-21%)	2,585 (22%)	-15,802 (-24%)	10,347 (27%)
Above Normal	-1,493 (-17%)	1,339 (23%)	-5,395 (-20%)	4,650 (29%)
Below Normal	434 (10%)	1,732 (58%)	1,402 (12%)	5,422 (73%)
Dry	777 (37%)	1,270 (78%)	2,234 (45%)	3,571 (100%)
Critical	442 (46%)	576 (70%)	1,092 (58%)	1,406 (89%)
	Shading indicates 10% or greater decrease in relative abundance.			

[a] Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

Rearing conditions for larval and juvenile longfin smelt can also be analyzed by assessing Delta outflows. On average, January–March Delta outflows would be similar to NAA conditions, while outflows would be increased under Alternative 8 from April–June by 10–14%.

Delta outflows would be similar or higher than NAA from January to June, providing improved habitat conditions for longfin smelt. Furthermore, longfin smelt may benefit from habitat restoration actions (CM2 and CM4), which are intended to provide additional food production and export to longfin smelt rearing areas. This potential habitat restoration benefit is not reflected in the X2-longfin smelt abundance regression, but may provide benefits to longfin smelt, particularly in Suisun Marsh, West Delta, and Cache Slough ROAs.

CEQA Conclusion: Under Alternative 8, average flows at Rio Vista would be similar (<10% difference) to Existing Conditions from January through March, and slightly reduced by 11% in

December. The impact of Alternative 8 on spawning habitat would be less than significant because flow conditions near longfin smelt spawning habitat would be largely similar to Existing Conditions. No mitigation would be required.

Relative longfin smelt abundance averaged across all water years would be similar to Existing Conditions (Table 11-8-7). Longfin smelt abundances by water year type would be greater under Alternative 8 in critical years (46–58%), increased in dry years (37–45%), and reduced in wetter water year types (17–24% less) compared to Existing Conditions.

Delta outflows would be similar or improved relative to Existing Conditions from January–June. A number of habitat restoration conservation measures (CM2 and CM4) may improve the quality of rearing habitat for longfin smelt by increasing food production in the Delta. Overall, the impact of Alternative 8 on longfin smelt abundance and Delta outflow during longfin smelt migration would be less than significant and may provide a benefit to the species.

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)

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for longfin smelt under Alternative 1A (Impact AQUA-25 through Impact AQUA-27) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on longfin smelt are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

CEQA Conclusion: All three of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required for the reasons identified for Alternative 1A.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for longfin smelt under Alternative 1A (Impact AQUA-28 through Impact AQUA-36) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on longfin smelt for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on longfin smelt, for the reasons identified for Alternative 1A, and no mitigation is required.

Winter-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of construction of the water conveyance facilities on winter-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-37) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for winter-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A, Impact 37, because only three intakes would be constructed rather than five. 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 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-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-38, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 8 would reduce overall entrainment of juvenile winter-run Chinook salmon at the south Delta export facilities by about 82% (~5,500 fish; Table 11-8-8) across all water year types compared to the NAA. As discussed for Alternative 1A, Impact AQUA-39, entrainment would be highest in wet years and would be reduced during drier water year types. Under Alternative 8, entrainment in wet years would be reduced by 73% compared the NAA (Table 11-8-8). In dry and critical years, entrainment would be virtually eliminated (fewer than 100 fish entrained), with relative reductions in salvage of 98% or greater compared to the NAA.

Table 11-8-8. Juvenile Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Winter-Run Chinook Salmon		
Wet	-8,199 (-72%)	-8,619 (-73%)
Above Normal	-5,273 (-80%)	-5,397 (-80%)
Below Normal	-6,032 (-84%)	-5,608 (-83%)
Dry	-3,709 (-98%)	-3,401 (-98%)
Critical	-1,261 (-100%)	-1,122 (-100%)
All Years	-5,572 (-82%)	-5,512 (-82%)
Spring-Run Chinook Salmon		
Wet	-77,797 (-88%)	-81,425 (-88%)
Above Normal	-25,409 (-95%)	-28,477 (-96%)
Below Normal	-5,932 (-93%)	-6,727 (-94%)
Dry	-16,419 (-100%)	-17,612 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,408 (-94%)	-37,018 (-94%)
Fall-Run Chinook Salmon		
Wet	-110,928 (-87%)	-111,105 (-87%)
Above Normal	-29,639 (-90%)	-30,113 (-90%)
Below Normal	-12,096 (-89%)	-12,456 (-89%)
Dry	-19,622 (-100%)	-21,270 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,643 (-92%)	-50,699 (-92%)
Late Fall–Run Chinook Salmon		
Wet	-4,706 (-79%)	-4,620 (-78%)
Above Normal	-516 (-90%)	-501 (-89%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,716 (-89%)	-1,635 (-88%)

Shading indicates10% or greater increased entrainment.

[a] Estimated annual number of fish lost, based on normalized data.

The proportion of the annual winter-run Chinook population (assumed to be 500,000 juveniles approaching the Delta) lost at the south Delta facilities averaged 1.4% under the NAA and would be reduced to 0.25% under Alternative 8. Proportional entrainment would be reduced slightly (difference less than 1.25%) under Alternative 8 compared to the NAA. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

In conclusion, Alternative 8 would reduce the total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be slightly beneficial. Therefore, this effect would not be adverse and would likely provide some benefit to the species because of the reductions in entrainment loss and mortality. The combined predation loss of juveniles at the south Delta facilities and at the proposed north Delta intakes would be increased. However because the combined predation loss would affect less than 5% of the population for all races of Chinook salmon, the effect under Alternative 8 would not be adverse.

NEPA Effects: Overall, the effects on entrainment would not be adverse.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta export facilities would be substantially reduced by approximately 82% under Alternative 8 for winter-run Chinook salmon across all water year types compared to Existing Conditions (Table 11-8-8). Overall, impacts to juvenile winter-run Chinook salmon would be beneficial because of the reductions in entrainment loss at the south Delta export facilities and at agricultural diversions. 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 8 would reduce the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to the 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 A8_LLT during May and June would generally be similar to or greater than flows under the NAA, except in dry years during June compared to NAA (9% lower). Flows under A8_LLT during July through September would generally be lower than flows under NAA by up to 29%.

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 A8_LLT would be lower compared to storage under NAA in above and below normal water years by 6% and 10%, respectively, and similar to NAA in wet, dry, and critical water years (Table 11-8-9).

Table 11-8-9. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-165 (-4%)	-131 (-3%)
Above Normal	-352 (-8%)	-266 (-6%)
Below Normal	-606 (-15%)	-408 (-10%)
Dry	-590 (-16%)	-146 (-4%)
Critical	-516 (-21%)	68 (4%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run 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 8 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern," as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-12. There would be no difference in levels of concern between NAA and Alternative 8.

Table 11-8-10. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided by NMFS and Used in the BDCP Effects Analysis

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
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
Feather River			
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
American River			
Watt Avenue Bridge	May–Oct	65	Juvenile steelhead rearing

Table 11-8-11. Number of Days per Month Required to Trigger Each Level of Concern for Water Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided 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

Table 11-8-12. Differences between Baseline and Alternative 8 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern[a]	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
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.
[a] For definitions of levels of concern, see Table 11-8-11.

Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type during May through September (Table 11-8-13). Total degree-days under Alternative 8 would be 12% lower than under NAA during May and up to 34% higher during June through September.

Table 11-8-13. Differences between Baseline and Alternative 8 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 Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	926 (246%)	-276 (-17%)
	Above Normal	151 (71%)	-204 (-36%)
	Below Normal	364 (166%)	-99 (-15%)
	Dry	560 (301%)	146 (24%)
	Critical	375 (170%)	-35 (-6%)
	All	2,375 (195%)	-469 (-12%)
June	Wet	409 (107%)	-302 (-28%)
	Above Normal	235 (159%)	6 (2%)
	Below Normal	559 (402%)	207 (42%)
	Dry	1,026 (546%)	492 (68%)
	Critical	492 (123%)	-58 (-6%)
	All	2,720 (216%)	344 (9%)
July	Wet	1,278 (247%)	672 (60%)
	Above Normal	731 (902%)	461 (131%)
	Below Normal	1,001 (681%)	545 (90%)
	Dry	1,287 (456%)	359 (30%)
	Critical	1,771 (215%)	-15 (-0.6%)
	All	6,068 (328%)	2,022 (34%)
August	Wet	2,633 (378%)	670 (25%)
	Above Normal	1,262 (309%)	603 (57%)
	Below Normal	1,592 (601%)	557 (43%)
	Dry	1,903 (284%)	293 (13%)
	Critical	2,590 (174%)	-29 (-1%)
	All	9,979 (283%)	2,092 (18%)
September	Wet	857 (116%)	148 (10%)
	Above Normal	616 (86%)	216 (19%)
	Below Normal	1,817 (244%)	671 (35%)
	Dry	2,845 (223%)	249 (6%)
	Critical	1,843 (89%)	-48 (-1%)
	All	7,980 (144%)	1,235 (10%)

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be generally greater (up to 131% greater on a relative scale or 2% on an absolute scale) than mortality under NAA, except in critical water years, in which there would be a 7% decrease (5% on an absolute scale) in egg mortality under Alternative 8 (Table 11-8-14). Therefore, the increase in mortality from NAA to A8_LLT, although relatively large in some years, would be negligible at an absolute scale to the winter-run population.

Table 11-8-14. 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. A8_LLT	NAA vs. A8_LLT
Wet	1 (353%)	0.3 (20%)
Above Normal	3 (685%)	2 (73%)
Below Normal	3 (331%)	2 (131%)
Dry	8 (509%)	2 (27%)
Critical	39 (146%)	-5 (-7%)
All	9 (192%)	0.4 (3%)

SacEFT predicts that there would be a 9% decrease(3% on an absolute scale) in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to NAA(Table 11-8-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A8_LLT would be identical to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A8_LLT would be 8% lower (6% on an absolute scale) than under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A8_LLT would be 10% lower (3% on an absolute scale) than under NAA. Because the reductions in spawning and egg incubation parameters, other than redd scour risk, are consistent, these results indicate that there would be biologically meaningful negative effects of Alternative 8 on spawning habitat.

Table 11-8-15. 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. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-29 (-50%)	-3 (-9%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-29 (-30%)	-6 (-8%)
Redd Dewatering Risk	1 (4%)	-3 (-10%)
Juvenile Rearing WUA	-1 (-2%)	24 (96%)
Juvenile Stranding Risk	-12 (-60%)	-23 (-74%)

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. Shasta reservoir storage volume would be up to 10% lower depending on water year type under Alternative 8 and flows would be reduced in the Sacramento River during the majority of months in which spawning and egg incubation occurs. The exceedance of NMFS water temperature thresholds under Alternative 8 would be 9% to 34% greater than those under the NAA in four of the five months evaluated. However, SacEFT and the Reclamation egg mortality model results do not predict that winter-run Chinook salmon spawning habitat conditions would decline under Alternative 8 relative to the NAA.

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. Even so, proposed mitigation (Mitigation Measure AQUA-40a through AQUA-40c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during May through July, except in wet years during May (up to 10% lower) and below normal and critical years during July (10% to 12% lower). Flows under A8_LLT would generally be lower by up to 33% during August through September.

Shasta Reservoir storage volume at the end of May under A8_LLT would be generally lower than Existing Conditions (up to 21% lower) in all water years except wet years, in which storage would be similar between A8_LLT and Existing Conditions (Table 11-8-9).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run 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 Existing Conditions and Alternative 8 during May and June at either location. Mean monthly water temperature would be up to 7% higher under Alternative 8 in July through September at both locations.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern" as defined in Table 11-8-11. The number of years classified as "red" would increase by 67% under Alternative 8 relative to Existing Conditions (Table 11-8-12).

Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type during May through September (Table 11-8-13). Total degree-days under Alternative 8 would be 144% to 328% higher than under Existing Conditions during May through September. The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be 146% to 685% greater than mortality under Existing Conditions, depending on water year type (Table 11-8-14). These increases in mortality under Alternative 8 would only affect the winter-run population in dry and critical years, in which the absolute percent increase of the winter-run population would be 8 and 39%, respectively.

SacEFT predicts that there would be a 50% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A8_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of years with good egg incubation conditions under A8_LLT would be 30% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A8_LLT would be similar to the percentage of years under Existing Conditions. These results indicate that Alternative 8 would cause small to moderate reductions in spawning WUA and egg incubation conditions.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant. Egg mortality in dry and critical years, during which winter-run Chinook salmon would already be stressed due to reduced flows and increased temperatures, would be up to 39% greater due to Alternative 8 compared to Existing Conditions (Table 11-8-14). The extent of spawning habitat is predicted by SacEFT to be 50% lower due to Alternative 8 compared to Existing Conditions (Table 11-8-15), which represents a substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying capacity. Egg incubation conditions are predicted by SacEFT to be good in 30% fewer years under Alternative 8 relative to Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Spawning Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on spawning habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to spawning habitat under Alternative 8. 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).

Mitigation Measure AQUA-40c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Spawning Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on winter-run Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-40a.

If feasible means are identified to reduce impacts on spawning habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain significant and unavoidable.

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 8 would reduce the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to the NAA.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing habitat. Flows under A8_LLT would generally be lower than flows under the NAA during August through November (up to 27% lower), but similar to flows under the NAA during December, except in above normal years (9% lower).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run juvenile rearing 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 8 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A8_LLT would be 96% greater than the percentage of years under NAA (Table 11-8-15). However, the percentage of years with good (low) juvenile stranding risk under A8_LLT is predicted to be 74% lower than under NAA. This indicates that the quantity of juvenile rearing habitat in the Sacramento River would be greater under A8_LLT relative to NAA, but the quality of such habitat would be lower.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A8_LLT would be similar to or lower than under NAA (<5% difference in each water year type).

NEPA Effects: These results indicate that the effect would be adverse. Differences in flows, although small to moderate in magnitude, are consistent among most months and water year types. In addition, effects on juvenile stranding risk are large (74% difference relative to NAA). 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. Even so, proposed mitigation (Mitigation Measure AQUA-41a through AQUA-41c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of fry and juvenile rearing habitat for winter-run Chinook salmon relative to Existing Conditions.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under Existing Conditions during August through November (up to 30% lower), and similar to flows under Existing Conditions during December, except in above normal and dry years (8% and 6% lower, respectively).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 8 in August through October depending on month, water year type, and location, and up to 5% higher during November and December at Bend Bridge.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A8_LLT would be similar to that under Existing Conditions (Table 11-8-15). However, the percentage of years with good (low) juvenile stranding risk under A8_LLT is predicted to be 60% lower than under Existing Conditions. This indicates that while the quantity of juvenile rearing habitat in the Sacramento River would be similar under A8_LLT relative to Existing Conditions, its quality would be lower.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A8_LLT would be 7% higher than under Existing Conditions.

Summary of CEQA Conclusion

These results indicate that the impact would be significant. There would be small to moderate reductions in flows under Alternative 8 during the majority of months and water year types. Further, egg mortality would increase by 9% across all water years and a 60% reduction in stranding risk would reduce upstream habitat conditions for winter-run fry and juveniles. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on rearing habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on winter-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of Fish and Wildlife 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-41a.

If feasible means are identified to reduce impacts on rearing habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain significant and unavoidable.

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

In general, Alternative 8 would reduce migration conditions for winter-run Chinook salmon relative to the NAA.

Upstream of the Delta

Juveniles

Flows in the Sacramento River upstream of Red Bluff were examined for the July through November juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run to migrate effectively down the Sacramento River. Flows under A8_LLT throughout the period would be up to 26% lower than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration 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 8 in any month or water year type throughout the period at either location.

Adults

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August). A reduction in flows may reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the upper Sacramento River. Flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June and up to 18% lower during July and August. These reductions would not be frequent or large enough to cause biologically meaningful effects to adult migration conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 8 in any month or water year type throughout the period at either location.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows (up to 15% in November averaged over all water year types) below the north Delta intakes compared to baseline. Predation at the north Delta would be increased at the three new intake structures. The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake structures. The predation effects would be the same as those described for Alternative 4, which also has three proposed intakes. Three NDD intakes would remove or modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be less than 2% compared to the annual production estimated for the Sacramento Valley (Table 11-4-11). A conservative assumption of 5% loss per intake would yield a cumulative loss of 11.6% of juvenile winter-run Chinook that reach the north Delta (Appendix 5F, *Biological Stressors*). This assumption is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon, as modeled by the DPM under Alternative 8,averaged 33.5% across all years, 27.1% in drier years, and 44% in wetter years (Table 11-8-16). Modeled survival was similar to NAA.

Table 11-8-16. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 8

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Type	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wetter Years	46.3	46.1	44.0	-2.3 (-5%)	-2.1 (-5%)
Drier Years	28.0	27.1	27.1	-0.9 (-3%)	0.0 (0%)
All Years	34.9	34.2	33.5	-1.4 (-4%)	-0.8 (-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).

Adults

Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, decreased under Alternative 8 by no more than 10% during the December through June migration period for winter-run adults compared to NAA when climate change effects are factored in, and similar in other months (Table 11-8-17). Olfactory cues from the Sacramento River would be strong throughout the adult winter-run migration, representing 58–71% of Delta outflows. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A.

NEPA Effects: Reductions under Alternative 8 in upstream flows in the Sacramento River during the juvenile winter-run Chinook salmon migration period would cause the effect to be adverse.

Near-field effects of Alternative 8 NDD on winter-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<2% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD.

Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 8 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 8 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on winter-run Chinook salmon migration conditions would be adverse.

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 impact 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 effect is adverse and unavoidable because there is no feasible mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-42a through AQUA-42c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion:

Upstream of the Delta

In general, Alternative 8 would reduce migration conditions for winter-run Chinook salmon relative to Existing Conditions.

Juveniles

Flows in the Sacramento River upstream of Red Bluff were examined during the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT for juvenile migrants would be up to 30% lower in all month except July.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 8 in July through October depending on month, water year type, and location.

Adults

Flows under A8_LLT during the December through August adult migration period would generally be similar to flows under NAA except during August in which flows would be up to 19% lower depending on water year type period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 Existing Conditions and Alternative 8 during December through June, except for a 5% increase under Alternative 8 in May of wet years at Bend Bridge. Mean monthly water temperature would be up to 13% higher under Alternative 8 in July through August depending on month, water year type, and location.

Through-Delta

Juveniles

Under Alternative 8 through-Delta survival of emigrating juvenile winter-run Chinook salmon as modeled by DPM similar to Existing Conditions (Table 11-8-16). Migrating juveniles would face potential predation losses, reduced flows and lost aquatic habitat at the three intake structures.

Adults

During the adult winter-run upstream migration period from December to June, the proportion of Sacramento River water in the Delta would be reduced 11% to 12% in March and April, and slightly reduced 5% to 8% in most other months compared to existing conditions (Table 11-8-17). Sacramento River flow olfactory cues would also still be strong since Sacramento River water would still represent 58–71% of Delta water under Alternative 8.

Table 11-8-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 8

Month	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.44	1.1	1.3
October	0.2	0.3	4.87	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.29	5.4	5.3
	Shading indicates a difference of 10% or greater in flow proportion.				

Summary of CEQA Conclusion

Collectively, the impact would be significant because Alternative 8 would reduce juvenile migration conditions for winter-run Chinook salmon relative to Existing Conditions due to reductions in flows during the majority of the period. Flows in the Sacramento River upstream of Red Bluff would be similar to Existing Conditions for most of the adult migration period. Through-Delta migration conditions would also be similar to Existing Conditions.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the

BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-42c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on winter-run Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-42a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-43 through Impact AQUA-45) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on winter-run Chinook salmon, are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

CEQA Conclusion: All three of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required, for the reasons identified for Alternative 1A.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-46 through Impact AQUA-54) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Spring-Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 8 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.

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of construction of the water conveyance facilities on spring-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for spring-run Chinook salmon.

CEQA Conclusion: As described Alternative 1A, Impact AQUA-55, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-56, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-56, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described Alternative 1A, Impact AQUA-56, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 8 would reduce overall entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities by 94% compared to NAA (Table 11-8-18). Entrainment would be eliminated in critical years, and nearly eliminated in dry years (~30 fish entrained) under Alternative 8. In wet years, entrained would be reduced 88% (~81,400 fish; Table 11-8-18) compared to NAA. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

The proportion of the annual spring-run Chinook population (assumed to be 750,000 juveniles approaching the Delta) lost at the south Delta facilities across all years averaged about 5% under the NAA, and would decrease to <0.5% under Alternative 8.

Table 11-8-18. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-77,797 (-88%)	-81,425 (-88%)
Above Normal	-25,409 (-95%)	-28,477 (-96%)
Below Normal	-5,932 (-93%)	-6,727 (-94%)
Dry	-16,419 (-100%)	-17,612 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,408 (-94%)	-37,018 (-94%)

Shading indicates 10% or greater increased entrainment.

[a] Estimated annual number of fish lost, based on normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

As described under Alternative 1A, potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed. In conclusion, Alternative 8 would reduce the total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be slightly beneficial. Therefore, this effect would not be adverse and would provide some benefit to the species because of the reductions in entrainment loss and mortality.

NEPA Effects: The overall effect on entrainment and entrainment-related predation on juvenile Chinook salmon would not be adverse.

CEQA Conclusion: Alternative 8 would substantially reduce entrainment and associated pre-screen losses of juvenile spring-run Chinook salmon by 94% at the south Delta facilities across all water year types compared to Existing Conditions (Table 11-8-18). Overall, impacts on spring-run Chinook salmon would be beneficial because of the reductions in entrainment loss at the south Delta facilities and at agricultural diversions. No mitigation would be required.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 8 would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon spawning and incubation period (September through January) under A8_LLT would generally be lower than those under NAA during September through November (up to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during December and January would generally be greater than those under NAA, except during December in above normal years (9%) and January in dry and critical years (7% and 11% lower, respectively).

Shasta Reservoir storage volume at the end of September influences flows downstream of the dam during the spring-run spawning and egg incubation period (September through January). Storage volume at the end of September under A8_LLT would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

Table 11-8-19. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-477 (-14%)	35 (1%)
Above Normal	-488 (-15%)	127 (5%)
Below Normal	-353 (-12%)	1 (0%)
Dry	-478 (-19%)	33 (2%)
Critical	-345 (-29%)	39 (5%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon 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 8 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern" as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-12 for Bend Bridge and in Table 11-8-20 for Red Bluff. There would be no difference in levels of concern between NAA and Alternative 8 at Bend Bridge. At Red Bluff, there would be 3 (7%) and 4 (50%) fewer years with a "red" and "yellow" level of concern, respectively, and 7 (35%) more with an "orange" level of concern under Alternative 8.

Table 11-8-20. Differences between Baseline and Alternative 8 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Red Bluff, October through April

Level of Concern[a]	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Red	33 (275%)	-3 (-7%)
Orange	14 (233%)	7 (35%)
Yellow	-5 (-38%)	-4 (-50%)
None	-42 (-82%)	0 (0%)

[a] For definitions of levels of concern, see Table 11-8-11.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 8 would be up to 12% lower than those under NAA during May and up to 34% higher during June through September (Table 11-8-13). At Red Bluff, total degree-days under Alternative 8 would be up to 32% lower to those under NAA during November, March and April and would be the same or similar during October and December through February (Table 11-8-21).

Table 11-8-21. Differences between Baseline and Alternative 8 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. A8_LLT	NAA vs. A8_LLT
October	Wet	994 (387%)	-175 (-12%)
	Above Normal	521 (200%)	44 (6%)
	Below Normal	823 (394%)	117 (13%)
	Dry	1,003 (204%)	-68 (-4%)
	Critical	931 (155%)	8 (1%)
	All	4,272 (235%)	-74 (-1%)
November	Wet	69 (6,900%)	-21 (-23%)
	Above Normal	29 (NA)	-32 (-52%)
	Below Normal	49 (NA)	1 (2%)
	Dry	136 (1,700%)	-15 (-9%)
	Critical	78 (1,950%)	-32 (-28%)
	All	361 (2,777%)	-99 (-21%)
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	10 (NA)	1 (11%)
	Above Normal	2 (NA)	-2 (-50%)
	Below Normal	9 (100%)	-12 (-40%)
	Dry	30 (214%)	-34 (-44%)
	Critical	27 (2,700%)	0 (0%)
	All	78 (325%)	-47 (-32%)
April	Wet	200 (174%)	-61 (-16%)
	Above Normal	66 (47%)	-163 (-44%)
	Below Normal	124 (157%)	-106 (-34%)
	Dry	157 (84%)	-163 (-32%)
	Critical	156 (1,300%)	5 (3%)
	All	703 (132%)	-488 (-28%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be up to 38% greater than mortality under NAA (Table 11-8-22). However, the absolute increase in the percent of spring-run population subject to mortality would be 2% in all but below normal water years. Therefore, the increase in mortality from NAA to A8_LLT, although relatively large in most years, would be negligible at an absolute scale to the winter-run population.

Table 11-8-22. 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. A8_LLT	NAA vs. A8_LLT
Wet	17 (166%)	2 (8%)
Above Normal	24 (179%)	2 (5%)
Below Normal	45 (378%)	16 (38%)
Dry	58 (294%)	1 (2%)
Critical	23 (31%)	1 (1%)
All	33 (146%)	4 (8%)

SacEFT predicts that there would be the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT would increase relative to NAA (Table 11-8-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A8_LLT relative to NAA. SacEFT predicts that there would be a 15% decrease in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to NAA. SacEFT predicts that there would be an 18% increase in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to NAA.

Table 11-8-23. 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. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-12 (-17%)	9 (18%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-57 (-66%)	-5 (-15%)
Redd Dewatering Risk	-9 (-18%)	6 (18%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-5 (-26%)	0 (0%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A8_LLT would generally be similar to or greater than flows under NAA, except in critical years during December (5% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A8_LLT would be the same as that under NAA in all water year types (Table 11-8-24).

Water temperatures were not modeled in Clear Creek.

Table 11-8-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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.

[a] 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.

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) where spring-run Chinook primarily spawn during September through January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_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.

Oroville Reservoir storage volume at the end of September influence flows downstream of the dam during the spring-run spawning and egg incubation period. Storage under A8_LLT would be greater than storage under NAA in all water year types except below normal years (7% lower) (Table 11-8-25). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 8.

Table 11-8-25. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-775 (-27%)	239 (13%)
Above Normal	-697 (-29%)	94 (6%)
Below Normal	-709 (-35%)	-100 (-7%)
Dry	-198 (-15%)	155 (15%)
Critical	-30 (-3%)	158 (20%)

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month over the egg incubation period compared to the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel during October through January were identical for A8_LLT, and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 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 8 in any month or water year type throughout the period, except for a 6% increase in below normal years during September.

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 11-8-26). The percent of months exceeding the threshold under Alternative 8 would generally be lower (up to 20% lower on an absolute scale) than the percent under NAA during September through November and similar during the other two months.

Table 11-8-26. Differences between Baseline and Alternative 8 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
September	0 (0%)	1 (1%)	7 (8%)	25 (34%)	47 (115%)
October	62 (278%)	67 (900%)	54 (880%)	43 (1,750%)	40 (1,600%)
November	53 (2,150%)	41 (3,300%)	28 (2,300%)	22 (NA)	14 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A8_LLT					
September	0 (0%)	0 (0%)	0 (0%)	1 (1%)	5 (6%)
October	-2 (-3%)	9 (13%)	5 (9%)	-4 (-8%)	2 (6%)
November	-11 (-17%)	-17 (-29%)	-20 (-40%)	-10 (-31%)	-11 (-45%)
December	-2 (-67%)	-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 11-8-27). Total degree-months would be higher under Alternative 8 than under NAA during September and October, lower under Alternative 8 than NAA during November and December, and the same between Alternative 8 and NAA during January.

Table 11-8-27. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, September through January

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
September	Wet	37 (34%)	12 (9%)
	Above Normal	30 (70%)	20 (38%)
	Below Normal	81 (135%)	50 (55%)
	Dry	118 (171%)	30 (19%)
	Critical	66 (102%)	4 (3%)
	All	332 (96%)	116 (21%)
October	Wet	76 (1,520%)	-20 (-20%)
	Above Normal	46 (460%)	11 (24%)
	Below Normal	76 (1,086%)	22 (36%)
	Dry	65 (929%)	-15 (-17%)
	Critical	66 (825%)	25 (51%)
	All	327 (884%)	21 (6%)
November	Wet	31 (NA)	-25 (-45%)
	Above Normal	25 (833%)	0 (0%)
	Below Normal	39 (3,900%)	5 (14%)
	Dry	31 (NA)	-20 (-39%)
	Critical	33 (NA)	5 (18%)
	All	159 (3,975%)	-35 (-18%)
December	Wet	0 (NA)	-1 (-100%)
	Above Normal	0 (NA)	-1 (-100%)
	Below Normal	1 (NA)	-2 (-67%)
	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.

NEPA Effects: Based on these results, it is concluded that the effect would not be adverse because habitat would not be substantially reduced. Reservoir storage would increase at Shasta and Folsom Reservoirs. There would be no changes to flows in Clear Creek or the Feather River and water temperatures would not substantially change due to Alternative 8 in the Sacramento and Feather Rivers. Flows in the Sacramento River would be lower in some months, SacEFT predicts a 5% reduction in “good” egg incubation habitat, and the egg mortality predicts an increase in egg mortality in below normal water years. Regardless of these changes, the weight of evidence indicates that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 8 would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A8_LLT would be generally lower than those under Existing Conditions during September through November (up to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during December and January would generally be similar to or greater than those under Existing Conditions, except in above normal and dry years (8% and 6% lower).

Shasta Reservoir Storage volume at the end of September would be 12% to 29% lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 8 during September and October would be 6% and 5% greater, respectively, than those under Existing Conditions, but not different in other months during the period. At Red Bluff, temperatures under Alternative 8 during October would be 5% greater than those under Existing Conditions, but would not be different in other months during the period.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern" as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-12 for Bend Bridge and in Table 11-8-20 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years with a "red" level of concern under Alternative 8 relative to Existing Conditions. At Red Bluff, there would be 275% and 233% increases in the number of years with "red" and "orange" levels of concern under Alternative 8 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 8 would be up to 144% to 328% higher than those under Existing Conditions depending on the month (Table 11-8-13). At Red Bluff, total degree-days under Alternative 8 would be 132% to 2,777% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-8-21).The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be 31% to 378% greater than mortality under Existing Conditions, depending on water year type (Table 11-8-22).

SacEFT predicts that there would be a 17% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 18% decrease in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A8_LLT would nearly always be similar to or greater than flows under Existing Conditions, except in critical years during September (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A8_LLT would be 50% in critical water years, though reductions would occur in above normal and dry years (percentages not calculated because dividing by zero) (Table 11-8-24).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River low-flow channel under A8_LLT are not different from Existing Conditions during the spring-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

Oroville Reservoir storage volume at the end of September would be 3% to 35% lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-25).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during October through January were identical between A8_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 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*). Temperatures under Alternative 8 would be 7% to 11% greater than those under Existing Conditions in all months and water year types during the period except wet and above normal years in September.

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 11-8-26). The percent of months exceeding the threshold under Alternative 8 would be similar to or up to 67% higher (absolute scale) than under Existing Conditions during September through November. There would be almost no difference in the percent of months exceeding the threshold between Existing Conditions and Alternative 8 during December and January.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during September through January (Table 11-8-27). Total degree-months exceeding the threshold under Alternative 8 would be 96% to 3,975% greater than those under Existing Conditions during September through November. There would be essentially no difference in total degree-months between Existing Conditions and Alternative 8 during December and January.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 8. There would be substantial decreases in reservoir storage in the Sacramento and Feather Rivers, substantial increases in egg mortality predicted by the Reclamation egg mortality model, substantial reductions in spawning and egg incubation conditions predicted by SacEFT, and reduced water temperature conditions under Alternative 8.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to H3 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and H3 indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between future conditions without the BDCP (NAA) and H3. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 8 would affect the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during this period would generally be similar to or greater than those under NAA, with few exceptions (up to 11% lower).

May Shasta storage volume under A8_LLT would generally be lower compared to storage under NAA in above and below normal water years by 6% and 10%, respectively, and similar to NAA in wet, dry, and critical water years (Table 11-8-9).

Shasta storage volume at the end of September would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the November through March spring-run Chinook salmon juvenile rearing 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 8 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A8_LLT would be 14% greater than that under NAA (Table 11-8-23). The percentage of years with good (lower) juvenile stranding risk conditions under A8_LLT would be identical to that under NAA.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be similar to NAA (<5% difference).

Clear Creek

Flows in Clear Creek during the November through March rearing period under A8_LLT would generally be similar to or greater than flows under NAA, with some exceptions, mostly in critical years (5% to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A8_LLT would not differ from those under NAA. In the high-flow channel, flows under A8_LLT would be lower (up to 50% lower) during November, December, and June compared to NAA. Flows under A8_LLT would be similar to or greater than flows under NAA during January through May.

May Oroville storage under A8_LLT would be 8% to 36% lower than storage under NAA in all water years (Table 11-8-28).

September Oroville storage volume would generally be greater than under NAA, except in below normal years (7% lower) (Table 11-8-25). Storage under A8_LLT would.

Table 11-8-28. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-689 (-20%)	-643 (-19%)
Above Normal	-1,168 (-33%)	-1,012 (-30%)
Below Normal	-1,414 (-43%)	-1,061 (-36%)
Dry	-1,064 (-39%)	-544 (-24%)
Critical	-436 (-24%)	-120 (-8%)

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during November through June (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 8 in any month or water year type throughout the period at either location.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-8-29). The percent of months exceeding the threshold under Alternative 8 would generally be similar to the percent under NAA during May and July, similar to or lower (up to 12% lower on an absolute scale) than the percent under NAA during May, and similar to or higher (up to 14% higher on an absolute scale) that the percent under NAA during August.

Table 11-8-29. Differences between Baseline and Alternative 8 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 63°F Threshold, May through August

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
May	4 (NA)	2 (NA)	1 (NA)	0 (NA)	0 (NA)
June	31 (56%)	38 (141%)	37 (750%)	22 (NA)	6 (NA)
July	0 (0%)	0 (0%)	1 (1%)	27 (37%)	57 (144%)
August	0 (0%)	12 (14%)	42 (72%)	60 (213%)	60 (613%)
NAA vs. A8_LLT					
May	-2 (-40%)	0 (0%)	0 (0%)	0 (NA)	0 (NA)
June	-2 (-3%)	-12 (-16%)	-5 (-11%)	1 (6%)	1 (25%)
July	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (3%)
August	0 (0%)	0 (0%)	1 (1%)	7 (9%)	14 (24%)

Total degree-months exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-8-30). Total degree-months under Alternative 8 would be similar to those under NAA during May and up to 19% higher than those under NAA during June through August.

Table 11-8-30. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Feather River above Thermalito Afterbay, May through August

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	0 (NA)	-1 (-100%)
	Above Normal	0 (NA)	-1 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	4 (NA)	0 (0%)
	All	7 (NA)	-1 (-13%)
June	Wet	32 (213%)	3 (7%)
	Above Normal	20 (143%)	3 (10%)
	Below Normal	28 (215%)	6 (17%)
	Dry	41 (178%)	8 (14%)
	Critical	26 (433%)	1 (3%)
	All	146 (206%)	20 (10%)
July	Wet	61 (51%)	20 (12%)
	Above Normal	29 (66%)	9 (14%)
	Below Normal	41 (69%)	13 (15%)
	Dry	55 (77%)	19 (18%)
	Critical	43 (83%)	11 (13%)
	All	229 (66%)	72 (14%)
August	Wet	61 (69%)	28 (23%)
	Above Normal	29 (116%)	11 (26%)
	Below Normal	49 (129%)	20 (30%)
	Dry	70 (175%)	17 (18%)
	Critical	43 (102%)	3 (4%)
	All	252 (108%)	79 (19%)

NA = could not be calculated because the denominator was 0.

NEPA Effects: Collectively, these results indicate that the effect would be adverse because habitat would be substantially reduced. Rearing habitat conditions in the Sacramento River would be reduced by Alternative 8 as a result of consistently lower flows. Further, flows in the Feather River, habitat conditions would be lower under Alternative 8 relative to the NAA due to substantially lower (8% to 36% lower) reservoir storage and substantially lower flows (up to 50% lower) during three months of eight-month rearing period that would increase exposure to higher water temperatures according to the NMFS threshold analyses. 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. Even so, proposed mitigation (Mitigation Measure AQUA-59a through AQUA-59c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November at both locations under A8_LLT would be generally lower than those under Existing Conditions (between 3 and 18% lower), while all other months would be similar to or greater than flows under Existing Conditions, with some exceptions (up to 19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir storage volume at the end of May under A8_LLT would be generally lower (8% to 21% lower) than Existing Conditions, in all water year types except wet years, in which storage would be similar to Existing Conditions (Table 11-8-9). As reported in Impact AQUA-58, storage volume at the end of September under A8_LLT would be 12% to 29% lower relative to Existing Conditions, depending on water year type (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the November through March spring-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 8.

SacEFT predicts that there would be a 17% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-23). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 18% decrease in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing Conditions.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A8_LLT would be 31% lower than under Existing Conditions.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A8_LLT would nearly always be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Relatively constant flows in the low-flow channel throughout the November through June period under A8_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A8_LLT would be nearly always lower during June, November, and December (up to 44% lower) relative to Existing Conditions, and always greater relative to Existing Conditions during January through May.

May Oroville storage volume under A8_LLT would be lower than Existing Conditions by 20% to 43% throughout the year (Table 11-8-28).

As reported in Impact AQUA-58, September Oroville storage volume would be 15% to 35% lower under A8_LLT relative to Existing Conditions in all water years except critical years, in which storage would be similar to Existing Conditions (Table 11-8-25).

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during the November through June juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 8 would be 5% to 9% greater than those under Existing Conditions during November through February, but similar (<5% difference) during March through June.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-8-29). The percent of months exceeding the threshold under Alternative 8 would be similar to those under Existing Conditions during May, but up to 613% greater during June through August.

Total degree-months exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-8-30). Total degree-months under Alternative 8 would be similar to those under Existing Conditions during May, but 66% to 206% higher during June through August.

Summary of CEQA Conclusion

These results indicate that the impact would be significant because it has the potential to substantially reduce the amount of suitable habitat. Spring-run Chinook salmon fry and juveniles rear in both the high-flow and low-flow channels of the Feather River. Flows and water temperatures in the low-flow channel would be unchanged by Alternative 8. However, flows in the high-flow channel would be mostly lower by up to 77% during half of the fry and juvenile rearing period. This frequency, duration, and magnitude of flow reduction is expected to have a significant effect on rearing fry and juveniles. In addition, flows would be lower during parts of the rearing period in the Sacramento River. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-59a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the

BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on rearing habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-59b: Conduct Additional Evaluation and Modeling of Impacts on Spring-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-59c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on spring-run Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife 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-59a.

If feasible means are identified to reduce impacts on rearing habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on spring-run Chinook salmon would remain significant and unavoidable.

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

Upstream of the Delta

In general, Alternative 8 would reduce migration conditions for spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period. Flows under A8_LLT would generally always be similar to or greater than flows under NAA, except during December in above normal years (9% lower) and during January in dry and critical years (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 8 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April through June under A8_LLT would nearly always be similar to or greater than flows under NAA except in dry years during June (9% lower), but would be generally lower during July and August (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 8 in any month or water year type throughout the period.

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A8_LLT would generally be similar to or greater than flows under NAA, with some exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during April through August under A8_LLT would nearly always be similar to or greater than flows under NAA except in critical water years during April and June (8% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during November and December would nearly always be lower relative to NAA (up to 35% lower), and would always be similar to or greater than NAA during January through May.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration 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 8 in any month or water year type throughout the period. Flows in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during June, July, and August under A8_LLT would nearly always be lower than flows under NAA (up to 85% lower), and would always be similar to or greater than flows under NAA during April and May.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be higher (up to 6% higher depending on water year type) in July under Alternative 8 than under NAA. There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in any other month or water year type throughout the period.

Through-Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Juveniles

Juvenile salmonids migrating down the Sacramento River would generally experience lower flows below the north Delta intakes compared to baseline. Predation and aquatic habitat loss at the north Delta would be increased at the three new intake structures, as described for Alternative 4. Estimated predation losses would range from less than 2% (bioenergetics model) (Table 11-4-11) to 11.8% (cumulative loss based on a fixed 5% loss per intake) of annual juvenile production. The latter estimate is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

Through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 8 (A8_LLT) would average 30.3% across all years, 25.3% in drier years, and 38.8% in wetter years (Table 11-8-31). Modeled survival was similar to NAA.

Table 11-8-31. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Alternative 8

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Type	EXISTING CONDITIONS	NAA	A8	EXISTING CONDITIONS vs. A8	NAA vs. A8
Wetter Years	42.1	40.4	38.8	-3.3 (-8%)	-1.6 (-4%)
Drier Years	24.8	24.3	25.3	0.5 (2%)	1.0 (4%)
All Years	31.3	30.3	30.3	-0.9 (-3%)	0.0 (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).

Adults

During the overall spring-run upstream migration from March–June, the proportion of Sacramento River in the Delta would be reduced by 11–12% in March–April, and similar (<5% difference) in May and June compared to NAA when climate change effects are incorporated (Table 11-8-32). Furthermore, olfactory cues for spring-run adults would be strong, as the proportion of Sacramento River under Alternative 8 would represent 58–67% of Delta outflows. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A.

Table 11-8-32. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 8

Month	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.44	1.1	1.3
October	0.2	0.3	4.87	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.29	5.4	5.3

NEPA Effects: Upstream of the Delta, these results indicate that the impact would be adverse because it has the potential to substantially reduce migration habitat conditions for spring-run Chinook salmon and interfere with the movement of fish. Flows in the Feather River would be up to 35% lower under Alternative 8 during two of seven months of the juvenile migration period, and up to 85% lower during three of five months of the adult upstream migration period in most water year types relative to NAA. These effects could reduce successful migration and increase adult straying. Because the majority of spring-run Chinook salmon spawn in the Feather River, this reduction in flows would affect a large proportion of the spring-run population. There would be no reduction in migration habitat conditions in the Sacramento River or Clear Creek. Near-field effects of Alternative 8 NDD on spring-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 8 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for spring-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 8 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on spring-run Chinook salmon migration conditions would be adverse.

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. Even so, proposed mitigation (Mitigation Measure AQUA-60a through AQUA-60c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion:

Upstream of the Delta

In general, Alternative 8 would reduce migration conditions for spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-run Chinook salmon migration period under A8_LLT would generally be similar to or greater than flows under Existing Conditions, except during December in above normal and dry years (8% and 6% lower, respectively) and wet years during May (8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period. Flows in the Sacramento River upstream of Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration period. Flows under A8_LLT would generally be lower than Existing Conditions during August (up to 19% lower) and similar to or greater than Existing Conditions during the rest of the period, except in wet years during May (8% lower) and below normal and critical years during July (11% and 10% lower, respectively).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 Existing Conditions and Alternative 8 during April through June. Mean monthly water temperatures under Alternative 8 would be 5% and 7% greater relative to Existing Conditions during July and August, respectively.

Clear Creek

Flows in Clear Creek were examined during the November through May juvenile Chinook salmon spring-run migration period. Flows under A8_LLT would always be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek were examined during the April through August adult spring-run Chinook salmon upstream migration period. Flows under A8_LLT would nearly always be similar to or greater than flows under Existing Conditions except during August in critical water years (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows were examined for the Feather River at the confluence with the Sacramento River during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November and December under A8_LLT would generally be lower than flows under Existing Conditions by up to 44%. Flows during the rest of the period would always be similar to or greater than flows under Existing Conditions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alterative 8 would be 5% greater than those under Existing Conditions in January, but similar during November and December and February through May. Flows were examined for the Feather River at the confluence with the Sacramento River during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April and May under A8_LLT would always be similar to or greater than flows under Existing Conditions, but flows during June through August under A8_LLT would always be lower by up to 85% than flows under Existing Conditions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 8 would be similar to those under Existing Conditions during April and May, but would be up to 9% higher during June through August

Through-Delta

Through-Delta migration under Alternative 8 would be similar or slightly lower (3.3% lower in wetter years, an 8% relative decrease) compared to Existing Conditions (Table 11-8-31). Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions during most of the year, but reduced slightly (11–12%) in March, April, and July. These months overlap with the migration periods for adult spring-run Chinook salmon. Sacramento River flow olfactory cues would also still be strong since Sacramento River water would still represent 54–71% of Delta water under Alternative 8. Because the impact under Alternative 1A was determined to be small, the Alternative 8 impact on adult Chinook salmon upstream migration through the Delta would also be small.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce migration habitat conditions for spring-run Chinook salmon and interfere with the movement of fish. Flows in the Feather River would be up to 35% lower under Alternative 8 during two of seven months of the juvenile migration period and up to 85% lower during three of five months of the adult upstream migration period in most water year types relative to Existing Conditions. This magnitude and frequency of these flow reductions would reduce the ability for juveniles to move downstream towards the ocean and for adults to sense olfactory cues from natal spawning areas in the Feather River. Both effects could reduce successful migration and increase adult straying. Through-Delta migration under Alternative 8 would be similar or slightly greater (0.5% more in drier years) compared to Existing Conditions, for juvenile spring-run Chinook salmon. Sacramento River olfactory cues would still be strong and the flows generally increased downstream of Rio Vista, so the impact under Alternative 8 would be similar or improved relative to Alternative 1A. Because the impact under Alternative 1A was determined to be small, the Alternative 8 impact on adult Chinook salmon upstream migration through the Delta would also be small.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on migration habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 8. 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).

Mitigation Measure AQUA-60c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on spring-run Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-60a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on spring-run Chinook salmon would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-61 through Impact AQUA-63) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on spring-run Chinook salmon are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

CEQA Conclusion: All three of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, for the reasons identified for Alternative 1A, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-64 through Impact AQUA-72) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 8 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.

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: The potential effects of construction of the water conveyance facilities on fall-run/late fall-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-73) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for fall-run/late fall-run Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-38, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

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

Fall-Run

Overall entrainment of juvenile fall-run Chinook salmon at the south Delta export facilities would be reduced under Alternative 8 compared to NAA. Under Alternative 8, juvenile fall-run Chinook salmon entrainment would be reduced by 92–93% (~51,000 fish) (Table 11-8-33) across all water year types compared to NAA. As discussed for Alternative 1A, Impact AQUA-75, entrainment for fall-run Chinook salmon would be highest in wet years and lowest in below normal years. The greatest net reduction in juvenile fall-run Chinook salmon entrainment under Alternative 8 would occur in wet years (~111,000–116,000 less fish, an 87% reduction), while entrainment in dry and critical years would be virtually eliminated (fewer than 25 fish entrained). Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

The proportion of the annual juvenile fall-run population (assumed to be 23 million) lost at the south Delta facilities is very low (<0.6%) under NAA, for all water year types, and reduced to negligible levels under Alternative 8

Table 11-8-33. Juvenile Fall-Run and Late Fall–Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Fall-run Chinook Salmon		
Wet	-110,928 (-87%)	-111,105 (-87%)
Above Normal	-29,639 (-90%)	-30,113 (-90%)
Below Normal	-12,096 (-89%)	-12,456 (-89%)
Dry	-19,622 (-100%)	-21,270 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,643 (-92%)	-50,699 (-92%)
Late Fall–Run Chinook Salmon		
Wet	-4,706 (-79%)	-4,620 (-78%)
Above Normal	-516 (-90%)	-501 (-89%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,716 (-89%)	-1,635 (-88%)

Shading indicates 10% or greater increased entrainment.

[a] Estimated annual number of fish lost, based on normalized data.

Late Fall-Run

Overall entrainment of juvenile late fall-run Chinook salmon at the south Delta export facilities would be reduced under Alternative 8 compared to NAA. Under Alternative 8, juvenile late fall-run Chinook salmon entrainment would be reduced by 88% (~1,600 fish) (Table 11-8-33) across all water year types compared to NAA. As discussed for Alternative 1A, Impact AQUA-75, entrainment for late fall-run Chinook salmon would be highest in wet years and lowest in below normal years. The greatest net reduction in juvenile late fall-run Chinook salmon entrainment under Alternative 8 would occur in wet years (~111,000–116,000 less fish, an 87% reduction), while entrainment in dry and critical years would be eliminated.

The proportion of the annual juvenile fall-run population (assumed to be 1 million) lost at the south Delta facilities is very low (<0.6%) under NAA for all water year types, and reduced to negligible levels under Alternative 8.

Water Exports from SWP/CVP North Delta Intake Facilities

Fall-Run

As described for Alternative 1A, potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for Alternative 1A, potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 8 would reduce the total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be slightly beneficial. Therefore, this effect would not be adverse and would likely provide some benefit to the species because of the reductions in entrainment loss and mortality at the south Delta export facilities and at agricultural diversions.

CEQA Conclusion: Entrainment and associated pre-screen losses of juvenile Chinook salmon at the south Delta facilities would always be substantially reduced under Alternative 8 for all salmon races and water year types compared to Existing Conditions. The reduction in entrainment would be a beneficial impact (Table 11-8-33). Overall, impacts on juvenile fall-run and late fall-run Chinook salmon would be beneficial because of the reductions in entrainment loss at the south Delta facilities and at agricultural diversions. No mitigation would be required.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 8 would not reduce the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to the 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 A8_LLT would be lower than flows under NAA during October and November (up to 24% lower). Flows during December through January under A8_LLT would generally be similar to or greater than flows under NAA except in above normal years during December (9% lower) and dry and critical years during January (7% and 11% lower, respectively).

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater under A8_LLT relative to NAA in all water year types (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Alternative 8 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern" as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-20. There would be 7 (35%) more years with an "orange" level of concern and 4 (50%) fewer years with a "yellow" level of concern under Alternative 8 relative to NAA.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 8 would be up to 32% lower to those under NAA during November, March and April and would be the same or similar during October and December through February (Table 11-8-21).The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be lower than or similar to mortality under NAA in all water year types (Table 11-8-34). Although there is an 8% increase in mortality during below normal years, this is only a 2% increase of the fall-run Chinook population in the Sacramento River and, therefore, would not affect the fall-run at a population level. These results indicate that Alternative 8 would have negligible effects on fall-run Chinook salmon egg mortality.

Table 11-8-34. 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. A8_LLT	NAA vs. A8_LLT
Wet	10 (98%)	0 (0%)
Above Normal	10 (92%)	-1 (-5%)
Below Normal	13 (120%)	2 (8%)
Dry	16 (109%)	-1 (-3%)
Critical	9 (31%)	-1 (-2%)
All	11 (82%)	-0.1 (-1%)

SacEFT predicts that there would be a 57% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-35). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under A8_LLT relative to NAA. SacEFT predicts that there would be an increase in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to NAA. SacEFT predicts that there would be a 22% increase in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to NAA.

Table 11-8-35. 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. A8_LLT	NAA vs. A8_LLT
Spawning WUA	7 (15%)	20 (57%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-20 (-21%)	5 (7%)
Redd Dewatering Risk	6 (22%)	6 (22%)
Juvenile Rearing WUA	-8 (-24%)	-15 (-38%)
Juvenile Stranding Risk	1 (3%)	12 (60%)

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 A8_LLT would nearly always be greater than or similar to flows under NAA, except in wet years during May (8% lower).

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, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be similar to mortality under NAA in all water years, resulting in negligible changes in the late fall-run Chinook population (Table 11-8-36).

Table 11-8-36. Difference and Percent Difference in Percent Mortality of Late Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	3 (162%)	-1 (-15%)
Above Normal	2 (76%)	-3 (-39%)
Below Normal	3 (190%)	-1 (-22%)
Dry	4 (147%)	-1 (-12%)
Critical	3 (138%)	-0.1 (-3%)
All	3 (145%)	-1 (-18%)

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Alternative 8 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-20. There would be 7 (35%) more and 4 (50%) fewer years with a “red” and “yellow” level of concern, respectively, under Alternative 8 relative to NAA.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 8 would be up to 32% lower to those under NAA during November, March and April and would be the same or similar during October and December through February (Table 11-8-21).SacEFT predicts that there would be 4%, 3%, and 2% reductions in the percentage of years with good spawning availability, redd scour risk, and egg incubation, respectively, for late fall–run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-37). SacEFT predicts that there would be no difference in the percentage of years with good (low) redd dewatering risk under A8_LLT compared to NAA.

Table 11-8-37. 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. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-8 (-10%)	-2 (-3%)
Egg Incubation	-2 (-2%)	-2 (-2%)
Redd Dewatering Risk	-5 (-8%)	0 (0%)
Juvenile Rearing WUA	-7 (-16%)	-25 (-40%)
Juvenile Stranding Risk	-23 (-32%)	3 (7%)

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 A8_LLT would nearly always be similar to or greater than flows under NAA, except in critical years during December (5% lower).

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 A8_LLT would be in the same as the reduction under NAA for all water year types (Table 11-8-38).

Table 11-8-38. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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.

[a] 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.

Feather River

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel under A8_LLT would be identical to those under NAA. Flows in the high-flow channel under A8_LLT would nearly always be lower than under NAA during October through December (up to 50% lower), but would be similar to or greater than flows under NAA during January.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during November through January were identical between A8_LLT and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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 Alternative 8 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 at Gridley was evaluated during October through April (Table 11-8-39). The percent of months exceeding the threshold under Alternative 8 would similar to the percent under NAA during December through February, but up to 41% lower (absolute scale) than the percent under NAA during the other months of the spawning and egg incubation period.

Table 11-8-39. Differences between Baseline and Alternative 8 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
October	2 (3%)	14 (16%)	23 (32%)	53 (130%)	67 (360%)
November	52 (1,400%)	31 (2,500%)	21 (NA)	12 (NA)	10 (NA)
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	7 (100%)	6 (167%)	5 (400%)	1 (NA)	1 (NA)
April	-10 (-14%)	-5 (-9%)	1 (4%)	9 (50%)	9 (78%)
NAA vs. A8_LLT					
October	0 (0%)	0 (0%)	0 (0%)	5 (6%)	7 (10%)
November	-6 (-10%)	-9 (-21%)	-11 (-35%)	-6 (-33%)	4 (60%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-4 (-100%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-30 (-67%)	-19 (-65%)	-5 (-44%)	-6 (-83%)	-2 (-67%)
April	-30 (-33%)	-28 (-35%)	-41 (-56%)	-33 (-56%)	-19 (-48%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-8-40). Total degree-months would be similar between NAA and Alternative 8 for November through February, but 47% and 38% lower during March and April, respectively, and 8% higher for October.

Table 11-8-40. Differences between Baseline and Alternative 8 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. A8_LLT	NAA vs. A8_LLT
October	Wet	106 (145%)	4 (2%)
	Above Normal	44 (100%)	8 (10%)
	Below Normal	68 (124%)	19 (18%)
	Dry	72 (136%)	1 (1%)
	Critical	60 (146%)	16 (19%)
	All	349 (131%)	47 (8%)
November	Wet	30 (NA)	-7 (-19%)
	Above Normal	21 (1,050%)	2 (10%)
	Below Normal	30 (3,000%)	9 (41%)
	Dry	24 (NA)	-7 (-23%)
	Critical	26 (2,600%)	8 (42%)
	All	130 (3,250%)	4 (3%)
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	0 (NA)	0 (NA)
	Critical	1 (NA)	-1 (-50%)
	All	1 (NA)	-2 (-67%)
March	Wet	2 (NA)	-3 (-60%)
	Above Normal	-1 (-100%)	-3 (-100%)
	Below Normal	6 (600%)	-15 (-68%)
	Dry	7 (175%)	-16 (-59%)
	Critical	17 (425%)	0 (0%)
	All	31 (310%)	-37 (-47%)
April	Wet	1 (7%)	-37 (-71%)
	Above Normal	-3 (-13%)	-30 (-60%)
	Below Normal	-7 (-18%)	-32 (-49%)
	Dry	17 (35%)	-24 (-27%)
	Critical	35 (121%)	4 (7%)
	All	106 (145%)	-119 (-38%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A8_LLT would be generally lower than mortality under NAA, except in below normal years (49% greater) (Table 11-8-41). Although the relative increase in dry years is 12%, this is only a 3% increase of the entire fall-run population in the Feather River. Therefore, the increase in dry years would not affect Feather River fall-run Chinook salmon at a population level.

Table 11-8-41. 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. A8_LLT	NAA vs. A8_LLT
Wet	10 (697%)	-9 (-46%)
Above Normal	8 (712%)	-4 (-32%)
Below Normal	20 (1,144%)	7 (49%)
Dry	21 (967%)	3 (12%)
Critical	21 (438%)	-2 (-7%)
All	16 (737%)	-2 (-11%)

American River

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 A8_LLT would generally be similar to or greater than flows under NAA during all months with some exceptions (up to 33% lower).

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 monthly reduction in American River flows during October through January under A8_LLT would be of greater magnitude by up to 138% relative to the greatest reduction under NAA in all water years except wet and dry years (Table 11-8-42).

Table 11-8-42. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-26 (-119%)	-1 (-2%)
Above Normal	-65 (-216%)	-55 (-138%)
Below Normal	-75 (-388%)	-47 (-101%)
Dry	32 (68%)	29 (66%)
Critical	-16 (-30%)	-28 (-68%)

NA = could not be calculated because the denominator was 0.

[a] 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.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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 Alternative 8 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-8-43). The percent of months exceeding the threshold under Alternative 8 would similar to that under NAA during December through February, but would be up to 53% lower (absolute scale) during November, March, and April.

Table 11-8-43. Differences between Baseline and Alternative 8 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
November	10 (22%)	5 (18%)	7 (55%)	10 (400%)	9 (700%)
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%)	2 (33%)	4 (150%)	0 (0%)	1 (NA)
April	-10 (-14%)	-10 (-16%)	-14 (-30%)	-6 (-19%)	-7 (-27%)
NAA vs. A8_LLT					
November	-37 (-40%)	-53 (-62%)	-53 (-72%)	-44 (-78%)	-31 (-76%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-4 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-35 (-70%)	-22 (-69%)	-10 (-62%)	-11 (-90%)	-4 (-75%)
April	-36 (-37%)	-41 (-44%)	-48 (-60%)	-46 (-64%)	-37 (-65%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-8-44). Total degree-months would be similar between NAA and Alternative 8 for all months.

Table 11-8-44. Differences between Baseline and Alternative 8 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. A8_LLT	NAA vs. A8_LLT
November	Wet	76 (304%)	-6 (-6%)
	Above Normal	29 (264%)	-7 (-15%)
	Below Normal	40 (500%)	-3 (-6%)
	Dry	47 (362%)	-4 (-6%)
	Critical	29 (181%)	-9 (-17%)
	All	221 (303%)	-29 (-9%)
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	1 (NA)	1 (NA)
	Critical	4 (NA)	0 (0%)
	All	5 (NA)	1 (25%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	13 (433%)	2 (14%)
	Dry	21 (525%)	-4 (-14%)
	Critical	23 (230%)	3 (10%)
	All	76 (400%)	-1 (-1%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	35 (159%)	1 (2%)
	Below Normal	38 (106%)	-3 (-4%)
	Dry	38 (50%)	-7 (-6%)
	Critical	29 (49%)	-6 (-6%)
	All	196 (89%)	-17 (-4%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A8_LLT would be similar to or lower than mortality under NAA in all water years (Table 11-8-45).

Table 11-8-45. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	24 (161%)	1 (2%)
Above Normal	23 (215%)	0 (0%)
Below Normal	22 (181%)	0.3 (1%)
Dry	14 (83%)	-3 (-9%)
Critical	7 (35%)	-2 (-8%)
All	19 (125%)	-1 (-2%)

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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 A8_LLT would nearly always be similar to or greater than flows under NAA, except in below normal years during December (9% lower). This indicates that changes in flows in the future would be due to climate change and not Alternative 8.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 8 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 Alternative 8 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 Alternative 8 would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect would not be adverse because habitat conditions are not substantially reduced. Flows would be reduced due to Alternative 8 in the Sacramento River, but this would not translate into biological effects, as evidenced by results of SacEFT and the Reclamation egg mortality model. Flows would be reduced in the Feather River, as well, but water temperature conditions and egg mortality as predicted by the Reclamation egg mortality model would not substantially change.

CEQA Conclusion: In general, Alternative 8 would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A8_LLT would generally be lower than Existing Conditions during October and November (up to 23% lower) and generally similar to or greater than flows under Existing Conditions during December and January, except in above normal and dry years during December (8% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Storage volume at the end of September would be 12% to 29% lower under A8_LLT relative to Existing Conditions (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Existing Conditions and Alternative 8 during the period, except during October, in which temperatures would be 5% higher under Alternative 8.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-20. There would be 275% and 233% increases in the number of years with "red" and "orange" levels of concern, respectively, under Alternative 8 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 8 would be 132% to 2,777% higher than those under Existing Conditions during October, November, March, and April, and would be similar during December through February (Table 11-8-21).The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be 31% to 120% greater than mortality under Existing Conditions, which is a 9% to 15% increase on an absolute scale (Table 11-8-34).

SacEFT predicts that there would be a 15% increase in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-35). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be a 21% decrease in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be a 22% increase in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing Conditions.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A8_LLT would generally be greater than or similar to flows under Existing Conditions, except in wet years during May (8% lower).

Storage volume at the end of September would be 12% to 29% lower under A8_LLT relative to Existing Conditions (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-20. There would be 275% and 233% increases in the number of years with "red" and "orange" levels of concern, respectively, under Alternative 8 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 8 would be 132% to 2,777% higher than those under Existing Conditions during October, November, March, and April, and would be similar during December through February (Table 11-8-21).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be 76% to 190% greater than mortality under Existing Conditions (Table 11-8-36). However, absolute differences in the percent of the late-fall population subject to mortality would be negligible (<5%) in all years.

SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-37). SacEFT predicts that there would be a 10% decrease in the percentage of years with good (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be negligible difference in the percentage of years with good (lower) egg incubation conditions under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 8% decrease in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir under A8_LLT during the September through February fall-run spawning and egg incubation period would always be similar to or greater than flows under Existing Conditions.

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 occurred. The greatest monthly reduction in Clear Creek flows during September through February under A8_LLT would be similar to or lower than the reduction under Existing Conditions in wet and below normal water years, but 27%, 67%, and 33% (absolute, not relative, differences) greater in above normal, dry, and critical water years, respectively (Table 11-8-38).

Feather River

Fall-Run

Flows in the low-flow channel during October through January under A8_LLT would be identical to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow channel under A8_LLT during October through December would always be lower by up to 50% than flows under Existing Conditions, but would always be greater than flows under Existing Conditions during January.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel were identical between A8_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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*). Mean monthly water temperatures under Alternative 8 relative to Existing Conditions would be 6% to 9% higher in the low-flow channel and 5% to 8% higher in the high-flow channel, depending on month.

The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley was evaluated during October through April (Table 11-8-39). The percent of months exceeding the threshold under Alternative 8 would similar to or up to 67% higher (absolute scale) than the percent under Existing Conditions during all months except December through February, during which there would be no difference in the percent of months exceeding the threshold.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-8-40). Total degree-months under Alternative 8 would be 131% to 3,250% higher than total degree-months under Existing Conditions, except during December through February, when there would be no differences. The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A8_LLT would be 438% to 1,144% greater than mortality under Existing Conditions (Table 11-8-41).

American River

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 A8_LLT would generally be similar to or greater than flows under Existing Conditions during October, but generally lower by up to 36% than flows under Existing Conditions during November through January.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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*). Mean monthly temperatures under Alternative 8 would be 5% to 12% greater than those under Existing Conditions depending on month. The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-8-43). The percent of months exceeding the threshold under Alternative 8 would be up to 10% greater (absolute scale) than the percent under Existing Conditions during November, up to 14% lower (absolute scale) during April, and similar to the percent under Existing Conditions during December through March.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-8-44). Total degree-months under Alternative 8 would be 89% to 400% greater than total degree-months under Existing Conditions during November, March and April and similar to total degree months under Existing Conditions during December through February.

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 monthly reduction in American River flows during October through January under A8_LLT would be up to 388% greater magnitude than those under Existing Conditions in all years except dry (68% lower magnitude) (Table 11-8-42).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A8_LLT would be 35% to 215% greater than mortality under Existing Conditions (Table 11-8-45).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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 A8_LLT would generally be lower than flows under Existing Conditions throughout the period by up to 18%.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would not be different from those under Existing Conditions during October, but 6% higher during November through January.

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 Alternative 8 would be 5% lower than flows under Existing Conditions during October, similar during November and December, and 6% greater during January.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 Alternative 8 would be 5% and 9% lower than flows under NAA during October and November, respectively, and 13% and 14% greater during December and January, respectively.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 8. There would be substantial decreases in reservoir storage in the Sacramento and Feather Rivers, substantial flow reductions in the Feather, American, and Stanislaus Rivers, substantial increases in egg mortality predicted by the Reclamation egg mortality model, substantial reductions in spawning and egg incubation conditions predicted by SacEFT, and reduced water temperature conditions under Alternative 8.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to H3 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and H3 indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between future conditions without the BDCP (NAA) and H3. This indicates that the differences between

Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 8 would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to the NAA.

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the Sacramento River upstream of Red Bluff under A8_LLT would nearly always be greater than or similar to flows under NAA, except in dry and critical years during January (7% and 11% lower, respectively).

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 8 in any month or water year type throughout the period. SacEFT predicts that there would be a 38% decrease in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-35). SacEFT predicts that there would be a 60% increase in the percentage of years with “good” (lower) juvenile stranding risk under A8_LLT relative to NAA.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A8_LLT would be similar to mortality under NAA.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during July under A8_LLT would be generally lower than those under NAA (up to 13% lower). Flows during the rest of the period would be generally similar to or greater under A8_LLT than under NAA, with some exceptions (up to 11% lower).

Shasta Reservoir storage at the end of September and May would affect flows during the late fall–run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta

Reservoir storage would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

As reported in Impact AQUA-40, May Shasta storage volume under A8_LLT would generally be lower compared to storage under NAA in above and below normal water years by 6% and 10%, respectively, and similar to NAA in wet, dry, and critical water years (Table 11-8-9).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 8 in any month or water year type throughout the period. SacEFT predicts that there would be a 40% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-37). SacEFT predicts that there would be an increase in the percentage of years with "good" (lower) juvenile stranding risk under A8_LLT relative to NAA.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A8_LLT would be similar to mortality under NAA.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to flows under NAA, with few exceptions (up to 8% lower).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A8_LLT would not differ from those under NAA. In the high-flow channel, flows under A8_LLT would be generally lower (up to 50% lower) during December and June and generally similar to or greater than flows under NAA during January through May.

As reported in Impact AQUA-59, May Oroville storage volume under A8_LLT would be 8% to 36% lower than storage under NAA depending on water year type (Table 11-8-24).

As reported in Impact AQUA-58, September Oroville storage volume would be generally similar to or greater than NAA, except in below normal years (7% lower) (Table 11-8-25).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing 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 8 in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be greater relative to NAA would generally be similar to or greater with few exceptions (up to 33% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing 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 8 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*. Flows under A8_LLT would similar to flows under NAA throughout the period, regardless of water year type.

Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA and Alternative 8 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis for Alternative 8 are not different from those under NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta for Alternative 8 are not different from those under NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Taken together, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat for fish. Flows and water temperatures would generally be similar under Alternative 8 relative to the NEPA point of comparison with few exceptions that would not rise to the level of adverse. SacEFT predicts that there would be a 38% and 40% reduction in years with good juvenile rearing habitat availability for fall- and late fall–run Chinook salmon, respectively, although SacEFT also predicts a 60% increase in years with good stranding risk conditions for fall-run Chinook salmon.

CEQA Conclusion: In general, Alternative 8 would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to the Existing Conditions.

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would nearly always be greater than or similar to flows under Existing Conditions, except in wet years during May (8% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 29% lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period. SacEFT predicts that there would be an 24% decrease in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-35). SacEFT predicts that the percentage of years with "good" (lower) juvenile standing risk under A8_LLT would be similar to that under Existing Conditions.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A8_LLT would be 7% lower than mortality under Existing Conditions.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during the period under A8_LLT would generally be similar to or greater than those under Existing Conditions, with some exceptions (up to 12% lower).

As reported in] Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 29% lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A8_LLT would be generally lower than Existing Conditions (up to 21% lower) in all water years except wet, in which storage would be similar between A8_LLT and Existing Conditions (Table 11-8-9).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 8 in any month throughout the period, except for a 5% increase during July. SacEFT predicts that there would be a 16% reduction in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table 11-8-37). SacEFT predicts that there would be a 32% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A8_LLT relative to Existing Conditions.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A8_LLT would be similar (<5% difference) to mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would always be similar to or greater than flows under Existing Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under A8_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A8_LLT would always be lower (up to 50% lower) during December and June, and always greater than flows under Existing Conditions during the rest of the period.

As reported under Impact AQUA-59, May Oroville storage volume under A8_LLT would be lower than Existing Conditions in all water year types (20% to 43% lower) (Table 11-8-28).

As reported in Impact AQUA-58, September Oroville storage volume would be 15% to 35% lower under A8_LLT relative to Existing Conditions in all water year types except critical years, during which storage would be similar to that under Existing Conditions (Table 11-8-25).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 8 would be 6% to 9% higher than those under Existing Conditions during December through February, but not different from those under Existing Conditions during March through June. In the high-flow channel, mean monthly water temperatures under Alternative 8 would be 5% to 8% higher than those under Existing Conditions during December through February, but not different from those under Existing Conditions during March through June.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under Existing Conditions during January (up to 35% lower), and generally similar to or greater than flows under Existing Conditions during the rest of the period with few exceptions (up to 32% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% to 7% higher than those under Existing Conditions in all months during the period except April, in which temperatures would not differ between Alternative 8 and Existing Conditions.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT throughout the period would be nearly always lower than flows under Existing Conditions, by up to 36%.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions in all months during the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to flows under Existing Conditions throughout the period except during January, in which flows would be 6% greater under Alternative 8.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 8 would be 14% and 12% greater than flows under Existing Conditions during January and February, similar to flows under Existing Conditions during March, and 8% to 12% lower than flows under Existing Conditions during April and May.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 8. There would be substantial changes in reservoir storage, flows, and water temperatures in multiple waterways that will reduce the availability and quality of juvenile rearing habitat for fall-/late fall-run Chinook salmon.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to H3 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and H3 indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between future conditions without the BDCP (NAA) and H3. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 8 would reduce migration conditions for fall-/late fall–run Chinook salmon relative to the NAA.

Upstream of the Delta

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February through May under A8_LLT would nearly always be similar to or greater than those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 8 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A8_LLT would generally be lower than those under NAA throughout the period (up to 27% lower).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration 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 8 in any month or water year type throughout the period.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A8_LLT would nearly always be similar to or greater than flows under NAA, except in dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 8 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A8_LLT would generally be similar to or greater than those under NAA, except in above normal years during December (9% lower) and dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration 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 8 in any month or water year type throughout the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants during February through May. Flows under A8_LLT would generally be similar to or greater than those under NAA, with few exceptions (up to 8% lower).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A8_LLT would always be similar to or greater than those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile migration period (February through May) under A8_LLT would always be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 8 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A8_LLT would be lower by up to 58% than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration 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 8 in any month or water year type throughout the period.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during February through May would generally be similar to or greater than flows under NAA in February, April, and May, except in critical years during February (11% lower). Flows under A8_LLT during March would generally be lower by up to 14%.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 Alternative8 in any month or water year type throughout the period.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to or greater than those under NAA throughout the period, except during below normal and critical years during September (16% and 10% lower, respectively) and below normal years during October (10% lower).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 8 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis* Flows under A8_LLT would be similar to flows under NAA throughout the period.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration 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 8 in any month or water year type throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA throughout the period.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 8 in any month or water year type throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period. Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through Delta

The effects on through-Delta migration were evaluated using the approach described in Alternative 1A, Impact AQUA-42.

Sacramento River

Fall-Run

Juveniles

Predation at the north Delta would be increased due to the installation of the three proposed SWP/CVP water export facilities on the Sacramento River. Bioenergetics modeling with a median predator density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of about 1.2% fall-run and 3.2% late fall-run population, as analyzed for Alternative 4 (Impact AQUA-78) (Appendix 5F, *Biological Stressors*). The overall effect of the predation and habitat loss associated with the three intake structures is not considered substantial.

Through-Delta survival by emigrating fall-run Chinook salmon juveniles under Alternative 8 (A8_LLT) would average 25% across all years, 22% in drier years, and 30% in wetter years (Table 11-8-46). Average survival across all years under Alternative 8 would be similar for the Sacramento River compared to NAA. Survival would be slightly greater for the Mokelumne River (2.4% greater survival, or 15% relative increase), particularly in wetter years (3.7% more). Overall, Alternative 8 would not have an adverse effect on fall-run Chinook salmon juvenile due to minor differences in survival across all water years.

Table 11-8-46. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Alternative 8

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Type	EXISTING CONDITIONS	NAA	A8	EXISTING CONDITIONS vs. A8	NAA vs. A8
Sacramento River					
Wetter Years	34.5	31.1	30.4	-4.1 (-12%)	-0.7 (-2%)
Drier Years	20.6	20.8	21.6	1.0 (5%)	0.8 (4%)
All Years	25.8	24.7	24.9	-0.9 (-4%)	0.2 (1%)
Mokelumne River					
Wetter Years	17.2	15.7	19.4	2.3 (13%)	3.7 (24%)
Drier Years	15.6	15.9	17.6	2.0 (13%)	1.6 (10%)
All Years	16.2	15.9	18.3	2.1 (13%)	2.4 (15%)
San Joaquin River[a]					

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).
[a] DPM results are anomalous for Alternative 8 San Joaquin River.

Adults

The adult fall-run migration extends from September–December. The proportion of Sacramento River water in the Delta under Alternative 8 would be similar (<10% change) NAA throughout the adult fall-run migration through the Delta (Table 11-8-47). The proportion of Sacramento River under Alternative 8 would represent 61–69% of Delta outflows during this period, and would thus still provide strong olfactory cues. This topic is further discussed in Impact AQUA-42 in Alternative 1A.Because the proportion of Sacramento River water in the Delta would not substantially change during the peak adult migration period under Alternative 8, it would not have an adverse effect on adult fall-run migration success through the Delta.

Late Fall-Run

Juveniles

Through-Delta survival by late fall–run Chinook salmon juveniles under Alternative 8 (A8_LLT) would be similar to NAA.

Adults

The adult late fall–run migration is from November through March, peaking in January through March. The proportion of Sacramento River water in the Delta would be similar to NAA, during the adult migration period (Table 11-8-47).

San Joaquin River

Fall-Run

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There would be no flow changes associated with the Alternative 8. Although the Delta Passage Model is used to estimate through-Delta survival for most Chinook salmon runs, it can be problematic applying the DPM to San Joaquin River salmon for certain Alternatives and operations scenarios with highly reduced south Delta exports (such as Alternatives 6A, 7, 8 and 9). These issues are discussed further in Impact AQUA-78 under Alternative 6A. A qualitative assessment is more appropriate given this modeling limitation. There is a beneficial effect of Alternative 8 to all San Joaquin River basin fish due to positive Old and Middle River flows during migratory months resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under Alternative 8, entrainment and entrainment-related mortality at the South Delta Facilities would be reduced.

Additionally, under Alternative 8, the reduction of entrainment at the South Delta Facilities would alleviate one of the primary concerns related to potential Old and Middle River corridor habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat, food availability, and overall salmonid fitness and survival.

Adults

Alternative 8 would slightly increase the proportion of San Joaquin River water in the Delta in September through December by 7.6% compared to NAA (Table 11-8-47). The increase in the proportion of San Joaquin River water in the Delta would be mainly due to the reduction in Sacramento River flows in the Delta. The migration conditions for San Joaquin River basin fall-run Chinook salmon under Alternative 8 would be similar to or slightly improved relative to NAA. Alternative 8 would have no effect on the fall-run adult migration because flow levels and olfactory cues would be effectively unchanged.

Table 11-8-47. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 8

Month	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.4	1.1	1.3
October	0.2	0.3	4.9	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.3	5.4	5.3
	Shading indicates greater than 10% reduction in the proportion of river flows.				

NEPA Effects: Upstream of the Delta, these results indicate that the impact would be adverse because it would substantially reduce migration conditions and interfere with the movement of fish. Flows during September and October in the Sacramento and Feather rivers would be lower in most water year types throughout the adult migration period under Alternative 8. However, there would be no other effects of Alternative 8 in these rivers and no effects in any other upstream waterway.

Near-field effects of Alternative 8 NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 13% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 8 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 8 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

Collectively, these results indicate that the effect of Alternative 8 would be adverse because it has the potential to substantially migration conditions and interfere with the movement of fish upstream of the Delta.

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. Even so, proposed mitigation (Mitigation Measure AQUA-78a through AQUA-78c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce migration conditions for fall-/late fall–run Chinook salmon, relative to Existing Conditions.

Upstream of the Delta

Sacramento River

Fall–Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February through May under A8_LLT would nearly always be similar to or greater than those under Existing Conditions, except in wet water years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A8_LLT would generally be lower than those under Existing Conditions throughout the period (up to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% and 5% greater than those under Existing Conditions during September and October, respectively.

Late Fall–Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A8_LLT would always be similar to or greater than flows under Existing Conditions (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A8_LLT would generally be similar to or greater than those under Existing Conditions, except in above normal and dry years during December (8% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon upstream migration period (February through May) under A8_LLT would be similar to or greater than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A8_LLT would nearly always be similar to or greater than those under Existing Conditions, except in critical years during September (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile migration period (February through May) under A8_LLT would always be similar to or greater than flows under (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A8_LLT would nearly always be lower than flows under Existing Conditions (up to 37% lower).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% greater than those under Existing Conditions during September and October.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during February through May would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 32% lower).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% and 7% higher than under Existing Conditions in February and March, respectively, and during April and May there would be little difference (<5%).

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during September would be 6% to 62% lower than flows under Existing Conditions. Flows under A8_LLT during October would generally be similar to or greater than those under Existing Conditions, except in wet and dry water years (9% and 19% lower, respectively).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% and 10% higher than those under Existing Conditions during September and October, respectively.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would predominantly be lower than flows under Existing Conditions, by up to 36%.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions in every month of the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during September would generally be similar to flows under Existing Conditions, except during wet and critical years (17% and 6% lower, respectively). Flows under A8_LLT during October would be 5% to 7% lower than flows under Existing Conditions.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions during September but there would be no difference in mean monthly water temperatures between Alternative 8 and Existing Conditions during October.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to Existing Conditions but with lower flows in two water years during February, and would be lower than Existing Conditions by up to 15% during March, April and May.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be lower than Existing Conditions by up to 11% during both months.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under Existing Conditions during February and March, but up to 18% lower than flows under Existing Conditions during April and May.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water year types throughout the period. Flows under Alternative 8 would be up to 29% lower than those under Existing Conditions depending on water year type.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Predation at the north Delta would be increased due to the installation of the three proposed SWP/CVP water export facilities on the Sacramento River. Bioenergetics modeling with a median predator density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of about 1.2% fall-run and 3.2% late fall-run population, as analyzed for Alternative 4 (Impact AQUA-78). The overall effect of the predation and habitat loss associated with the three intake structures is not considered substantial.

For fall-run Chinook salmon juveniles, DPM results show a small increase in survival from the Mokelumne River (2.1% compared to Existing Conditions) and similar survival from the Sacramento River under Alternative 8. Late fall–run Chinook survival was similar to Existing Conditions. The impact on juvenile Chinook salmon migration through the Delta would not be substantial.

Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing Conditions during most of the year, but reduced slightly (11–12%) in March, April, and July (Table 11-8-47). These months overlap with the migration periods for late fall–run adult Chinook salmon. Sacramento River flow olfactory cues would also still be strong since Sacramento River water would still represent 54–71% of Delta water under Alternative 8.

Summary of CEQA Conclusion

These results indicate that the impact would be significant because it has the potential to reduce migration habitat and interfere with the movement of fish. Through-Delta migration conditions for fall-/late fall-run Chinook salmon in the Sacramento and San Joaquin rivers would not be substantially affected by Alternative 8 relative to Existing Conditions. In the Sacramento River, Alternative 8 would not substantially reduce olfactory cues for Sacramento River Chinook salmon and Mokelumne River flows would be slightly increased. Alternative 8 also would not substantially increase predation and remove important instream habitat as the result of the presence of three NDD structures. Through-Delta survival of emigrating juveniles would not be expected to be reduced, compared to Existing Conditions. Therefore, it is concluded that the through-Delta impact on the Sacramento River is less than significant and no mitigation would be required. In the San Joaquin River, because of similar and olfactory attraction cues, the impact of Alternative 8 on fall-run Chinook salmon migration would be less than significant and no mitigation would be required.

Flows in all waterways upstream of the Delta except Clear Creek under Alternative 8 would be lower than those under Existing Conditions during one or both months of the September through October adult migration period. These flow reductions would reduce the ability of fall-run Chinook salmon adult migrants to sense olfactory cues from their natal spawning grounds, potentially delaying or preventing them from reaching these spawning grounds. In addition, temperatures would be slightly, but consistently, higher in the Sacramento, Feather, American, and Stanislaus Rivers under Alternative 8.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on migration conditions, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on rearing habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-78c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on steelhead habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife 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-78a.

If feasible means are identified to reduce impacts on migration conditions consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on fall-/late fall-run Chinook salmon migration conditions is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on fall-/late fall-run Chinook salmon would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for fall- and late fall-run Chinook salmon under Alternative 1A (Impact AQUA-79 through Impact AQUA-81) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on fall- and late fall-run Chinook salmon are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for fall- and late fall–run Chinook salmon under Alternative 1A (Impact AQUA-82 through Impact AQUA-90) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on fall and late fall-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on fall and late fall-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Steelhead

Construction and Maintenance of CM1

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

NEPA Effects: The potential effects of construction of the water conveyance facilities on steelhead would be similar to those described for Alternative 1A (Impact AQUA-91) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for steelhead.

CEQA Conclusion: As described in for Alternative 1A, Impact AQUA-91, the impact of the construction of water conveyance facilities on steelhead would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-92, except that only three intakes would be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in for Alternative 1A, Impact AQUA-92, the effect would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Water Exports from SWP/CVP South Delta Facilities

Alternative 8 would substantially reduce entrainment losses of juvenile steelhead at the SWP/CVP south Delta export facilities, similar to Alternative 1A, Impact AQUA-93. Alternative 8 would result in overall reduced entrainment of juvenile steelhead at the south Delta export facilities, estimated by the salvage density method, by about 82% compared to NAA (Table 11-8-48). Entrainment under Alternative 8, when broken down by water year type, would range from a reduction of 75% in wet years to 99% in critical years compared to NAA. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities. This effect would be beneficial to steelhead.

Water Exports from SWP/CVP North Delta Intake Facilities

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because intakes would have state-of-the-art screens installed. For juvenile steelhead, changes at the NBA would have minimal effect because steelhead are generally not present in this area so would have minimal risk of entrainment under Existing Conditions. Overall, the effect on steelhead under Alternative 8 would not be adverse and may provide a small benefit to the species because entrainment would be reduced, especially at the south Delta facilities.

NEPA Effects: Entrainment and associated pre-screen predation losses would be substantially reduced at the south Delta facilities, compared to NAA. The effect under Alternative 8 would not be adverse.

CEQA Conclusion: Entrainment losses of juvenile steelhead would be substantially reduced under Alternative 8 compared to Existing Conditions (Table 11-8-48). Overall, impacts would be beneficial to steelhead because of the reduction in entrainment loss and mortality. No mitigation would be required.

Table 11-8-48. Juvenile Steelhead Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-4,670 (-75%)	-4,762 (-75%)
Above Normal	-10,306 (-79%)	-10,650 (-80%)
Below Normal	-9,748 (-82%)	-9,018 (-81%)
Dry	-7,349 (-98%)	-6,759 (-97%)
Critical	-5,820 (-99%)	-5,470 (-99%)
All Years	-7,356 (-82%)	-7,214 (-82%)

[a] Estimated annual number of fish lost, based on non-normalized data.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, effects of Alternative 8 on steelhead spawning habitat would be negligible relative to the NAA.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A8_LLT throughout the period would generally be similar to or higher those under NAA except during January in dry (-7%) and critical (-11%) years.

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 8 in any month or water year type throughout the period at either location

SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-49). SacEFT predicts that there would be a small decrease in suitable spawning area (-6%) between NAA and A8_LLT, negligible (<5%) effects on redd scour risk and dewatering risk, and no effect (0%) on egg incubation compared to NAA. These results indicate that there would be a low effect of Alternative 8 on spawning habitat quantity but no difference in redd scour risk or temperature-related egg incubation conditions.

Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg incubation in the Sacramento River would be negligible.

Table 11-8-49. Difference and Percent Difference in Percentage of Years with "Good" Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-5 (-6%)	-2 (-3%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	2 (4%)
Juvenile Rearing WUA	-12 (-29%)	-16 (-36%)
Juvenile Stranding Risk	0 (0%)	14 (70%)

WUA = Weighted Usable Area.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A8_LLT would generally be similar to flows under NAA throughout the period, except in wet years during January (7% lower), below normal and critical years in March (6% and 8% lower, respectively) and critical years during April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering indicate the greatest monthly flow reduction would be identical between NAA and A8_LLT for all water years except for a 67 cfs decrease in critical years (Table 11-8-50).

Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg incubation habitat in Clear Creek would be negligible.

Table 11-8-50. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_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	-67 (NA)	-67 (NA)

NA = could not be calculated because the denominator was 0.

[a] 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.

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 A8_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 A8_LLT at Thermalito Afterbay would be greater than flows under NAA (up to 566% higher).

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. May Oroville storage under A8_LLT would be lower than storage under NAA (up to 36%) (Table 11-8-51). Storage volume at the end of September under A8_LLT would be greater than storage under NAA (up to 24%) depending on water year type except for below normal years (7% lower) (Table 11-8-52).

Table 11-8-51. May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	-689 (-20%)	-643 (-19%)
Above Normal	-1,168 (-33%)	-1,012 (-30%)
Below Normal	-1,414 (-43%)	-1,061 (-36%)
Dry	-1,064 (-39%)	-544 (-24%)
Critical	-436 (-24%)	-120 (-8%)

Table 11-8-52. September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	-775 (-27%)	239 (13%)
Above Normal	-697 (-29%)	94 (6%)
Below Normal	-709 (-35%)	-100 (-7%)
Dry	-198 (-15%)	155 (15%)
Critical	-30 (-3%)	158 (20%)

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 8 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 11-8-53). The percent of months exceeding the threshold under Alternative 8 would generally be similar to or lower (up to 17% lower on an absolute scale) than the percent under NAA depending on month and degrees above the threshold.

Table 11-8-53. Differences between Baseline and Alternative 8 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	1 (100%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
April	21 (243%)	10 (200%)	9 (NA)	2 (NA)	1 (NA)
NAA vs. A8_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-7 (-75%)	-2 (-100%)	-1 (-100%)	-1 (-100%)	-1 (-100%)
April	-23 (-44%)	-17 (-54%)	-9 (-50%)	-4 (-60%)	0 (0%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-8-54). Total degree-months would be similar between NAA and Alternative 8 during January and February, but would be 69% lower under Alternative 8 than NAA during March and 28% lower during April.

Table 11-8-54. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, January through April

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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	1 (NA)	-1 (-50%)
	Dry	1 (NA)	-1 (-50%)
	Critical	1 (100%)	-7 (-78%)
	All	3 (300%)	-9 (-69%)
April	Wet	1 (NA)	-2 (-67%)
	Above Normal	5 (250%)	-6 (-46%)
	Below Normal	7 (175%)	-9 (-45%)
	Dry	16 (320%)	-10 (-32%)
	Critical	22 (NA)	-1 (-4%)
	All	51 (464%)	-28 (-31%)

NA = could not be calculated because the denominator was 0.

Overall for the Feather River, these results indicate that project-related effects of Alternative 8 on mean monthly flow would consist of no effects (0% difference) in the low-flow channel and substantial increases in flow (to 566%) that would have beneficial effects on spawning conditions below Thermalito Afterbay. Project-related effects of Alternative 8 would consist of negligible (<5%) or beneficial effects on water temperatures. Project-related effects on storage in Oroville Reservoir (i.e., coldwater pool availability) would consist of decreases in storage in May (to -36%) when the egg incubation period is over, and increases in storage in September (to 20%) that would have a beneficial effect heading toward the onset of spawning in the winter months. These results indicate that effects of Alternative 8 on flow and water temperature would not have biologically meaningful negative effects on steelhead spawning conditions in the Feather River.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to or larger than flows under NAA during the period except in critical years during January, February and March (9%, 11% and 14%, respectively) and dry years during January and March (5% and12%, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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 8 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-8-43). Steelhead spawn and eggs incubate in the American River between January and April. The percent of months exceeding the threshold under Alternative 8 would similar to that under NAA during January and February, but would be up to 53% lower (absolute scale) during March and April, depending on month and threshold level.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-8-44). During the January through April steelhead spawning and egg incubation period, total degree-months would be similar between NAA and Alternative 8.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 8 throughout 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*).

Mokelumne River

Flows in the Mokelumne River at the confluence were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be the same as flows under NAA.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg development. Project-related effects of flow, including water temperatures, under Alternative 8 would have small and inconsistent effects on steelhead spawning conditions in the upstream waterways evaluated, with beneficial effects in some locations (i.e., a prevalence of increases in mean monthly flow of up to 44% in all rivers analyzed and up to 566% in the Feather River, and a 20% increase in cold-water pool storage in Oroville Reservoir in September) and negligible or small-scale effects on spawning metrics calculated with SacEFT (up to 6%). There would be an increase in the greatest monthly flow reduction in Clear Creek in critical years (-67 cfs), although, based on the remaining results, this isolated effect is not expected to have biologically meaningful effects on spawning success.

CEQA Conclusion: In general, under Alternative 8 water operations, the quantity and quality of spawning habitat for steelhead would not be reduced relative to the CEQA baseline.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during this period (up to 47% higher) with some exceptions. Upstream of Red Bluff Diversion Dam, flows under A8_LLT would generally be similar to or higher (up to 29% higher) than Existing Conditions throughout the period except for wet years during April (8% lower).

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period at either location.

SacEFT predicts no or negligible differences in spawning habitat, egg incubation, and redd dewatering risk between Existing Conditions and Alternative 8 and a small change (-6%) in years considered "good" in terms of redd scour risk (Table 11-8-49).

Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg incubation habitat in the Sacramento River would be negligible.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A8_LLT would be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between Existing Conditions and A8_LLT for all water year types except wet, in which the greatest reduction would be 38% lower (worse) under A8_LLT than under Existing Conditions (Table 11-8-50).

Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg 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 A8_LLT would not differ from Existing Conditions 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 A8_LLT at Thermalito Afterbay would be greater than flows under Existing Conditions throughout the period (up to 565%).

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. Oroville Reservoir storage volume at the end of September would be 3% to 35% lower under A8_LLT relative to Existing Conditions depending on water year type (Table 11-8-52). May Oroville storage volume under A8_LLT would be lower than Existing Conditions by 20% to 43% depending on water year type (Table 11-8-51).

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*). In the low-flow channel, mean monthly water temperatures under Alternative 8 would be 6% and 7% greater than those under Existing Conditions during January and February, respectively, and similar to temperatures under Existing Conditions during March and April. In the high-flow channel, mean monthly water temperatures under Alternative 8 would be 5% and 7% greater than those under Existing Conditions during January and February, respectively, and similar to temperatures under Existing Conditions during March and April.

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 11-8-53). The percent of months exceeding the threshold under Alternative 8 would be similar to the percent under Existing Conditions during January through March and similar to or up to 21% greater (absolute scale) than the percent under Existing Conditions depending on degrees above the threshold during April.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-8-54). Total degree-months would be similar between Existing Conditions and Alternative 8 during January through March and 464% higher under Alternative 8 compared to Existing Conditions during April.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under Existing Conditions during January and greater than flows under Existing Conditions during February, March and April with some exceptions.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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*). Mean monthly water temperature under Alternative 8 would be 5% to 7% higher than those under Existing Conditions during January through March, and temperatures would not differ between Alternative 8 and Existing Conditions during April.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-8-43). Steelhead spawn and eggs incubate in the American River between January and April.

During January through March, the percent of month exceeding the threshold under Existing Conditions and Alternative 8 would be similar. During April the percent of months exceeding the threshold under Alternative 8 would be up to 14% lower (absolute scale) that the percent under Existing Conditions.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-8-44). During January and February, there would be no difference in total degree-months above the 56°F threshold between Existing Conditions and Alternative 8. During March and April, total degree-months under Alternative 8 would be 400% and 89% greater, respectively, than those under Existing Conditions.

Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg incubation habitat in the American River would be moderate to substantial.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under Existing Conditions during the entire period.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was evaluated 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*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions in all four months of the period.

Overall, these results indicate that the effect of Alternative 8 on steelhead spawning and egg incubation in the Stanislaus River would be substantial.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 8 would generally be similar to flows under Existing Conditions during March, up to 18% greater during February, and up to 14% lower during April.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Alternative 8 would affect steelhead spawning conditions through reduced mean monthly flows in the American River (decreases to -35% in drier water years for January through March) and the Stanislaus River (decreases to -36% in most water years for January through April), and through increased magnitude of monthly flow reductions in Clear Creek (-38% in wet years and a 39% reduction in critical years), Effects of Alternative 8 would not affect spawning conditions in the Sacramento and Feather Rivers, based on negligible effects on mean monthly flow, spawning metrics calculated with SacEFT, NMFS temperature threshold analyses, and calculations of monthly flow reductions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, Alternative 8 would reduce the quantity and quality of steelhead rearing habitat relative to the NAA.

Sacramento River

Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or greater (up to 25%) than flows under NAA during

February through June and December, and lower than flows under NAA (up to 26% lower) during January and July through November.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing 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 8 in any month or water year type throughout the period at either location. SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions under A8_LLT would be 36% lower than under NAA (Table 11-8-49). The percentage of years with good (lower) juvenile stranding risk conditions under A8_LLT would be 70% higher than under NAA. These results indicate that Alternative 8 would cause decreases in rearing habitat conditions but reductions in juvenile mortality risk resulting from stranding in the Sacramento River.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A8_LLT would generally be similar to or sometimes greater than flows under NAA, except for wet years in January (7% lower) and below normal years in March (6% lower) and critical years in March, April, June and December (all 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 8 relative to NAA in all water years except in wet years and critical years when they would be 7% and10% higher, respectively (Table 11-8-55).

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.

Overall, these results indicate that Alternative 8 would not affect juvenile rearing conditions in Clear Creek

Table 11-8-55. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	6 (7%)	6 (7%)
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 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 A8_LLT would not differ from those under NAA. In the high flow channel, flows under A8_LLT would be lower (up to 72%) during June through December, greater (up to 566%) than flows under NAA during January through May.

May Oroville storage under A8_LLT would be lower under NAA (up to 36% lower) (Table 11-8-51). September Oroville storage volume would be greater than under NAA (up to 20% greater) except for being 7% lower in below normal water years (Table 11-8-52).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing 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 8 in most months and water year types throughout the period at either location. However, above Thermalito Afterbay mean monthly temperature was greater under Alternative 8 than NAA during September of below normal years and below Thermalito Afterbay mean monthly temperature was greater under Alternative 8 than NAA during July in all water year types except critical years, during August of above normal years and during September of wet and above normal years.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 8 would generally be similar to or lower (up to 12% lower on an absolute scale) than the percent under NAA, but would be higher (up to 14% higher on an absolute scale) during August, depending on threshold level (Table 11-8-29). At Gridley, the percent of months exceeding the threshold under Alternative 8 would similar to or up to 41% lower (absolute scale) than the percent under NAA (Table 11-8-39).

Total degree-months exceeding 63°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) during May through August and total degree-months exceeding 56°F at Gridley during October through April. In the low-flow channel, total degree-months under Alternative 8 would be similar to those under NAA during May and greater (up to 19% greater) under Alternative 8 during June through August (Table 11-8-30). At Gridley, total degree-months would be similar between NAA and Alternative 8 during November through February, 8% higher under Alternative 8 during October, and 47% and 38% lower under Alternative 8 during March and April, respectively (Table 11-8-40).

Overall, project-related effects of Alternative 8 on flow in the Feather River low-flow channel would have negligible effects on mean monthly flow and relatively small effects on water temperatures that would not affect steelhead rearing conditions. Effects of Alternative 8 in the Feather River below Thermalito Afterbay would include substantial increases in mean monthly flow (to 566%) during January through May in all water year types, and moderate to substantial reductions in flow (to -76%) during June to December, including in drier water types, that would have negative effects on juvenile steelhead rearing conditions in all water year types for the warmer summer months. The effects of flow reductions would be offset by project-related increases in flows that would occur prior to these months, including increases to 566% in below normal years, to 284% in dry years, and to 106% in critical years. Effects on water temperatures would generally be negligible.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to flows under NAA during February, April, October and December, greater than flows under NAA during May and June, lower than flows under NAA during March, July and November, and mixed with both higher and lower flows in January, August and September.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing 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 8 in any month or water year type throughout the period.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-8-56). During May, September, and October, the percent of months exceeding the threshold under Alternative 8 would similar to or up to 60% lower (absolute scale) than the percent under NAA. During June through September, the percent of months exceeding the threshold would mostly be similar between NAA and Alternative 8 with one, two, or three degree categories in which there would be increases of up to 44% on an absolute scale in percent of months exceeding the threshold under Alternative 8.

Table 11-8-56. Differences between Baseline and Alternative 8 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
May	10 (50%)	4 (25%)	2 (22%)	4 (60%)	0 (0%)
June	32 (50%)	38 (72%)	44 (109%)	52 (168%)	52 (247%)
July	0 (0%)	1 (1%)	37 (59%)	64 (179%)	83 (479%)
August	0 (0%)	2 (3%)	19 (23%)	52 (108%)	69 (224%)
September	7 (9%)	32 (60%)	37 (115%)	36 (223%)	25 (333%)
October	16 (325%)	2 (100%)	2 (NA)	0 (NA)	0 (NA)
NAA vs. A8_LLT					
May	-35 (-54%)	-31 (-63%)	-26 (-66%)	-22 (-69%)	-12 (-71%)
June	-2 (-3%)	0 (0%)	4 (5%)	17 (26%)	25 (51%)
July	0 (0%)	0 (0%)	2 (3%)	28 (40%)	44 (80%)
August	0 (0%)	0 (0%)	0 (0%)	4 (4%)	10 (11%)
September	-7 (-7%)	-12 (-13%)	-16 (-19%)	-22 (-30%)	-28 (-47%)
October	-59 (-74%)	-60 (-92%)	-43 (-95%)	-30 (-100%)	-11 (-100%)

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-8-57). During May, June, and October, total degree-months would be similar between NAA and Alternative 1A or up to 26% lower under Alternative 8. During July through September, there would be increases(up to 31%) in total degree-months exceeding the threshold.

Table 11-8-57. Differences between Baseline and Alternative 8 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 CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	19 (317%)	-2 (-7%)
	Above Normal	23 (NA)	-4 (-15%)
	Below Normal	17 (567%)	-6 (-23%)
	Dry	13 (59%)	-21 (-38%)
	Critical	17 (89%)	-15 (-29%)
	All	89 (178%)	-48 (-26%)
June	Wet	62 (365%)	-6 (-7%)
	Above Normal	29 (121%)	-3 (-5%)
	Below Normal	42 (145%)	4 (6%)
	Dry	40 (59%)	0 (0%)
	Critical	40 (80%)	-10 (-10%)
	All	213 (113%)	-15 (-4%)
July	Wet	85 (109%)	36 (28%)
	Above Normal	36 (133%)	30 (91%)
	Below Normal	44 (129%)	23 (42%)
	Dry	76 (123%)	25 (22%)
	Critical	74 (91%)	28 (22%)
	All	316 (112%)	143 (31%)
August	Wet	114 (144%)	6 (3%)
	Above Normal	29 (71%)	-4 (-5%)
	Below Normal	34 (61%)	-3 (-3%)
	Dry	98 (144%)	17 (11%)
	Critical	67 (85%)	3 (2%)
	All	341 (106%)	18 (3%)
September	Wet	60 (250%)	-14 (-14%)
	Above Normal	33 (206%)	-3 (-6%)
	Below Normal	53 (189%)	6 (8%)
	Dry	94 (224%)	8 (6%)
	Critical	56 (114%)	3 (3%)
	All	296 (186%)	0 (0%)
October	Wet	44 (4,400%)	-10 (-18%)
	Above Normal	30 (NA)	4 (15%)
	Below Normal	25 (NA)	-14 (-36%)
	Dry	32 (NA)	-5 (-14%)
	Critical	24 (480%)	-6 (-17%)
	All	155 (2,583%)	-31 (-16%)

NA = could not be calculated because the denominator was 0.

These results indicate that the effects of Alternative 8 on flow and water temperatures would reduce juvenile rearing conditions in the American River.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA throughout the period.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternatives 8 would be 6% greater than those under Existing Conditions during January through May, September, November, and December and would be similar to those under Existing Conditions in the remaining 4 months.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect of Alternative 8 would be adverse because it has the potential to substantially reduce rearing habitat. Flows and water temperatures in the Sacramento, Feather, and American Rivers would be affected by Alternative 8. Although there would be benefits to rearing juvenile steelhead during spring months, those rearing in summer and fall months would experience reduced flows and higher temperatures. There would generally be no effects in other waterways.

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. Even so, proposed mitigation (Mitigation Measure AQUA-95a through AQUA-95c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of steelhead rearing habitat relative to Existing Conditions.

Sacramento River

Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*

II Model Results utilized in the Fish Analysis). Flows during January through June under A8_LLT would generally be similar to or greater than those under Existing Conditions. Flows during July through December would generally be lower under A8_LLT than under Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, mean monthly water temperatures under Alternative 8 would generally be similar to those under Existing Conditions, except during July through October, during which temperatures would be 5% to 7% higher under Alternative 8.

SacEFT predicts that there would be no change in juvenile stranding risk under Alternative 8 relative to Existing Conditions, but a 29% reduction in years classified as "good" in terms of juvenile rearing habitat (Table 11-8-49).

Based on the incremental effects of reductions in mean monthly flows (up to 30% lower) for some months during drier water year types, decreased occurrence of "good" juvenile habitat (-29%) calculated with SacEFT, and persistent, moderate reductions in minimum instream flows (to -29%), effects of Alternative 8 on flow would affect juvenile rearing conditions in the Sacramento River.

Clear Creek

Flows in Clear Creek during the year-round rearing period under A8_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years in August and September in which flows would be 17% to 38% lower, respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was conducted in Clear Creek.

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 11-8-55. Results indicate that Alternative 8 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to Existing Conditions in all water years except for that they would be 8% lower in critical water years.

Based on the infrequency and relatively small magnitude (two occurrences to -14%) of flow reductions under Alternative 8, only small-scale effects on minimum instream flows (-8%), and negligible effects on water temperature, Alternative 8 would not have biologically meaningful effects on juvenile steelhead rearing conditions in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 8 relative to Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows under A8_LLT would be mostly lower (up to 77% lower) during June through December and higher (up to 565% higher) in January through May.

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 8 would be similar to those under Existing Conditions between March and August, but would be 6% to 9% higher between September and February. In the high-flow channel, mean monthly water temperatures under Alternative 8 would be similar to those under Existing Conditions between March and June, but would be 5% to 8% in the remaining eight months.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 8 would generally be similar to the percent under Existing Conditions during May, and similar or up to 60% (absolute scale) higher than the percent under Existing Conditions during June through August (Table 11-8-29). At Gridley, the percent of months exceeding the threshold under Alternative 8 would be similar to the percent under Existing Conditions during December through April, but similar to or up to 67% greater (absolute scale) than the percent under Existing Conditions in the other 2 months (Table 11-8-39).

Total degree-months exceeding 63°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) during May through August and total degree-months exceeding 56°F at Gridley during October through April. In the low-flow channel, total degree-months under Alternative 8 would be similar to those under Existing Conditions during May and 66% to 206% higher during June through August (Table 11-8-30). At Gridley, total degree-months under Alternative 8 would be similar to those under Existing Conditions during December through February and 131% to 3,250% greater than those under Existing Conditions in the remaining four months (Table 11-8-40).

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be generally lower than flows under Existing Conditions (up to 62% lower) in June through December, generally higher flows in February, April and May (up to 53% higher), and mixed higher and lower flows depending on water year during March and October January.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be up to 83% increases in mean monthly water temperature under Alternative 8 relative to Existing Conditions in all months examined.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-8-56).

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-8-57). There would be 106% to 2,583% increases in total degree-months exceeding the threshold under Alternative 8 relative to Existing Conditions in all months during the period examined.

These results indicate that Alternative 8 would affect flows and water temperatures in the American River throughout most of the year.

Stanislaus River

Flows in the Stanislaus River for Alternative 8 are generally lower than Existing Conditions in most water years in all months except that they are higher in above normal years in January, in wet years in March and June and in critical years in June. For a discussion of the topic see the analysis for Alternative 1A.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternatives 8 would be 6% greater than those under Existing Conditions during January through May, September, November and December, would be 5% greater during August, and would be similar during June, July, and October.

San Joaquin River

Flows in the San Joaquin River for Alternative 8 are generally lower than Existing Conditions in most water years in all months except that they higher during January except in critical years (6% lower) and during November and December the flows are only slightly lower than Existing Conditions.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 8 are generally lower than Existing Conditions in all months and all water years except that they are similar in March, and generally higher in January, February and December (up to 18% higher depending on water year).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality. Effects of Alternative 8 on flow would negatively affect juvenile rearing conditions in all locations analyzed with the exception of Clear Creek, based on persistent reductions in mean monthly flow (to -30% in the Sacramento River, to -77% in the Feather River, to -62% in the American River and to -36% in the Stanislaus River), negative effects on rearing conditions based on SacEFT rearing metrics (29% reduction in occurrence of good habitat) and increases in exceedance of critical water temperatures in the Sacramento, Feather, and American Rivers. Degraded rearing conditions for juvenile steelhead would reduce their survival and growth in these waterways.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on rearing habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts on Steelhead Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-95c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Steelhead Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on steelhead habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife 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-95a.

If feasible means are identified to reduce impacts on rearing habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on steelhead would remain significant and unavoidable.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

Upstream of the Delta

In general, Alternative 8 would reduce the quantity and quality of steelhead migration habitat relative to the NAA.

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A8_LLT would be higher than NAA in some water years during January (up to 12% higher), similar to or greater than NAA during February, March, April and May, lower than NAA (up to 21% lower) during October and November, and similar to or lower than NAA during December (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 8 in any month or water year type throughout the period.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be higher than NAA in some water years during January (up to 12% higher), similar to or greater than NAA during February and March and May, lower than NAA (up to 26% lower) during September, October and November, and similar to or lower than NAA during December (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 8 in any month or water year type throughout the period.

Kelt

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to or greater than NAA during these two months (up to 36% greater) and these two months would be minimally different between NAA and A8_LLT.

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 8 in any month or water year type throughout the period.

Overall in the Sacramento River, these results indicate that Alternative 8 would affect migration conditions for juvenile and adult steelhead in the early portion of their respective migration periods, particularly in drier water years (based on persistent, small to moderate flow reductions to -26% during September, October, and December), and would not affect kelt steelhead migration conditions.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile steelhead migration period under A8_LLT would generally be similar to or greater than flows under NAA except in critical years during December (5% lower), wet years during February (7% lower), below normal years and critical years during March (6% and 8% lower, respectively) and critical years in April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A8_LLT would generally be similar to or greater than flows under NAA except in critical years during December (5% lower), wet years during February (7% lower), and below normal years and critical years during March (6% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A8_LLT would generally be similar to flows under NAA except in below normal years and critical years during March (6% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, these results indicate that effects of Alternative 8 on flows would not affect juvenile, adult, or kelt steelhead migration based on a prevalence of negligible effects on flow with infrequent, small increases (to 12%) or decreases (to -8%) in flow that would not have biologically meaningful effects on migration conditions.

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under NAA during October through December (up to 28% lower) and greater than flows under NAA during January through May (up to 130% greater).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 8 in any month or water year type throughout the period.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under NAA during September through December (up to 57% lower) and greater than flows under NAA during January through March (up to 95% greater).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 8 in any month or water year type throughout the period, except for a 5% increase under Alternative 8 for above normal years in September.

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be greater than flows under NAA during March and April (up to 130% greater).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 8 in any month or water year type throughout the period. Overall in the Feather River, these results indicate that effects of Alternative 8 on flows would affect juvenile and adult migration conditions through persistent, substantial reductions in flow in the months prior to (starting in June, to -84%), and during the first few months of (to -50% for juveniles and to -72% for adults), their respective migration conditions. Effects of Alternative 8 on flow would not affect kelt steelhead migration based on a prevalence increases in flow (to 566%) in all water years. Effects of Alternative 8 on water temperatures would increase exceedances of suitable water temperatures in the summer and early fall that would affect migration conditions for juveniles and adults.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period. Flows under A8_LLT would be lower than under NAA during October (although 33% higher in above normal years) and November (up to 33% lower in critical years), similar to or lower than flows under NAA during December and March (up to 14% lower in critical years), greater than flows under NAA during May and mixed in January and

February with some water years higher and some lower(20% higher in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 8 in any month or water year type throughout the period.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be lower than under NAA during September (up to 33% lower in above normal years), October (although 33% higher in above normal years) and November (up to 33% lower in critical years), similar to or lower than flows under NAA during December and March (up to 14% lower in critical years), and mixed in January and February with some water years higher and some lower.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 8 in any month or water year type throughout the period.

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A8_LLT would generally be similar to or lower during March ((up to 14% lower in critical years) and generally greater than flows under NAA during April (up to 44% higher in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 8 in any month or water year type throughout the period.

Overall in the American River, the effects of Alternative 8 on flows would have variable effects that would include flow reductions in some months/water year types (to -18% in some drier water years for some months), but not to the extent that would have biologically meaningful negative effects on juvenile, adult, or kelt migration conditions.

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 8 are not different from flows under NAA for any month except for higher flows in below normal, dry and critical water years during June and lower flows in below normal water years in December. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the Stanislaus River.

Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River for Alternative 8 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the Stanislaus River.

San Joaquin River

Flows in the San Joaquin River at Vernalis for Alternative 8 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the San Joaquin River.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta for Alternative 8 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the Mokelumne River.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Juveniles

The juvenile steelhead outmigration period through the Delta occurs October through May, with the peak during February and March. Juvenile steelhead would be exposed to increased risk of predation near the NDD intakes, but they are not expected to be negatively affected by predation at the three NDD intakes because of their size and strong swimming ability. Therefore the effect on juvenile steelhead outmigration success through the Delta under Alternative 8 would not be substantial.

Adults

The upstream adult steelhead migration occurs from September-March, peaking during December-February. The steelhead kelt downstream migration occurs from January–April. Straying rates of adult hatchery-origin Chinook salmon that were released upstream of the Delta are low (Marston et al. 2012), suggesting that Plan Area flows in relation to straying have low importance under existing conditions for adult Sacramento River region steelhead.

The proportion of Sacramento River water in the Delta under Alternative 8 would be similar to NAA (5% or less difference) throughout the adult steelhead migration (Table 11-8-47). Sacramento

River-origin water would still predominate Delta flows, providing sufficient olfactory cues for migration. Alternative 8 would not have a negative effect on steelhead adult and kelt migration through the Delta.

San Joaquin River

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There would be no project-related flow changes associated with the alternatives. Flows associated with Alternative 8 would have no effect on steelhead migration success through the Delta.

Adults

Little information apparently currently exists as to the importance of Plan Area flows on the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult San Joaquin River region steelhead adults as well. The proportion of San Joaquin River water in the Delta in September through December would increase from less than 1% under NAA to 1.4% to 8.2%under Alternative 8 (Table 11-8-47). The increase in the proportion of San Joaquin River flows in Delta outflows would be mainly due to the reduction in Sacramento River flows in the Delta. Therefore the effect on the adult steelhead and kelt migration would not be negative and may provide a minor benefit to the species.

NEPA Effects: The effects of Alternative 8 on steelhead migration vary by location. Upstream of the Delta, collectively, the results indicate that the impact would be adverse because it would substantially reduce migration habitat conditions and substantially interfere with the movement of fish. Effects of Alternative 8 on mean monthly flows would include persistent flow reductions that would affect juvenile and adult migration conditions in the Sacramento River (reductions to -28% in drier years), and the Feather River (with persistent and substantial flow reductions, to -84% during portions of the juvenile and adult migration periods). Effects of Alternative 8 on flows in the American River would be variable but would not be substantial enough to be considered adverse.

Near-field effects of Alternative 8 NDD on Sacramento River steelhead related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 8 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide adequate migration conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly uncertain.

Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8 predict improvements in smolt condition and survival associated with increased access to the Yolo Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of all of these elements of BDCP operations and conservation measures to predict smolt migration survival throughout the entire Plan Area. The current draft of this model predicts that smolt migration survival under Alternative 8 would be similar to those estimated for NAA. Further refinement and testing of the DPM, along with several ongoing and planned studies related to salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable future. These efforts are expected to improve our understanding of the relationships and interactions among the various factors affecting salmonid survival, and reduce the uncertainty around the potential effects of BDCP implementation on migration conditions for steelhead. However, until these efforts are completed and their results are fully analyzed, the overall cumulative effect of Alternative 8 on steelhead migration remains uncertain.

Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on steelhead conditions would be adverse.

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. Even so, proposed mitigation (Mitigation Measure AQUA-96a through AQUA-96c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of steelhead migration habitat relative to Existing Conditions at upstream locations but not through the Delta for the Sacramento and San Joaquin River origin fish.

Upstream of the Delta

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be lower than flows under Existing Conditions during October and November (up to 23% lower), generally similar during December (except for 6% lower in critical water years), and generally greater than flows under Existing Conditions during February through April (up to 29% higher).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 8 in all months but October, in which the temperature under Alternative 8 would be 5% greater than that under Existing Conditions.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be mixed in September (higher flows in wet and above normal years but lower flows in below normal, dry and critical water years), lower than flows under Existing Conditions during October and November (up to 23% lower), generally similar during December (except for 6% lower in critical water years), and generally greater than flows under Existing Conditions during February through May (up to 29% higher).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 8 in all months except September and October, during which the temperature under Alternative 8 would be 6% and 5% greater, respectively, than that under Existing Conditions.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be greater than flows under Existing Conditions during March and April (up to 29% higher).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

Overall in the Sacramento River, these results indicate that Alternative 8 would affect migration conditions for juvenile and adult steelhead in the early portion of their respective migration periods, particularly in drier water years (based on persistent, small to moderate flow reductions to -30% during September, October, and December), and would not affect kelt steelhead migration conditions.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Flows in Clear Creek during the October through May juvenile steelhead migration period under A8_LLT would be similar to or greater than flows under Existing Conditions (up to 54% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A8_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in critical years during September (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A8_LLT would be similar to flows under Existing Conditions except that they would be 29% higher in wet years during March (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, the effects of Alternative 8 on flows would not affect juvenile, adult, or kelt steelhead migration based on primarily negligible effects (<5%) or increases in mean monthly flow (to 52%).

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be lower than flows under Existing Conditions during October, November, and December (up to 37% lower), and greater flows than Existing Conditions during January through May (up to 121% higher).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 8 in all months except October and January, in which months temperatures under Alternative 8 would be 5% greater than temperatures under Existing Conditions.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be lower than flows under Existing Conditions during September, October, November, and December (up to 37% lower), and greater flows than Existing Conditions during January through March (up to 90% higher).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 8 in all months except September, October, and January, in all three of which months temperatures under Alternative 8 would be 5% greater than temperatures under Existing Conditions.

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be higher than Existing Conditions during March and April (up to 121% higher).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

Overall in the Feather River, the of Alternative 8 on flows would affect juvenile and adult migration conditions in all water years during the first several months of their respective migration periods based on persistent, moderate to substantial reductions in mean monthly flow (up to -37%). There would be substantial increases in flow that would have beneficial effects during January through May (up to 121%) that would partially offset some of the substantial flow reductions that would occur starting in June and that would persist into the juvenile and adult migration periods.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower during November and December (up to 33% lower). Flows during February, April and May would generally be higher (up to 80%) although individual water years would be lower (up to 36% lower), and flows in October, January and March would be mixed with two or three water years higher and two or three water years lower in each month.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% to 10% higher than those under Existing Conditions in all months during the period except December, April, and May, in which there would be no difference in water temperatures between Existing Conditions and Alternative 8.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower during September, November and December (up to 62% lower). Flows during February would generally be higher (up to 28%) although critical water years would be lower (26% lower), and flows in October, January and March would be mixed with two or three water years higher and two or three water years lower in each month.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% to 10% higher than those under Existing Conditions in all months during the period except December, in which there would be no difference in water temperatures between Existing Conditions and Alternative 8.

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows during March would be mixed with higher flows than Existing Conditions in wet and below normal water years (14% lower for each) and lower flows in dry and critical years (7% and 17% lower, respectively) while April flows would generally be higher than Existing Conditions (e.g., 53% in critical years) except that they would be 11% lower in above normal water years.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% higher than those under Existing Conditions in March but temperatures would be similar between Existing Conditions and Alternative 8 during April.

Overall in the American River, the effects of Alternative 8 on flows would affect juvenile and adult migration conditions (based on moderate to substantial flow reductions in drier water years for September through March, to -62%) and would not affect kelt steelhead migration (based on variable results but limited occurrence of relatively small flow reductions, to -17%, in drier water years).

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A8_LLT would be 6% to 16% lower than flows under Existing Conditions depending on month.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May steelhead juvenile downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 8.

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). Mean monthly flows under A8_LLT would be 6% to 16% lower than flows under Existing Conditions depending on month.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 8.

Kelt

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A8_LLT would be 8% and 12% lower than flows under Existing Conditions during March and April, respectively.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis). Mean monthly water temperatures under Alternative 8 would be 6% higher than those under Existing Conditions during March and April.

San Joaquin River

Flows in the San Joaquin River for Alternative 8 are generally below those under Existing Conditions for juveniles, adults or kelts (e.g., 13% lower in below dry years during March and 15% lower in dry years during April) although flow conditions are similar during November and December.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 8 are generally substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 17% lower in below normal years during May) during September, October, November, April and May (up to 29% lower) but generally higher during December (e.g., 6% higher in below normal years), January and February, and similar to Existing Conditions in March except for 8% lower flows in dry years

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Juvenile steelhead are not expected to be negatively affected by predation at the three NDD intakes because of their size and strong swimming ability. DPM results for Alternative 1A, Impact AQUA-96, for Chinook salmon predict juvenile salmonid outmigration survival through the Delta would not be reduced by more than 0.5%. Assuming similar effects on steelhead, Alternative 8 would have a minimal effect on steelhead migration success through the Delta. Therefore the impact on juvenile steelhead migration through the Delta at the Sacramento River would not be substantial.

The proportion of Sacramento River water in the Delta under Alternative 8 would to be similar to Existing Conditions (<10% difference) during the majority of the adult upstream and kelt downstream migrations. There would be a slight reduction in the proportion of Sacramento River flows in March and April (11–12% less) relative to Existing Conditions, but still sufficient to provide strong olfactory cues from Sacramento source water (Table 11-8-47.

For the San Joaquin River steelhead, the impact of Alternative 8 impact on steelhead adult and kelt migration through the Delta would not be substantial.

Summary of CEQA Conclusion

The results of the Impact AQUA-96 analysis indicate significant impacts of Alternative 8 upstream of the Delta compared to Existing Conditions, less than significant impacts on through-Delta conditions for Sacramento River origin fish, and less than significant impacts on through-Delta conditions for San Joaquin River origin fish compared to Existing Conditions.

Through the Delta, Alternative 8 would result in some effects on flow conditions during steelhead migration periods (juvenile, adult and kelt), although these effects would not be substantial in either the Sacramento or San Joaquin River. Similarly, olfactory effects are not expected to be substantial in both locations. Consequently, the through the Delta impacts of Alternative 8 in the both the Sacramento River and the San Joaquin River would be less than significant and no mitigation is required. Through-Delta survival of juvenile steelhead under Alternative 8 may be similar or improved relative to NAA based on DPM results for juvenile Chinook salmon from the Sacramento basin (Impact AQUA-60). The effect of Alternative 8 would be less than significant on through-Delta steelhead adult and kelt migrations.

Upstream of the Delta, the results indicate that the impact would be significant because it would substantially reduce steelhead migration conditions and substantially interfere with the movement of fish. Flows under Alternative 8 would negatively affect juvenile and adult migration conditions in the Sacramento, Feather, American, and Stanislaus Rivers. Alternative 8 would also increase exposure of steelhead to water temperatures in the Feather, American, and Stanislaus Rivers Afterbay that would affect juvenile, adult, and kelt migration behavior and survival.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on migration, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts on Steelhead Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration under Alternative 8. 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).

Mitigation Measure AQUA-96c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on steelhead habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-96a.

If feasible means are identified to reduce impacts on migration consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on steelhead habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on steelhead would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through Impact AQUA-99) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

NEPA Effects: Detailed discussions regarding the potential effects of these three impact mechanisms on steelhead are the same for Alternative 8, as those described under Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-100 through Impact AQUA-108) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no mitigation is required.

Sacramento Splittail

Construction and Maintenance of CM1

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: The potential effects of construction of the water conveyance facilities on Sacramento splittail would be similar to those described for Alternative 1A (Impact AQUA-109) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. As concluded for Alternative 1A, Impact AQUA-109, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-109, the impact of the construction of water conveyance facilities on Sacramento splittail would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-110, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance of water conveyance facilities on Sacramento splittail would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Water Exports from SWP/CVP South Delta Facilities

Total entrainment of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass inundation method) under Alternative 8 would be similar to NAA, averaged across all water year, but increased 216–410% in above normal and below normal water year types. This very substantial increase in entrainment is related to the expected increase in overall juvenile splittail abundance resulting from additional floodplain habitat occurring in wetter years. However, the per capita juvenile splittail entrainment when averaged across water year types would be reduced 88% under NAA. Adult per capita entrainment would be reduced 80% compared to NAA. The reduction in per capita salvage of splittail at the SWP/CVP south Delta facilities would be because of reductions in south Delta exports once the proposed north Delta facilities become operational.

Table 11-8-58. Juvenile Sacramento Splittail Entrainment Index[a] (Yolo Bypass Days of Inundation Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	135,862 (14%)	-50,797 (-4%)
Above Normal	71,586 (156%)	80,191 (216%)
Below Normal	11,788 (345%)	12,221 (410%)
Dry	4,428 (154%)	4,773 (188%)
Critical	-185 (-12%)	265 (25%)
All Years	56,512 (18%)	-1,198 (0%)

Shading indicates entrainment increased 10% or more.

[a] Average May–July salvage number, based on normalized data, estimated from Yolo Bypass Inundation Method.

Table 11-8-59. Juvenile Sacramento Splittail Entrainment Index[a] (per Capita Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-1,777,756 (-89%)	-1,456,434 (-87%)
Above Normal	-13,647 (-98%)	-112,815 (-98%)
Below Normal	-9,664 (-97%)	-9,346 (-97%)
Dry	-1,773 (-88%)	-1,283 (-85%)
Critical	-1,151 (-86%)	-896 (-83%)
All Years	-493,649 (-90%)	-392,102 (-88%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

Table 11-8-60. Adult Sacramento Splittail Entrainment Index[a] (Salvage Density Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-2,649 (-67%)	-2,784 (-68%)
Above Normal	-3,837 (-80%)	-3,852 (-80%)
Below Normal	-2,834 (-84%)	-2,570 (-82%)
Dry	-2,388 (-98%)	-2,223 (-97%)
Critical	-3,325 (-99%)	-3,103 (-99%)
All Years	-2,797 (-80%)	-2,720 (-80%)

Shading indicates entrainment increased 10% or more.

[a] Estimated annual number of fish lost, based on normalized data. Average (December–March).

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A, Impact AQUA-111 (with five intakes), but the degree would be less because Alternative 8 would have only three intakes, therefore, under Alternative 8 there would be about a 60% reduction in impingement and predation risk relative to Alternative 1A, Impact AQUA-111. The conclusion is the same as for Alternative 1A, Impact AQUA-111.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effect of implementing dual conveyance for the NBA with a screened alternative Sacramento River intake would be the same as described under Alternative 1A (Impact AQUA-111).

Predation Associated with Entrainment

Splittail predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Per capita juvenile splittail entrainment would be reduced under Alternative 8 at the south Delta by 88% compared to NAA; predation losses would be reduced at a similar proportion.

Predation at the north Delta would be increased due to the installation of the proposed water export facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was not a factor currently limiting splittail abundance. ***NEPA Effects:*** In conclusion, the effect from entrainment and predation loss under Alternative 8 would not be adverse, because while predation loss of splittail would be increased, per capita entrainment risk would be reduced substantially compared to the NAA.

CEQA Conclusion: Under Alternative 8, per capita entrainment of juvenile and adult splittail at the south Delta would be reduced by 90% and 80%, respectively, compared to Existing Conditions. Entrainment of splittail would be reduced at the NBA. The impact and conclusion for predation associated with entrainment would be the same as described above. Entrainment and hence pre-screen predation loss at the south Delta would be reduced by 18% compared to Existing Conditions, which would partially offset potential predation losses at the proposed three north Delta diversion intakes. Although predation losses at the north Delta would exceed reductions in predation at the south Delta, in any case, millions of juvenile splittail can be entrained at the south Delta in a given year, but the population is still able to persist. Overall, the impact would be less than significant, because the predation levels under Alternative 8 would not inhibit persistence of the splittail population in the Delta.

In conclusion, the impact from entrainment and predation loss would be less than significant, because the increase in predation losses at the north Delta under Alternative 8 would be offset by the substantial reduction in south Delta per capita entrainment losses and the increased production of juvenile splittail from *CM2 Yolo Bypass Fisheries Enhancement*. No mitigation would be required.

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

In general, Alternative 8 would have beneficial effects on splittail spawning habitat relative to the NAA by increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be beneficial effects on spawning conditions in channel margin and side-channel habitats from moderate to substantial increases in mean monthly flow during most of the spawning period in the Sacramento River and the Feather River. There would be a moderate increase in exposure to critical water temperatures in the Feather River, but this negative effect would be offset by the improvements in spawning habitat based on increases in flow in the Sacramento and Feather rivers and by increases in spawning habitat in the Yolo Bypass.

Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning overwhelmingly dominates production in wet years. During low-flow years when floodplains are not inundated, spawning in side channels and channel margins would be much more critical.

Floodplain Habitat

Effects of Alternative 8 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow velocity was generally very low throughout the modeled area for most conditions, with generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo Bypass inundation events compared to NAA for drier water year types and generally decrease the frequency and duration of Yolo Bypass inundation events for wetter water year types; the changes are attributable to the influence of the Fremont Weir notch at lower flows. For the drier type years (below normal, dry, and critical), Alternative 8 generally results in an increase in frequency of inundation events greater than 30 days compared to the NAA. For below normal years, Alternative 8 would result in the occurrence of four inundation events ≥70 days, compared to zero such events for the NAA. For dry years, Alternative 8 would result in the occurrence of one inundation event 50–69 days, compared to zero such events for the NAA. For critical years, Alternative 8 would result in the occurrence of one inundation event lasting more than 30 days, compared to no such events for the NAA. The overall project-related effects consist of an increase in occurrence of longer-duration inundation events during drier years that would be beneficial for splittail spawning by creating better spawning habitat conditions. Decreases in the number of longer-duration inundation events in wetter years would affect spawning conditions to some degree, increasing the importance of channel margin and side-channel habitats during these time-frames compared to the NAA.

Table 11-8-61. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February 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. A8_LLT	NAA vs. A8_LLT
30–49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	5	5
Dry	7	7
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	0	0
Below Normal	-1	-1
Dry	1	1
Critical	0	0
≥70 Days		
Wet	7	-2
Above Normal	3	1
Below Normal	4	4
Dry	0	0
Critical	0	0

There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 8 ranging from 2 to 944 acres relative to NAA (Table 11-8-62). Areas under Alternative 8 would be 53%, 82%, and 443% for wet, above normal, and below normal water years, respectively. There would be increases in area under A8_LLT for dry and critical years relative to NAA, but they would be small to minor (113 and 2 acres, respectively. These results indicate that increases in inundated acreage in each water year type would result in increased habitat and have a beneficial effect on splittail spawning.

Table 11-8-62. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass from Existing Biological Conditions to Alternative 8 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	1,038 (67%)	900 (53%)
Above Normal	953 (83%)	944 (82%)
Below Normal	558 (425%)	562 (443%)
Dry	113 (NA)	113 (NA)
Critical	2 (NA)	2 (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).

A potential adverse effect of Alternative 8 that is not included in the modeling is reduced inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the Yolo Bypass.

Channel Margin and Side-Channel Habitat

Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel habitat upstream of the Delta. These habitats are likely to be especially important during dry years, when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are affected by changes in flow because greater flows cause more flooding, thereby increasing availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are expected to be most important to the splittail population because in years of high-flows, when most production comes from floodplain habitats, the upstream side-channel habitats contribute relatively little production.

Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the Sacramento River for the time-frame February through June. These are the most important months for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from the side-channel habitats during May and June if conditions become unfavorable.

Differences between model scenarios for monthly average flows during February through June by water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For the Sacramento River at Wilkins Slough flows during February and March would be similar to or with small increased flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During April through June there would be increases in flow (to 39%). Therefore the effect on spawning habitat for Sacramento splittail would be beneficial. These results indicate that there would be some increases in flow (up to 39%) that would have beneficial effects on splittail rearing conditions in the Sacramento River.

For the Feather River at the confluence flows during February through May would be greater than under NAA (up to 130%) for all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During June there would be flow reductions (up to 39% lower) although these would be late in the spawning period. There would be an overall beneficial effect on Sacramento splittail spawning.

Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather River at the confluence with the Sacramento River, respectively were used to investigate the potential effects of Alternative 8 on the suitability of water temperatures for splittail spawning and egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and egg incubation.

There would be no biologically meaningful difference (>5% absolute scale) between NAA and Alternative 8 in the frequency of water temperatures in the Sacramento and Feather Rivers being within the suitable 45°F to 75°F regardless of water year type.

Table 11-8-63. Difference (Percent Difference) in Percent of Days or Months[a] during February to June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at Hamilton City and Feather River at the Confluence with the Sacramento River[b]

	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River at Hamilton City		
Temperatures below 45°F		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-7 (-25%)	2 (11%)
All	-7 (-19%)	0 (0%)
Temperatures above 75°F		
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 at Sacramento River Confluence		
Temperatures below 45°F		
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)
Temperatures above 75°F		
Wet	6 (NA)	1 (19%)
Above Normal	11 (NA)	2 (22%)
Below Normal	13 (NA)	2 (18%)
Dry	15 (338%)	1 (6%)
Critical	15 (900%)	2 (13%)
All	11 (891%)	1 (9%)

NA = could not be calculated because the denominator was 0.
[a] Days were used in the Sacramento River and months were used in the Feather River.
[b] Based on the modeling period of 1922 to 2003.

Overall, Alternative 8 would have negligible or beneficial effects on upstream spawning and rearing conditions in the upper Sacramento and Feather rivers.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, the following provides a narrative summary of potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture, which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al. 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds. Actions under Alternative 8 to increase the frequency of Yolo Bypass inundation would increase the frequency of potential stranding events. For splittail, an increase in inundation frequency would also increase the production of Sacramento splittail in the bypass. While total stranding losses may be greater under Alternative 8 than under NAA, the total number of splittail would be expected to be greater under Alternative 8.

In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the potential improvements in habitat capacity outweighed the potential stranding problems that may exist in some years.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The effects of Alternative 8 on splittail spawning habitat are largely beneficial. There would be substantial benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that would increase suitable spawning conditions. Benefits due to increased inundation in the Yolo Bypass would outweigh relatively small, project-related increases in exceedance of preferred water temperatures in the Feather River. This is because the Yolo Bypass is a more important splittail spawning habitat than the Feather River channel margin habitat, as evidenced by the large amount of spawning activity in the Bypass when inundated. Effects of Alternative 8 on mean monthly flows would consist primarily of negligible effects (<5%), increases in flow (to 39% in the Sacramento River and to 130% in the Feather River) that would have beneficial effects on spawning conditions, with small, infrequent reductions in flow (to -16%) in the Sacramento River and more persistent and substantial flow reductions (to -39%) in the Feather River that would occur at the end of the spawning period and therefore would not have biologically meaningful effects on spawning conditions. There would be negligible effects on water temperatures in the Sacramento and Feather Rivers, relative to NAA.

CEQA Conclusion: In general, Alternative 8 would have beneficial impacts on splittail spawning habitat relative to Existing Conditions by increasing the quantity of spawning habitat in the Yolo Bypass through increased acreage subjected to periodic inundation. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River, with beneficial effects due to moderate to substantial increases in mean monthly flow for some months and water year types during the spawning period. There would be negative effects on water temperatures in the Feather River relative to Existing Conditions, but the benefits due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River as evidenced by the large amount of spawning activity when inundated.

Floodplain Habitat

The proposed changes to the Fremont Weir under Alternative 8 would have variable effects on the frequency and duration of Yolo Bypass inundation events compared to Existing Conditions depending on inundation duration and water year type (Figure 11-8-4, Table 11-8-61). There would be no effect or small changes in occurrence of inundation events of all durations analyzed for all water years with the exception of an increase of five and seven occurrences of 30 to 49-day inundation events in below normal and dry years, respectively, and a decrease of nine inundation events of 30 to 69-day inundation events in wet years, compared to Existing Conditions. However, there would also be an increase of between three and seven inundation events of ≥70 days, for wet, above normal and below normal water year types, compared to Existing Conditions. Decreases in the number of longer-duration inundation events in wetter years would affect spawning conditions to some degree, increasing the importance of channel margin and side-channel habitats during these time-frames compared to Existing Conditions.

Comparisons of splittail weighted habitat area for Alternative 8 to Existing Conditions (Table 11-8-62) indicate that Alternative 8 would result in increased acreage of suitable spawning habitat compared to Existing Conditions in all water year types, with increases of between 2 and 1,038 acres of suitable spawning habitat depending on water year type. Increased areas for wet, above normal, and below normal water years are predicted to be 67%, 83%, and 425%, respectively, for Alternative 8. Comparisons for dry and critical water years indicate project-related increases of 113 and 2 acres of suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions. Conclusions are that Alternative 8 would have beneficial impacts on splittail habitat through increasing spawning habitats by up to 425%.

Channel Margin and Side-Channel Habitat

Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate that Alternative 8 would have primarily negligible effects (<5%) on channel margin and side channel habitats through increased flows during February and March, and generally beneficial effects in April, May, and June from small to moderate increases in flow (to 39%). Therefore, the impact on spawning habitat for Sacramento splittail on the upper Sacramento River would be less than significant.

Flows in the Feather River at the confluence with the Sacramento River were evaluated during February through June. Flows would be higher than Existing Conditions during February through May in all water years but lower than Existing Conditions during June in all water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results show that Alternative 8 flow would not have biologically meaningful effects on splittail rearing conditions in the Feather River.

There would generally be no biologically meaningful difference (>5% absolute scale) between Existing Conditions and Alternative 8 in the frequency of water temperatures in the Sacramento and Feather Rivers being within the suitable 45°F to 75°F, except in critical years (7% lower) for the

45°F threshold in the Sacramento River and all water years (6% to 15% greater) for the 75°F threshold in the Feather River.

Stranding Potential

As described in the NEPA effects section above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 8 would be as described for Alternative 1, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

Collectively, these results indicate that the effect would be less than significant because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality; no mitigation would be necessary. The impacts of Alternative 8 on splittail spawning habitat are largely beneficial. There would be substantial benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that would increase suitable spawning conditions. Benefits due to increased inundation in the Yolo Bypass would outweigh relatively small, project-related increases in exceedance of preferred water temperatures in the Feather River. This is because the Yolo Bypass is a more important splittail spawning habitat than the Feather River channel margin habitat, as evidenced by the large amount of spawning activity in the Bypass when inundated. Impacts of Alternative 8 on mean monthly flows would consist primarily of negligible effects (<5%), increases in flow (to 39% in the Sacramento River and to 121% in the Feather River) that would have beneficial impacts on spawning conditions, with small, infrequent reductions in flow (to -6%) in the Sacramento River and more persistent and substantial flow reductions (to -47%) in the Feather River that would occur at the end of the spawning period and therefore would not have biologically meaningful effects on spawning conditions. There would be negligible effects on water temperatures in the Sacramento and Feather Rivers, relative to Existing Conditions.

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

In general, Alternative 8 would have beneficial effects on splittail rearing habitat relative to the NAA by increasing the quantity and quality of rearing habitat in the Yolo Bypass. There would be beneficial effects on rearing conditions in channel margin and side-channel habitats from moderate to substantial increases in mean monthly flow during most of the rearing period in the Sacramento River and the Feather River. There would be a moderate increase in exposure to critical water temperatures in the Feather River, but this negative effect would be offset by the improvements in rearing habitat based on increases in flow in the Sacramento and Feather rivers and by increases in rearing habitat in the Yolo Bypass.

Floodplains are important rearing habitats for juvenile splittail during periods of high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion applies to rearing as well as spawning habitat for splittail.

NEPA Effects: Based on the analyses above, the effect of Alternative 8 on splittail rearing habitat would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality.

CEQA Conclusion: In general, Alternative 8 would have beneficial impacts on splittail rearing habitat relative to Existing Conditions, by increasing the quantity of rearing habitat in the Yolo Bypass through increased acreage subjected to periodic inundation. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River**,** with beneficial effect due to moderate to substantial increases in mean monthly flow for some months and water year types during the rearing period. There would be negative effects on water temperatures in the Feather River relative to Existing Conditions, but the benefits due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water temperatures in the Feather River because the Yolo Bypass is a more important rearing habitat to splittail than channel margin habitat in the Feather River, as evidenced by the large amount of rearing activity when inundated.

As described above, floodplains are important rearing habitats for juvenile splittail during periods of high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion applies to rearing as well as spawning habitat for splittail. Based on the analyses above, the effect of Alternative 8 on splittail rearing habitat would be less than significant because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality and no mitigation would be necessary.

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

Upstream of the Delta

In general, effects of Alternative 8 would not affect splittail migration conditions in the Sacramento River or the Feather River relative to the NAA, based on negligible or beneficial effects on mean monthly flow during the migration period. There would be a negative effect based on a small increase in exposure to critical water temperatures in the Feather River but this would be offset by the more substantial beneficial effects from increases in mean monthly flow for much of the migration period.

The effects of Alternative 8 on splittail migration conditions would be the same as described for channel margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both locations from increases in mean monthly flow; the negative effect of a small increase in exposure to critical high water temperatures compared to the NAA would not alter the conclusion of beneficial effects.

Therefore, the effect of Alternative 8 would not be adverse because it would not substantially reduce or degrade migration habitat or substantially reduce the number of fish as a result of mortality.

Through-Delta

Alternative 8 would reduce OMR reverse flows during the period of juvenile splittail migration through the Delta. OMR flows under Alternative 8 would be greater than NAA conditions across all water year types during the splittail migration. Therefore the effect on survival during the splittail migration would be beneficial because of the substantial improvement in OMR flow conditions.

NEPA Effects: The effect of Alternative 8 on upstream conditions would not substantially reduce or degrade migration habitat or substantially affect survival. In addition, Alternative 8 would reduce OMR reverse flows during the through-Delta juvenile splittail migration period, across all water type years, resulting in a beneficial effect. Therefore, the overall effect of Alternative 8 would not be adverse.

CEQA Conclusion:

Upstream of the Delta

In general, effects of Alternative 8 would have beneficial effects on splittail migration conditions relative to Existing Conditions based on moderate to substantial increases in mean monthly flow in the Sacramento River and the Feather River. There would be a negative effect based on a small increase in exposure to critical water temperatures in the Feather River but this would be offset by the more substantial beneficial effects from increases in mean monthly flow for much of the migration period.

Effects of Alternative 8 on splittail migration conditions are the same as described for channel margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact would be less than significant because it would not substantially reduce suitable migration habitat or substantially reduce the number of fish as a result of mortality and no mitigation would be necessary. Effects of Alternative 8 on flow would not have negative effects on the availability of channel margin and main-channel habitat, and would have a beneficial effect through increases in mean monthly flow for some months and water year types during the migration period. Benefits to flow conditions would outweigh negative effects of increased exposures to critical water temperatures in the Feather River.

Through-Delta

Average OMR flows would be greater under Alternative 8 than the Existing Conditions during the juvenile splittail migration through the Delta. Therefore the impact on splittail migration survival would be beneficial because of the substantial improvement in OMR flow conditions.

Summary of CEQA Conclusion

In general, Alternative 8 would have beneficial effects on upstream conditions for splittail migrations, relative to Existing Conditions, based on moderate to substantial increases in mean monthly flow in the Sacramento River and the Feather River. In addition the average OMR flows would be greater under Alternative 8, which would improve juvenile migration survival. Overall, the impact would be less than significant, and likely beneficial, as it would not substantially reduce suitable migration habitat or substantially reduce survival. No mitigation would be necessary.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115 through Impact AQUA-117) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to Sacramento splittail, and most would be at least slightly beneficial. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for Sacramento splittail under Alternative 1A (Impact AQUA-118 through Impact AQUA-126) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to Sacramento splittail, and most would be at least slightly beneficial.

CEQA Conclusion: All nine of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Green Sturgeon

Construction and Maintenance of CM1

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

The potential effects of construction of the water conveyance facilities on green sturgeon would be similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-127, the impact of the construction of water conveyance facilities on green sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-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 8 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 8 rather than five under Alternative 1A. As concluded Alternative 1A, Impact AQUA-128, the effect would not be adverse for green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-128 for green sturgeon, the impact of the maintenance of water conveyance facilities on green sturgeon would be less than significant and no mitigation would be 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 8 would be the same as those under Alternative 1A, Impact AQUA-129. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Alternative 8 would substantially reduce entrainment of juvenile green sturgeon at the south Delta export facilities by about 82% (~120 fish) relative to NAA (Table 11-8-64). Relative entrainment reductions would be greater in below normal, dry and critical years (99% reduction, ~41 fish) than in wet and above normal years (76% reduction, ~79 fish) compared to NAA. Therefore, the effect on entrainment would be generally beneficial to the species.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 8 and NAA (120 fish). 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.

NEPA Effects: The overall effect of water operations on entrainment and entrainment-associated predation of green sturgeon would not be adverse.

CEQA Conclusion: Annual entrainment losses of juvenile green sturgeon across all years would be reduced by 84% under Alternative 8 (A8_LLT)(26 fish) relative to Existing Conditions (166 fish)(Table 11-8-64). Overall, impacts to green sturgeon would be beneficial and no mitigation would be required.

Table 11-8-64. Juvenile Green Sturgeon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities for Alternative 8

	Entrainment Index			Absolute Difference (Percent Difference)	
Water Year[b]	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet and Above Normal	116	104	25	-91 (-78%)	-79 (-76%)
Below Normal, Dry, and Critical	50	42	1	-49 (-99%)	-41 (-99%)
All Years	166	146	26	-140 (-84%)	-120 (-82%)

[a] Estimated annual number of fish lost.
[b] Sacramento Valley water year-types.

The impact and conclusion for predation associated with entrainment would be the same as described above. Since few juvenile green sturgeon are entrained at the south Delta, reductions in entrainment (84% reduction compared to Existing Conditions, representing 140 fish) under Alternative 8 would have little effect on entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 8.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 8 would not affect spawning and egg incubation habitat for green sturgeon relative to the NAA.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows can reduce the instream area available for spawning and egg incubation. Flows under A8_LLT would nearly always be similar to or greater than flows under NAA, except in dry years during June (9% lower at both locations) and in all years during July (up to 13% lower at both locations) although flows can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be very few reductions in flows in the Sacramento River under Alternative 8 during the spawning and egg incubation period for green sturgeon.

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 8 in any month or water year type throughout the period.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees above the 63°F threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-65. There would be substantial increases the number of days with "orange" and "yellow" "levels of concern" between NAA and Alternative 8.

Table 11-8-65. Differences between Baseline and Alternative 8 Scenarios in the Number of Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Red	10 (250%)	1 (7%)
Orange	3 (300%)	3 (75%)
Yellow	6 (300%)	3 (38%)
None	-19 (-25%)	-7 (-13%)

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-8-66). Total degree-days under Alternative 8 would be up to 67% lower under Alternative 8 than under NAA during May and June, up to 13% higher under Alternative 8 during August and September, and no different (<5%) in the July.

Table 11-8-66. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	48 (369%)	-15 (-20%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	49 (377%)	-14 (-18%)
June	Wet	6 (NA)	-12 (-67%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	6 (NA)	-12 (-67%)
July	Wet	643 (8,038%)	22 (3%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	-7 (-78%)
	Critical	0 (NA)	0 (NA)
	All	645 (8,063%)	15 (2%)
August	Wet	1,608 (800%)	156 (9%)
	Above Normal	4 (NA)	-2 (-33%)
	Below Normal	23 (NA)	-23 (-50%)
	Dry	51 (NA)	2 (4%)
	Critical	47 (NA)	-30 (-39%)
	All	1,733 (862%)	104 (6%)
September	Wet	1,798 (603%)	178 (9%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	12 (NA)	12 (NA)
	Dry	177 (NA)	64 (57%)
	Critical	41 (NA)	15 (58%)
	All	2,027 (680%)	268 (13%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. Flows under A8_LLT would be greater than flows under NAA in all years at both locations. Flows under A8_LLT would be similar to or greater than flows under NAA at both locations from March through May. Flows under A8_LLT during June would generally be lower at both locations (up to 39% lower depending on water year type). (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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 8 in any month or water year type throughout the period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-8-67). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In both May and June, the percent of months exceeding the threshold under Alternative 8 would be similar to or lower (up to 31% lower on an absolute scale) than the percent under NAA.

Table 11-8-67. Differences between Baseline and Alternative 8 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 64°F Threshold, May through September

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
May	9 (27%)	11 (60%)	9 (88%)	10 (267%)	7 (300%)
June	5 (5%)	7 (8%)	12 (16%)	21 (33%)	35 (72%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	31 (45%)
August	0 (0%)	0 (0%)	9 (9%)	20 (25%)	38 (62%)
September	27 (39%)	38 (70%)	57 (200%)	62 (833%)	49 (2,000%)
NAA vs. A8_LLT					
May	-31 (-43%)	-27 (-48%)	-14 (-42%)	-5 (-27%)	-2 (-20%)
June	-1 (-1%)	-1 (-1%)	-4 (-4%)	-7 (-8%)	-5 (-6%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (3%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (4%)
September	28 (42%)	33 (56%)	36 (73%)	26 (60%)	23 (83%)

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-8-68). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 8 would be 26% lower than that under NAA during May and 8% higher than that under NAA in June.

Table 11-8-68. Differences between Baseline and Alternative 8 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 CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	8 (133%)	-16 (-53%)
	Above Normal	3 (27%)	-11 (-44%)
	Below Normal	7 (88%)	-17 (-53%)
	Dry	25 (179%)	-4 (-9%)
	Critical	25 (147%)	5 (14%)
	All	68 (121%)	-43 (-26%)
June	Wet	66 (88%)	-1 (-1%)
	Above Normal	40 (78%)	11 (14%)
	Below Normal	48 (74%)	16 (16%)
	Dry	70 (74%)	17 (12%)
	Critical	43 (77%)	4 (4%)
	All	266 (78%)	46 (8%)
July	Wet	136 (80%)	120 (65%)
	Above Normal	75 (142%)	58 (83%)
	Below Normal	107 (157%)	75 (75%)
	Dry	133 (155%)	89 (68%)
	Critical	84 (106%)	30 (23%)
	All	534 (117%)	371 (60%)
August	Wet	107 (60%)	90 (46%)
	Above Normal	64 (142%)	42 (63%)
	Below Normal	87 (124%)	55 (54%)
	Dry	125 (184%)	47 (32%)
	Critical	61 (72%)	11 (8%)
	All	443 (99%)	244 (38%)
September	Wet	61 (156%)	88 (733%)
	Above Normal	37 (231%)	46 (657%)
	Below Normal	53 (189%)	13 (19%)
	Dry	73 (261%)	21 (26%)
	Critical	58 (290%)	4 (5%)
	All	282 (215%)	172 (71%)

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 8 would be similar to those under NAA throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that this effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be very few reductions in flows or increases in water temperature exceedances in the Sacramento, Feather, and San Joaquin Rivers under Alternative 8 during the spawning and egg incubation period.

CEQA Conclusion: In general, Alternative 8 would not affect spawning and egg incubation habitat for green sturgeon relative to Existing Conditions.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under A8_LLT would generally be similar to or greater than those under Existing Conditions, except in wet years during May at Keswick and Red Bluff (10% and 8% lower, respectively) and during June in most years at Keswick and Red Bluff (up to 12% and 11%, respectively) although flows can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that there would be few reductions in flows in the Sacramento River under Alternative 8 relative to Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-8-65). The combination of number of days and degrees above the 63°F threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-12. The number of "red" years would be 250% higher under Alternative 8 relative to Existing Conditions.

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-8-66). Water temperatures under Alternative 8 would exceed the threshold 49 degree-days (377%) more than those under Existing Conditions during May and 6 degree-days (no relative change calculation possible due to division by 0) more than those under Existing Conditions during June.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period. At both locations, flows under A8_LLT would be greater in all years during February than under Existing Conditions, would be similar to or greater than flows under Existing Conditions during March through May, and would be lower than flows under Existing Conditions during June (9% to 47% lower depending on water year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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

Existing Conditions and Alternative 8 in any month or water year type throughout the period, except during February, in which mean monthly temperature under Alternative 8 would be 5% higher than that under Existing Conditions.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-8-67). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. During the period, the percent of months exceeding the threshold under Alternative 8 would be similar to or higher (up to 35% higher on an absolute scale) than the percent under Existing Conditions.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-8-68). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 8 would be 121% and 77% higher than those under Existing Conditions during May and June.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 8 would be similar to those under Existing Conditions during wetter water years but up to 15% lower during drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the NEPA conclusion set forth above. Flows under Alternative 8 in the Feather River would be up to 47% lower than Existing Conditions and water temperatures in the Sacramento and Feather Rivers would be elevated under Alternative 8 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands. The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

In general, Alternative 8 would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to the NAA.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing 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 8 in any month or water year type throughout the period.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 8 in any month or water year type throughout the period, except for higher temperatures under Alternative 8 in all water year types except critical during July, and above normal and below normal years in August.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-8-67). The percent of months exceeding the threshold under Alternative 8 would be similar to the percent under NAA during June through August, lower (up to 31% lower on an absolute scale) than the percent under NAA in May, and higher (up to 36% higher on an absolute scale) in September.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-8-68). Total degree-months exceeding the threshold under Alternative 8 would be 26% lower than those under NAA during May, and would be up to 71% higher those under NAA during June through September. These results indicate that there would be both beneficial and negative temperature-related effects to green sturgeon rearing in the Feather River.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be no effect of Alternative 8 on temperatures in the Sacramento River. There would be both increases and decreases in temperatures in the Feather River, which combined do not rise to the level of adverse.

CEQA Conclusion: In general, Alternative 8 would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature under Alternative 8 would be similar to those under Existing Conditions during May through July, but 5% to 9% lower than those under Existing Conditions during August through October.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 Existing Conditions and Alternative 8 in any month of the rearing period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-8-67). The percent of months exceeding the threshold under Alternative 8 would be similar to or greater (up to 36% higher on an absolute scale) than the percent under Existing Conditions in all months during the period.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-8-68). Total degree-months exceeding the threshold under Alternative 8 would be 41% to 170% greater than those under Existing Conditions depending on month.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. Water temperatures would be higher in the Sacramento and Feather Rivers under Alternative 8. Higher temperatures for rearing larval and juvenile green sturgeon could increase stress, mortality, and susceptibility to disease.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water

demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

In general, Alternative 8 would reduce green sturgeon migration conditions relative to the NAA.

Upstream of the Delta

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June (at Keswick and at Wilkins Slough), with some exceptions (up to 18% lower). Sacramento River flows under A8_LLT during July through November at both locations would generally be lower than flows under NAA by up to 29% lower depending on location, month, and water year type.

Feather River flows under A8_LLT would always be similar to or greater than those under NAA LLT during January through May, and nearly always lower by up to 85% during June through December.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved green sturgeon larval transport that results in improved year class strength. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be greater and lower under Alternative 8 depending on month.

NEPA Effects: Collectively, these results indicate that the effect would be adverse because it has the potential to substantially interfere with the movement of fish. Reductions in flows in the Sacramento and Feather rivers during multiple months would affect the migratory abilities of all three life stages by slowing or inhibiting downstream migration of larvae and reducing the ability to sense upstream migration cues and pass impediments by adults. 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. Even so, proposed mitigation (Mitigation Measure AQUA-132a through AQUA-132c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce green sturgeon migration conditions relative to Existing Conditions.

Upstream of the Delta

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Flows in the Sacramento River at Keswick under A8_LLT would generally be similar to or greater than flows under Existing Conditions during January through July, with some exceptions (up to 12% lower), and would generally be lower than flows under Existing Conditions during August through December (up to 33% lower). Flows in the Sacramento River at Wilkins Slough under A8_LLT would nearly always be similar to or greater than flows under Existing Conditions during December through June, except in dry years during December (5% lower) and in wet years during may (6% lower). Flows at Wilkins Slough under A8_LLT would generally be lower than flows under Existing Conditions during July through November (up to 35% lower).

Flows in the Feather River at both locations examined under A8_LLT would always be similar to or greater than flows under Existing Conditions during January through May, and nearly always lower during June through December (up to 85% lower).

For Delta outflow, the percent of months exceeding flow thresholds under A8_LLT would consistently be lower than those under Existing Conditions for each flow threshold, water year type, and month (8% to 50% lower) (see Table 11-8-74 below). The percentage of months exceeding flow thresholds under A8_LLT would consistently be similar to or greater than those under Existing Conditions, for each flow threshold and water year type during April, and lower than the percentage under Existing Conditions for each flow threshold during May and during the April/May averaged period (8% to 50% lower depending on water year type and period).

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially interfere with the movement of fish. The reduction in flows in the Sacramento and Feather rivers during multiple months would affect the migratory abilities of all three life stages by slowing or inhibiting downstream migration of larvae and reducing the ability to sense upstream migration cues and pass impediments by adults.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on spawning habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts on Green Sturgeon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration habitat under Alternative 8. 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).

Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-132a.

If feasible means are identified to reduce impacts on migration habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on green sturgeon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on green sturgeon would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-135) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to green sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-136 through Impact AQUA-144) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

White Sturgeon

Construction and Maintenance of CM1

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

The potential effects of construction of the water conveyance facilities on white sturgeon would be similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-145, the impact of the construction of water conveyance facilities on white sturgeon would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-146 except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance of water conveyance facilities on white sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Water Exports

The potential entrainment effects under Alternative 8 would be the same as those under Alternative 1A, Impact AQUA-147. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Alternative 8 would substantially reduce overall entrainment of juvenile white sturgeon at the south Delta export facilities, estimated as salvage density, by about 84% across all years relative to NAA (Table 11-8-69). Under Alternative 8, entrainment in wet and above normal water years would be reduced 85%, and reduced 80% in below normal, dry, and critical water year types compared to NAA. This effect would be generally beneficial to the species.

Predation Associated with Entrainment

Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile white sturgeon entrainment, and hence predation loss, would change minimally between Alternative 8 and NAA (228 fish). 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-147.

NEPA Effects: The overall effect on entrainment and entrainment-related predation under Alternative 8 would not be adverse.

CEQA Conclusion: Operational activities associated with water exports from SWP/CVP south Delta facilities would result in an overall 86% reduction in entrainment for juvenile white sturgeon compared to Existing Conditions. Overall, impacts from Alternative 8 on white sturgeon would be beneficial and no mitigation would be required.

Table 11-8-69. Juvenile White Sturgeon Entrainment Index[a] at the SWP and CVP Salvage Facilities for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between Model Scenarios

	Absolute Difference (Percent Difference)	
Water Year[b]	NAA vs. A8_LLT	EXISTING CONDITIONS vs. A8_LLT
Wet and Above Normal	-227 (-85%)	-203 (-84%)
Below Normal, Dry, and Critical	-30 (-80%)	-26 (-77%)
All Years	-256 (-84%)	-228 (-83%)

[a] Estimated annual number of fish lost.
[b] Sacramento Valley water year-types.

The impact and conclusion for predation associated with entrainment would be the same as described above. Since few juvenile white sturgeon are entrained at the south Delta, reductions in entrainment (86% reduction compared to Existing Conditions, representing 283 fish) under Alternative 8 would have little effect in affecting entrainment related predation loss. Overall, the impact would be less than significant, because there would be little change in predation loss under Alternative 8.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 8 would not affect spawning and egg incubation habitat for white sturgeon relative to the 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 at Wilkins Slough under A8_LLT would nearly always be similar to or greater than those under NAA, except in critical years during April (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Verona under A8_LLT from February to May would always be similar to or greater than flows under 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 8 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 11-8-10). The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-70. For the 61°F threshold, there would be 4 fewer (8% fewer) "red" years under Alternative 8 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 8.

Table 11-8-70. Differences between Baselines and Alternative 8 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. A8_LLT	NAA vs. A8_LLT
61°F threshold		
Red	45 (563%)	-4 (-8%)
Orange	-3 (-20%)	0 (0%)
Yellow	-19 (-61%)	2 (17%)
None	-23 (-82%)	2 (40%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	2 (NA)	-1 (-50%)
None	-2 (-2%)	1 (1%)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-8-71, Table 11-8-72). During March through May, total degree-days exceeding the 61°F threshold under Alternative 8 would be up to 56% lower than those under NAA, while there would be no difference (<5%) during June. (Table 11-8-71). Total degree-days exceeding the 68°F threshold would not differ between NAA and Alternative 8 during March, April, and June, but would be 21% lower under Alternative 8 than under NAA during May (Table 11-8-72).

Table 11-8-71. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	-2 (-50%)
	Dry	4 (NA)	-7 (-64%)
	Critical	1 (NA)	0 (0%)
	All	7 (NA)	-9 (-56%)
April	Wet	54 (450%)	-12 (-15%)
	Above Normal	15 (150%)	-53 (-68%)
	Below Normal	32 (533%)	-30 (-44%)
	Dry	83 (163%)	-61 (-31%)
	Critical	18 (1,800%)	4 (27%)
	All	202 (253%)	-152 (-35%)
May	Wet	848 (255%)	-267 (-18%)
	Above Normal	124 (57%)	-227 (-40%)
	Below Normal	337 (183%)	-112 (-18%)
	Dry	570 (282%)	137 (22%)
	Critical	302 (150%)	-48 (-9%)
	All	2,181 (191%)	-517 (-13%)
June	Wet	494 (86%)	-464 (-30%)
	Above Normal	279 (91%)	-87 (-13%)
	Below Normal	688 (326%)	186 (26%)
	Dry	1,220 (364%)	518 (50%)
	Critical	421 (113%)	-125 (-14%)
	All	3,102 (172%)	28 (1%)

NA = could not be calculated because the denominator was 0.

Table 11-8-72. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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	0 (NA)	-20 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	14 (NA)	12 (600%)
	Critical	0 (NA)	-1 (-100%)
	All	45 (643%)	-14 (-21%)
June	Wet	7 (NA)	-1 (-13%)
	Above Normal	7 (700%)	3 (60%)
	Below Normal	6 (NA)	4 (200%)
	Dry	17 (NA)	17 (NA)
	Critical	5 (NA)	-22 (-81%)
	All	42 (4,200%)	1 (2%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at both locations under A8_LLT would always be similar to or greater than those under NAA. These results indicate that there would be no reductions in flows in the Feather River during the white sturgeon spawning and egg incubation period under Alternative 8.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ between NAA and Alternative 8 at either location throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 8 during February through May would not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperature modeling was not conducted for the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 8 are generally similar to flows under the NAA. In addition, exceedances above key water temperature thresholds for spawning adults and egg incubation under Alternative 8 would generally be similar to or lower than exceedances under the NAA.

CEQA Conclusion: In general, Alternative 8 would not affect spawning and egg incubation habitat for white sturgeon relative to Existing Conditions.

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 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would nearly always be similar to or greater than those under Existing Conditions at both locations, except in wet years during May at Wilkins Slough (6% lower). These results indicate that there would be nearly no reduction in flows in the Sacramento River under Alternative 8 relative to Existing Conditions.

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 Existing Conditions and Alternative 8 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 11-8-10). The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-8-70. For the 61°F threshold, there would be 45 more (563% increase) "red" years under Alternative 8 than under Existing Conditions. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between Existing Conditions and Alternative 8.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-8-71, Table 11-8-72). Total degree-days exceeding the 61°F threshold under Alternative 8 would range from 202 more degree-days (253% increase) to 3,102 more degree-days (172% increase) during April through June, with a much smaller difference (7 degree days - percent change unable to be calculated due to division by 0) in March. Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and Alternative 8 during March and April. During May and June, total degree-days would be 45 (643%) and 42 (4,200%) degree-days higher under Alternative 8.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at both locations from February to May under A8_LLT would always be greater than those under Existing Conditions. These results indicate that there would be no reductions in flows in the Feather River under Alternative 8 relative to Existing Conditions.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would not differ between Existing Conditions and Alternative 8 at either location throughout the period, except below Thermalito Afterbay during February, in which the mean temperature under Alternative 8 would be 5% higher than the temperature under Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 8 during February through May would not be different from flows under Existing Conditions in wetter water year types, but would be up to 16% lower during drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat and cause mortality due to elevated water temperatures, contrary to the NEPA conclusion set forth above. Flows under Alternative 8 are generally similar to flows under Existing Conditions in the Sacramento and Feather Rivers, although flows in drier years in the San Joaquin River during February through May would be 5% to 15% lower in all months. In addition, exceedances above NMFS temperature thresholds for spawning adults and egg incubation in the Sacramento River would be greater under Alternative 8 than those under Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the

months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on white sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

In general, Alternative 8 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to the NAA.

Water temperature was used to determine the potential effects of Alternative 8 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing 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 8 in any month or water year type throughout the period. Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing 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 8 in any month or water year type throughout the period, except for above normal years in April, all water year types except critical in July, all water year types except dry and critical in August, and wet and above normal years in September.

Water temperatures were not modeled in the San Joaquin River.

NEPA Effects: These results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Water temperatures in the Sacramento and Feather Rivers under Alternative 8 would not differ from those under the NEPA point of comparison.

CEQA Conclusion**:** In general, Alternative 8 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 8 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be similar between Existing Conditions and Alternative 8 during November through June, but would be 5% to 7% higher under Alternative 8 relative to Existing Conditions during July through October.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be similar between Existing Conditions and Alternative 8 during March through May, but 5% to 10% higher under Alternative 8 during June through February.

Water temperatures were not modeled in the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat and cause mortality due to elevated water temperatures, contrary to the NEPA conclusion set forth above. Water temperatures would be elevated during large portions of the year-round white sturgeon rearing period in the Sacramento and Feather Rivers under Alternative 8 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on white sturgeon rearing habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, Alternative 8 would reduce white sturgeon migration conditions relative to the NAA.

Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-8-73). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A8_LLT would generally be similar to or greater than those under NAA, except in above normal years (5% lower). The number of months per year above 31,000 cfs at Verona under A8_LLT would generally be similar to or greater than those under NAA. Overall, there is no consistent negative effect of Alternative 8.

Table 11-8-73. Difference and Percent Difference in Number of Months between February and May in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona

	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wilkins Slough, 17,700 cfs[a]		
Wet	0 (-2%)	0 (0%)
Above Normal	0.1 (6%)	-0.1 (-5%)
Below Normal	0 (0%)	0.1 (33%)
Dry	0.1 (33%)	0.1 (33%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs[b]		
Wet	-0.1 (-2%)	0.1 (1%)
Above Normal	-0.2 (-3%)	0.2 (3%)
Below Normal	0.5 (10%)	0.8 (16%)
Dry	0.2 (5%)	-0.1 (-1%)
Critical	0.1 (2%)	0 (0%)
Verona, 31,000 cfs[a]		
Wet	-0.2 (-9%)	0.1 (5%)
Above Normal	0.3 (15%)	0.4 (28%)
Below Normal	0.1 (29%)	0.2 (50%)
Dry	0 (0%)	0.1 (25%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.
[a] Months analyzed: February through May.
[b] Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percentage of months exceeding flow thresholds under A8_LLT would consistently be similar to or greater than those under NAA for each flow threshold and water year type during April, and generally lower than those under NAA for each flow threshold during May and during the April/May averaged period (up to 50% lower depending on water year type and period) (Table 11-8-74). These results indicate that, using the positive correlation between Delta outflow and year class strength, year class strength would be greater and lower under Alternative 8 depending on month.

Table 11-8-74. Difference and Percent Difference in Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April and May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	8 (9%)	8 (9%)
20,000 cfs	Wet	4 (5%)	4 (5%)
	Above Normal	17 (22%)	25 (38%)
25,000 cfs	Wet	0 (0%)	4 (5%)
	Above Normal	0 (0%)	8 (17%)
May			
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%)
April/May Average			
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%)

For juveniles, migration flows at Verona would nearly always be up to 50% lower under A8_LLT relative to NAA during July through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during January through June would generally be similar to or greater than flows under NAA with few exceptions (up to 18% lower).

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-8-73). The average number of months exceeding 5,300 cfs under A8_LLT would always be similar to greater than the number of months under NAA.

NEPA Effects: Collectively, these results indicate that the effect would be adverse because it has the potential to substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish. Juvenile migration flows in the Sacramento River at Verona would be up to 50% lower in six of 12 months. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality. 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. Even so, proposed mitigation (Mitigation Measure AQUA-150a through AQUA-150c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce white sturgeon migration conditions relative to Existing Conditions.

The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough under A8_LLT would be similar to or greater those under Existing Conditions, in all water year typed (Table 11-8-73). The number of months per year above 31,000 cfs at Verona under A8_LLT would be generally similar to or greater than the number under Existing Conditions, except in wet years (9% lower).

For Delta outflow, the percent of months exceeding flow thresholds under A8_LLT would consistently be lower than those under Existing Conditions for each flow threshold, water year type, and month (8% to 50% lower) (Table 11-8-74). The percentage of months exceeding flow thresholds under A8_LLT would consistently be similar to or greater than those under Existing Conditions, for each flow threshold and water year type during April, and lower than the percentage under Existing Conditions for each flow threshold during May and during the April/May averaged period (8% to 50% lower depending on water year type and period).

For juveniles, year-round migration flows at Verona would be up to 50% lower under A8_LLT relative to Existing Conditions in nearly all water year types during June through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during other months are similar to or greater than flows under Existing Conditions regardless of water year type.

For adult migration, the average number of months exceeding 5,300 cfs under A8_LLT would generally be similar to or greater than the number of months under Existing Conditions regardless of water year type (Table 11-8-73).

Summary of CEQA Conclusion

These results indicate that this would be a significant impact because it has the potential to substantially reduce the amount of suitable habitat. Juvenile migration flows in the Sacramento River at Verona would be up to 50% lower in seven of 12 months. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-150a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to White Sturgeon to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on migration, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-150b: Conduct Additional Evaluation and Modeling of Impacts on White Sturgeon Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration under Alternative 8. 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).

Mitigation Measure AQUA150c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on White Sturgeon Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on white sturgeon habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-150a.

If feasible means are identified to reduce impacts on migration consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on white sturgeon habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact white sturgeon would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-153) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to white sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for white sturgeon under Alternative 1A (Impact AQUA-154 through Impact AQUA-162) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

Pacific Lamprey

Construction and Maintenance of CM1

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

The potential effects of construction of the water conveyance facilities on Pacific lamprey would be similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-163, the impact of the construction of water conveyance facilities on Pacific lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-164, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Water Exports

The potential entrainment impacts of Alternative 8 on Pacific lamprey would be the same as described above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impact AQUA-165), non-physical barriers at the entrances to CCF and the DMC (Impact AQUA-165), and decommissioning agricultural diversions in ROAs (Impact AQUA-165). These actions would avoid or reduce potential entrainment on Pacific lamprey and the effect would not be adverse.

The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta facilities is combined because the salvage facilities do not distinguish between the two lamprey species. Under Alternative 8, average annual entrainment of lamprey at the south Delta export facilities would be substantially reduced by about 82% (~2,700 fish) (Table 11-8-75) across all year types compared to NAA. Therefore, Alternative 8 would not have adverse effects on lamprey.

Predation Associated with Entrainment

Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Lamprey entrainment to the south Delta would be reduced by 81% compared to NAA and predation losses would 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 installation 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 Alternative 8 on entrainment and entrainment-related predation on lamprey would not be adverse.

CEQA Conclusion: Annual entrainment losses of Pacific lamprey would be decreased under Alternative 8 by 82% relative to Existing Conditions (Table 11-8-75). Impacts of water operations on entrainment of Pacific lamprey would be less than significant, and would provide a benefit to Pacific lamprey from the reduction in entrainment loss at water export facilities. No mitigation would be required.

Table 11-8-75. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for Alternative 8

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All Years	-2,774 (-82%)	-2,668 (-81%)

[a] Number of fish lost, based on non-normalized data, for all months.

The impact and conclusion for predation associated with entrainment would be 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 since 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 8 would reduce the quantity and quality of Pacific lamprey spawning habitat relative to the NAA due to a substantial increase exposure to critical water temperatures in the Feather River. There would be negligible effects of Alternative 8 on flow and therefore redd dewatering risk in all locations analyzed.

Flow-related impacts to Pacific lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk and effects on water temperature for the Sacramento River at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the Sacramento River, and Stanislaus River at the confluence with the San Joaquin River. Pacific lamprey spawn in these rivers between January and August. Rapid reductions in flow can dewater redds leading to mortality. 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%. Water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under all model scenarios in the upper Sacramento, Trinity, Feather, and American Rivers.

Comparisons for Alternative 8 relative to NAA indicates negligible effects (<5%) for all locations analyzed, indicating that project-related effects of Alternative 8 on flow would not affect the number of Pacific lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than 50% in the Sacramento, Trinity, Feather and American Rivers. (Table 11-8-76).

Table 11-8-76. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River at Keswick	Difference	21	-1
	Percent Difference	38%	-1%
Sacramento River at Red Bluff	Difference	18	0
	Percent Difference	33%	0%
Trinity River downstream of Lewiston	Difference	-38	4
	Percent Difference	-25%	4%
Feather River at Thermalito Afterbay	Difference	39	2
	Percent Difference	46%	2%
American River at Nimbus Dam	Difference	45	5
	Percent Difference	47%	4%
American River at Sacramento River confluence	Difference	1	1
	Percent Difference	1%	1%
Stanislaus River at San Joaquin River confluence	Difference	0	-2
	Percent Difference	0%	-3%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 8 than under Existing Conditions or NAA.

Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from January 1 through August 31, and 648 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Exact spawning locations of Pacific lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

In most locations, egg cohort exposure to 22°C (71.6°F) would be similar between NAA and Alternative 8 or would be higher under Alternative 8, with the largest increases in the Sacramento River at Hamilton (185 more cohorts, 17% increase) and in the Feather River below Thermalito Afterbay (156 more cohorts, 170% increase) (Table 11-8-77). However, the number of cohorts exposed to 22°C (71.6°F) under Alternative 8 would be 29% lower in the Trinity River at North Fork.

Table 11-8-77. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg Cohort Temperature Exposure[a]

Location	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River at Keswick	57 (NA)	6 (12%)
Sacramento River at Hamilton City	1,253 (NA)	185 (17%)
Trinity River at Lewiston	8 (NA)	3 (60%)
Trinity River at North Fork	12 (NA)	-5 (-29%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	224 (933%)	156 (170%)
American River at Nimbus	80 (727%)	6 (7%)
American River at Sacramento River Confluence	181 (323%)	21 (10%)
Stanislaus River at Knights Ferry	5 (NA)	3 (150%)
Stanislaus River at Riverbank	84 (4,200%)	-3 (-3%)

NA = could not be calculated because the denominator was 0.

[a] 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 Alternative 8 than in EXISTING CONDITIONS or NAA.

NEPA Effects: Collectively, these results indicate that the 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. This is based on a substantial increase in egg cohorts exposed to elevated water temperatures in the Sacramento, Feather and American Rivers. Effects of Alternative 8 on flow would not affect redd dewatering risk in any of the locations analyzed. 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. Even so, proposed mitigation (Mitigation Measure AQUA-166a through AQUA-166c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of Pacific lamprey spawning habitat relative to Existing Conditions due to substantial increases in Pacific lamprey redd dewatering risk in the Feather River and the American River, and substantial increases in exposure to critical water temperatures during the incubation period in the Feather River. Rapid reductions in flow can dewater redds leading to mortality. Effects of Alternative 8 on month-over-month flow reduction compared to Existing Conditions, consist of negligible effects (<5% difference) in the American River at the confluence and the Stanislaus River, a substantial decrease in egg cohorts exposed to flow reductions (-25%) in the Trinity River, and increases in exposures in the Sacramento River, Feather River, and American River at Nimbus Dam (Table 11-8-76). Changes would be most substantial for the American River (increased risk of dewatering exposure to 45 cohorts or 47% at Nimbus Dam). For the Sacramento River, there would be increased exposure to flow reductions for 21 cohorts or 38% at Keswick, and to 18 cohorts or 33% at Red Bluff. For the Feather River, there would be increased exposure to 39 cohorts or 46%.

The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 8 would be greater by up to 933% than that under Existing Conditions in at least one location in every river examined (Table 11-8-77).

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. Effects of Alternative 8 on flow would result in substantial increases in Pacific lamprey redd dewatering risk in the Feather River (46%) and the American River (47%). More egg cohorts are predicted to be exposed to elevated temperatures in at least one location in every river examined.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of Mitigation to Reduce Impacts to Spawning Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on spawning habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to spawning habitat under Alternative 8. 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).

Mitigation Measure AQUA-166c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on Pacific lamprey habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-166a.

If feasible means are identified to reduce impacts on spawning habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on Pacific lamprey habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on Pacific lamprey would remain significant and unavoidable.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, Alternative 8 would reduce rearing habitat conditions for Pacific lamprey relative to the NAA.

Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin 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 8 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 11-8-78). Results for Alternative 8 compared to NAA indicate either no effect (0%) or negligible effects (<5%) on cohort exposures to all flow reductions. These results indicate that effects of Alternative 8 on flow would not affect Pacific lamprey ammocoete stranding in the Sacramento River at Keswick.

Table 11-8-78. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	3	3
-70%	3	3
-75%	-5	-3
-80%	4	-3
-85%	47	0
-90%	NA	NA

NA = all values were 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-8-79) for Alternative 8 compared to NAA indicate no change (0%) or negligible effects (≤5%) in all but one flow reduction category, 80% flow reductions with a moderate decrease (-16%) under Alternative 8, which would have a beneficial effect on spawning success. These results indicate that effects of Alternative 8 on flow would not affect Pacific lamprey ammocoete cohort stranding in the Sacramento River at Red Bluff.

Table 11-8-79. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	4	0
-60%	3	2
-65%	6	5
-70%	9	-3
-75%	7	-3
-80%	-6	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Isolating the effects of the project from the effects of climate change (A8_LLT compared to NAA) indicates no effect (0%) or negligible effects (≤5%) attributable to the project for all flow reduction categories. These results indicate that effects of Alternative 8 on flow would not affect Pacific lamprey ammocoete stranding in the Trinity River (Table 11-8-80).

Table 11-8-80. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	31	3
-85%	24	5
-90%	33	-2

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons of Alternative 8 to NAA for the Feather River no effect (0%) or reductions in the percentage of cohorts exposed to all flow reduction categories (to -100% or a reduction from 128 to 0 cohorts) which would have beneficial effects on spawning success (Table 11-8-81). These results indicate that effects of Alternative 8 on flow would not have negative effects on Pacific lamprey ammocoete stranding in the Feather River.

Table 11-8-81. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-7	-7
-70%	-10	-10
-75%	-13	-13
-80%	-48	-47
-85%	-91	-93
-90%	-100	-100

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons for the American River at Nimbus Dam (Table 11-8-82) and at the confluence with the Sacramento River (Table 11-8-83) indicate indicates negligible effects (<5%) and moderate increases in exposure (15% to 35%), attributable to the project. Increases at Nimbus Dam range from 15% (increase from 284 to 327 cohorts) to 20% (increase from 483 to 580 cohorts); increases at the confluence range from 28% (392 to 500 cohorts) to 35% (429 to 578 cohorts). These results indicate that there would be substantial dewatering risk under NAA; project-related effects would contribute increases dewatering risk but would not be considered to have biologically meaningful negative effects on Pacific lamprey ammocoete rearing success in the American River.

Table 11-8-82. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	2	0
-70%	40	1
-75%	130	20
-80%	346	18
-85%	483	15
-90%	200	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Table 11-8-83. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	8	0
-75%	42	4
-80%	299	35
-85%	346	28
-90%	323	1

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons of Alternative 8 to NAA for the Stanislaus River (Table 11-8-84) indicates no effect (0%) or negligible effects to the lower flow reduction categories and 100% reduction (from 56 cohorts to 0) in the 80%, 85%, and 90% flow reduction categories which would have beneficial effects on spawning success. These results indicate that project-related effects of Alternative 8 on flow would not have negative effects on Pacific lamprey ammocoete stranding in the Stanislaus River.

Table 11-8-84. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the San Joaquin River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	5	1
-75%	52	1
-80%	-100	-100
-85%	-100	-100
-90%	-100	-100

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

To evaluate water temperature-related effects of Alternative 8 on Pacific lamprey ammocoetes, we examined the predicted number of ammocoete "cohorts" that experience water temperatures greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each individual day or month starts a new "cohort" such that there are 18,244 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

There would be differences in the number of ammocoete cohorts exposed to temperatures greater than 71.6°F in most of the rivers (Table 11-8-85). There would be 3,155 more cohorts (28% decrease) under Alternative 8 in the Sacramento River at Hamilton City, 23 more cohorts (20% increase) exposed under Alternative 8 in the Trinity River at Lewiston, but 112 fewer cohorts (37% decrease) exposed in the Trinity River at North Fork. In addition, there would be 72 more cohorts (14% increase) exposed under Alternative 8 in the Feather River below Thermalito Afterbay, and 57 more cohorts (102% increase) exposed in the Stanislaus River at Knights Ferry. Overall, the increases and decreases are expected to balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

Table 11-8-85. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month

Location	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River at Keswick[b]	1,711 (NA)	6 (0.4%)
Sacramento River at Hamilton City[b]	14,410 (NA)	3,155 (28%)
Trinity River at Lewiston	136 (NA)	23 (20%)
Trinity River at North Fork	193 (NA)	-112 (-37%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	383 (197%)	16 (3%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	113 (NA)	57 (102%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.
[a] Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.
[b] Based on daily data; all other locations use monthly data; 1922–2003.

NEPA Effects: Collectively these results indicate that the effect would be adverse because it would substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. There would be similar or decreased stranding risk in all river except the American River, in which stranding risk would increase at both sites by up to 25%. Further, exposure to elevated temperatures would increase in at least one location in all rivers except the American River.

CEQA Conclusion: In general, Alternative 8 would reduce rearing habitat conditions for Pacific lamprey relative to the Existing Conditions. As described for operations-related effects of Alternative 8 on spawning habitat for Pacific lamprey above, it was determined that the effects of Alternative 8 on water temperatures for the Sacramento River, Trinity River, American River, and Stanislaus River were the same as described for Alternative 1A, Impact AQUA-167, which are that there would not be adverse effects on ammocoete cohort rearing based on water temperatures for these locations.

Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of Alternative 8 to Existing Conditions for the Sacramento River at Keswick indicate negligible changes (≤5%) in ammocoete cohort exposure to flow reductions for all flow reduction categories with the exception of an increase (47%) in cohorts exposed to 85% flow reductions (Table 11-8-78). Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%) or small increases (to 9%) for all flow reduction categories, with the exception of a small decrease in exposure (-6%) for 80% flow reduction events and an increase in exposure (56 to 112 cohorts or a 100% increase) for 85% flow reduction events. Based on the fact that increases in exposure would only be substantial for a single flow reduction category at both locations, Alternative 8 would not be expected to have biologically meaningful negative effects on spawning success in the Sacramento River.

Comparisons of Alternative 8 to Existing Conditions for the Trinity River indicate no effect (0% difference) for flow reductions from 50% to 70%, and increases ranging from 24% to 33% for the larger flow reduction categories (Table 11-8-79). Despite the prevalence of increased exposure risk to the higher flow reduction events, the percentage of cohorts exposed to stranding risk is relatively small compared to the total number of cohorts exposed to dewatering risk under Existing Conditions (for example, an increase from 413 to 542 cohorts) and therefore effects of Alternative 8 are not expected to have biologically meaningful effects on spawning success in the Trinity River.

In the Feather River, Alternative 8 would have no effect (0%) or decreased occurrence of ammocoete cohorts exposed to flow reductions for all flow reduction categories, ranging from -7% to -100%, which would have beneficial effects on spawning success (Table 11-8-81). These results indicate that the effects of Alternative 8 on flow would not have negative effects on Pacific lamprey ammocoete cohort stranding in the Feather River.

Comparisons for the American River at Nimbus Dam (Table 11-8-82) and at the confluence with the Sacramento River (Table 11-8-83) predict negligible effects (<5%) for the lower flow reduction categories, and increased occurrence of flow reductions between 65% or 70% and 90% for Alternative 8 compared to Existing Conditions; predicted increases ranged from 40% to 483% for Nimbus Dam and from 42 to 346% for the confluence. These percentage increases are based on increases on the order of 56 to 327 cohorts and 112 to 500 cohorts exposed to flow reductions at Nimbus Dam, and 56 to 237 and 112 to 500 cohorts exposed to flow reductions at the confluence. These persistent and substantial increases in exposures to larger flow reduction events would have biologically meaningful effects on Pacific lamprey ammocoete cohort stranding and therefore spawning success in the American River.

Comparisons for the Stanislaus River indicate that Alternative 8 would have no effect (0%) or decreased occurrence of ammocoete cohorts exposed to flow reductions for flow reduction categories from 50% to 70%, an increase (52%) in exposure to 75% flow reduction events, and substantial decreases (from 56 cohorts to 0) in exposure to 80% through 90% flow reduction events which would have beneficial effects on spawning success (Table 11-8-84). Substantial reductions to the higher flow reduction events would offset the increase (52%) to 75% flow reduction events in terms of biological effects on rearing success. These results indicate that the effects of Alternative 8 on flow would not have negative effects on Pacific lamprey ammocoete cohort stranding in the Stanislaus River.

The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under Alternative 8 would be higher than those under Existing Conditions in all the river locations (Table 11-8-85).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 is significant because, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality. Effects of Alternative 8 on flow relative to Existing Conditions would have biologically meaningful, negative effects in the Trinity and American Rivers through substantial increases in the number of ammocoete cohorts exposed to a broad range of flow reductions. There would be no biologically meaningful effects on Pacific lamprey ammocoete stranding in the Sacramento or Feather Rivers. Exposure to elevated water temperatures would substantially increase under Alternative 8 relative to Existing Conditions in every location evaluated.

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

In general, effects of Alternative 8 on Pacific lamprey migration conditions would be negligible relative to the NAA.

Macropthalmia

After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. Migration generally is associated with large flow pulses in winter months (December through March) (USFWS unpublished data) meaning alterations in flow have the potential to affect downstream migration conditions. The effects of Alternative 8 on seasonal migration flows for Pacific lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the migration pathways of Pacific lamprey during the likely migration period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, the American River at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

Sacramento River

The difference in mean monthly flow rate for the Sacramento River at Rio Vista for Alternative 8 compared to NAA for December to May indicates variable results, with decreases in mean monthly flow to -17% during December for all but wet water years (<5%), and negligible effects (<5%) or small increases (to 13%) or decreases (to -14%) in flow for the remainder of the migration period, with the exception of larger increases during April and May (to 34%) that would have beneficial effects on migration conditions. These results indicate that the effects of Alternative 8 on flow would not have biologically meaningful negative effects on macropthalmia migration conditions in the Sacramento River at Rio Vista.

For the Sacramento River at Red Bluff, the difference in mean monthly flow rate for Alternative 8 compared to NAA for December through May indicates primarily negligible effects (<5%) on flow attributable to the project throughout the migration period, with relatively infrequent increases in flow (to 20%) and more persistent and substantial increases (to 36%) during April and May that would be beneficial for migration. There would be infrequent, small decreases in flow during December in above normal years (-9%), and during January in dry (-7%) and critical years (-11%). These decreases would be isolated and small in magnitude and would not have biologically meaningful effects on migration conditions. These results indicate that the project-related effects on flow in the Sacramento River at Red Bluff would not have biologically meaningful negative effects on migration conditions.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for December to May indicate similar results with a few occurrences of negligible effects (<5%) but otherwise primarily decreases in flow (to -28%) during December and increases in flow (to 130%) during January through May. The fairly persistent, project-related decreases in flow during December would have negative effects at the start of the migration period, but would be offset by persistent, substantial increases for the remainder of the migration period, which would have beneficial effects. These results indicate that Alternative 8 would not have biologically meaningful negative effects on migration conditions in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for Alternative 8 compared to NAA for all December through May indicate project-related effects consist of negligible effects (<5%) or small increases (to 9%) and decreases (to -14%) in mean monthly flows that would not have biologically meaningful effects on migration, and more substantial increases in flow during April and May (to 131%), including in drier water years, which would have beneficial effects on migration conditions. These results indicate that the effects of Alternative 8 on flow would not have biologically meaningful negative effects on macropthalmia migration in the American River.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River for Alternative 8 compared to NAA for all December through May indicate project-related effects consist of negligible effects (<5%) for each month and water year type throughout the migration period. These results indicate that the project-related effects of Alternative 8 on flow would not have biologically meaningful negative effects on macropthalmia migration in the Stanislaus River.

Overall, for macropthalmia migration conditions, these results indicate that project-related effects of Alternative 8 on flow consist primarily of negligible effects (<5%) and small to substantial increases in flow (depending on location, to 36% in the Sacramento River, 130% in the Feather River, and 131% in the American River) that would have beneficial effects on migration conditions, with infrequent and/or small decreases in flow (to -17%, to -28% in the American River) that would not have biologically meaningful negative effects on migration conditions, for all locations analyzed.

Adult

CALSIM flow data form the basis for the summary of changes in adult lamprey migration flows for the January to June migration period.

Sacramento River

For the Sacramento River at Red Bluff for January to June, analysis of Alternative 8 indicates that project-related effects throughout the migration period would be negligible (<5%), with small to moderate increases in flow (to 36%) for some water years in each month that would have beneficial effects on migration conditions, and infrequent, small reductions in flow, during January in dry (-7%) and critical years (-11%) and during June in dry years (-9%). These decreases in flow would be infrequent and of small magnitude and would not have biologically meaningful negative effects. These results indicate that the effects of Alternative 8 on flow would not have negative effects on adult migration in the Sacramento River.

Feather River

For the Feather River at the confluence with the Sacramento River for January to June, mean monthly flows under Alternative 8 indicates project-related effects consist primarily of negligible effects (<5%) and increases in flow to 130% that would have beneficial effects on migration conditions for January through May, and decreases in flow for most water years during June ranging from -24% to -39%. These decreases during June would occur at the end of the migration period and following a lengthy portion of the migration period that would experience increases in flow under Alternative 8, and would therefore not have negative effects on migration conditions. These results indicate that effects of Alternative 8 on flow would not have biologically meaningful negative effects on adult migration in the Feather River.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June indicate predominantly negligible effects (<5%) and small-scale increases (to 9%) or decreases (to -14%) attributable to the project during January through March, more substantial increases (to 131%) during April, May and June, including in drier years, that would have beneficial effects on migration conditions. These results indicate that project-related effects of Alternative 8 on flow would not have biologically meaningful negative effects on adult migration conditions in the American River.

Stanislaus River

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin River for January to June indicate negligible effects (<5%) attributable to the project for all months and water year types throughout the migration period, with the exception of moderate increases in flow during June in dry (19%) and critical years (16%) that would have beneficial effects on migration conditions. These results indicate that project-related effects of Alternative 8 on flow would not have biologically meaningful negative effects on adult migration conditions in the Stanislaus River.

Overall, results for adult migration indicate that project-related effects of Alternative 8 on flow would consist primarily of negligible effects (<5%), small to substantial increases in flow (to 36% in the Sacramento River, 130% in the Feather River, and 131% in the American River) that would have beneficial effects on migration conditions, and infrequent and/or small reductions in flow (to -14%, to -39% late in the migration period in the Feather River), that would not have biologically meaningful negative effects on adult migration.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Effects of Alternative 8 on mean monthly flow during the Pacific lamprey macropthalmia and adult migration periods consist primarily of negligible effects (<5%), small to substantial increases in flow (to 131%) that would have beneficial effects on migration conditions, with infrequent and/or small decreases in flow (to -39%) that would not have biologically meaningful negative effects on migration conditions, for all locations analyzed.

CEQA Conclusion: In general, under Alternative 8 water operations, the quantity and quality of Pacific lamprey migration conditions would not be reduced relative to the CEQA baseline.

Macropthalmia

Sacramento River

Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista for December to May for Alternative 8 relative to Existing Conditions indicate persistent, moderate reductions in mean monthly flow during December (to -21%), and negligible effects (<5% difference) or small-scale increases (to 13%) and decreases (to -8%) in flow for January through March, with more substantial increases during April and May in drier water years (to 33%) when effects on migration conditions would be beneficial, and decreases in flow during May in wetter years when effects on migration conditions would be less critical. The persistent, moderate decreases in December would occur at the start of the migration period and would not persist to the same magnitude through the rest of the migration period, and would therefore not have biologically meaningful negative effects on migration conditions. These results indicate that effects of Alternative 8 on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Sacramento River at Rio Vista.

Comparisons for the Sacramento River at Red Bluff for December to May for Alternative 8 relative to Existing Conditions indicate primarily negligible effects (<5%) or increases in flow (to 29%) that would have beneficial effects on migration conditions, with limited occurrence of reductions in flow during December in above normal (-8%) and dry years (-6%) that would not have biologically meaningful negative effects. These results indicate that the effects of Alternative 8 on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Sacramento River at Red Bluff.

Feather River

Comparisons for the Feather River at the confluence for December to May indicate variable effects by month and water year type, with decreases in mean monthly flow during December for all water year types, ranging from -7% to -44%, and increases in flow for the remainder of the migration period in all water years (to 121%) that would have beneficial effects on migration conditions. The persistent, moderate flow reductions during December would occur at the start of the migration period and would be offset by moderate to substantial increases in flow for the rest of the migration period and would therefore not have biologically meaningful negative effects. These results indicate that effects of Alternative 8 on flows would not have biologically meaningful negative effects on macropthalmia migration in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for December to May indicate variable effects of Alternative 8 relative to Existing Conditions, with decreases in mean monthly flow during December (to -29%), including in drier water years; variable effects during January, February and March with primarily increases in wetter years (to 29%) and decreases in drier years (to -35%); primarily increases in flow during April (to 53%), including in drier water years; and reductions in wetter years (to -32%) and increases in drier years (to 80%) during May. Effects that would be most critical for migration conditions consist of reductions in flow in drier water years; these would occur in December (to -29%) and January (to -35%) at the start of the migration period, and would persist in critical years during February (-26%) and March (-17%). Negative effects of these reductions would be somewhat offset by substantial increases in flow in drier years during April (to 53%) and May (to 80%), the last two months of the migration period. The persistent, moderate decreases, particularly in drier water years, from January through March would have negative effects on migration conditions that would only be partially offset by later increases.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River for December to May indicate primarily decreases in mean monthly flow throughout the migration period (to -36%) with the exception of three isolated occurrences of increases in flow during December in below normal years (7%), January in above normal years (14%), and March in wet years (7%). Effects that would be most critical for migration conditions consist of reductions in flow in drier water years;

these would occur in December (to -7%) and January (to -16%) at the start of the migration period, and would persist in drier water years through May (to -27% in below normal years, to -36% in dry years, and to -29% in critical years). The persistent, moderate decreases, particularly in drier water years, from December through May would have negative effects on migration conditions throughout the migration period.

Overall for juvenile migration, the effects of Alternative 8 on mean monthly flows consist of variable results for most locations, with increases and decreases in mean monthly flow depending on the month and water year type. Generally results would not be expected to result in biologically meaningful negative effects on migration conditions with the exception of the American River and the Stanislaus River, where persistent, moderate flow reductions would occur in drier water years for most of the migration period (to -35% in the American River, to -36% in the Stanislaus River) and could have negative effects on migration conditions in those locations.

Adult

Sacramento River

Comparisons of mean monthly flow for the Sacramento River at Red Bluff during the Pacific lamprey adult migration period from January through June indicate that for most months and water year types, flows under Alternative 8 would be similar to (<5% difference) or greater than flows under Existing Conditions, with increases in mean monthly flow to 29% that would have a beneficial effect on migration conditions, with the only exception being a small decrease in flow during May in wet years (-8%) when effects of flow reductions would be less critical for migration conditions. Increases in mean monthly flow, particularly those that would occur in drier water years during January, March, May and June, would have beneficial effects on migration. These results indicate that the effects of Alternative 8 on flow would not affect adult migration conditions in the Sacramento River.

Feather River

Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento River for January to June indicate effects of Alternative 8 on flow consist entirely of small (6%) to substantial increases in flow (to 121%) for January through May that would have beneficial effects on migration conditions, and decreases in flow during June (to -47%) in all water years. The decreases in June would occur in the last month of the migration period and would occur after a prolonged period of persistent, substantial increases in flow under Alternative 8 in all water years. Therefore, the overall effects of Alternative 8 would be beneficial, and the flow reductions in June would not have biologically meaningful negative effects on migration conditions.

American River

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June indicate variable effects of Alternative 8 depending on the month and water year type, with primarily increases in mean monthly flow (to 29%) during January through March in wetter years, and decreases (to -35%) in drier years. There would be primarily increases during April (to 53%) and May (to 80%) in drier years that would have beneficial effects on migration conditions, with negligible effects (<5%), or small (-11%) to moderate (-32%) decreases in wetter years. There would be decreases during June in wet (-36%) and critical (-21%) years, an increase (10%) in dry years, and negligible effects in the remaining years. Effects during dry and critical years when changes in flow would be more important for migration consist of decreases in flow (to -35%) for the first three months of the migration period, followed by substantial increases in flow (to 80%) for two months, followed by a decrease in critical years for the last month of the migration period. Despite the variability of these results, the persistent, moderate decreases in flow for the first three months of the migration period could have negative effects on migration conditions.

Stanislaus River

Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin River for January to June indicate primarily decreases in mean monthly flow (to -36%) during January through June with only a few, isolated exceptions consisting of negligible effects (<5%) or small increases in flow (to 14%). The persistent, small to moderate decreases in flow throughout the migration period, including in drier water years, would have negative effects on migration conditions.

Overall regarding adult migration, the effects of Alternative 8 on flow consist predominantly of increases in mean monthly flow (to 29% in the Sacramento River, 121% in the Feather River) with the exception of decreases that would occur late in the migration period in the Feather River (to -47%), and therefore not have biologically meaningful negative effects on migration conditions, and decreases in flow for the first half of the migration period (to -35%) in drier water years in the American River, and throughout the migration period in all water years in the Stanislaus River (to -36%), that would have negative effects on migration conditions.

Summary of CEQA Conclusion

Collectively, these results indicate that the effect of Alternative 8 would less than significant because there would be no substantial reduction in migration habitat or potential to substantially interfere with the movement of fish. Flows in each river, except the Stanislaus River, would generally be similar to or higher than those under the CEQA baseline. In the Stanislaus River, mean monthly flows would be 8% to 14% lower during a large portion of both the macropthalmia and adult migration periods. These reductions, due to their small magnitude, are not expected to cause a biologically meaningful effect to the Pacific lamprey population.

Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish contrary to the NEPA conclusion set forth above. Effects of Alternative 8 on flow would have negative effects on juvenile migration conditions in the American River (based on persistent, moderate reductions in flow, to -35%, including in drier water years, during most of the juvenile migration period and the first half of the adult migration period) and in the Stanislaus River (based on persistent, small to moderate reductions in flow, to -36%, in all months and most water year types throughout the migration period), and despite some variability based on month and water year type would not have biologically meaningful negative effects in the Sacramento River or the Feather River.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 8 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration conditions for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-171) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to Pacific lamprey, and most would be at least slightly beneficial.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact AQUA-172 through Impact AQUA-180) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A, and no mitigation is required.

River Lamprey

Construction and Maintenance of CM1

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

The potential effects of construction of the water conveyance facilities on river lamprey would be similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-181, the impact of the construction of water conveyance facilities on river lamprey would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. 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 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-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-182, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Water Exports

The potential entrainment impacts of Alternative 8 on river lamprey would be the same as described above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impacts AQUA-183), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-183), and decommissioning agricultural diversions in ROAs (Impacts AQUA-183). These actions would avoid or reduce potential entrainment and the effect would not be adverse.

The analysis of river lamprey entrainment at the SWP/CVP south Delta facilities is combined with the analysis of Pacific lamprey because the salvage facilities do not distinguish between the two lamprey species. Like Alternative 1A (Impact AQUA-183), Alternative 8 would substantially reduce average annual entrainment of lamprey, estimated by salvage density, by about 81% (Table 11-8-86) averaged across all years compared to the NAA.

NEPA Effects: The overall effect on entrainment under Alternative 8 would not be adverse.

CEQA Conclusion: As described above, annual entrainment losses of river lamprey would be reduced under Alternative 8 by approximately 82% compared to Existing Conditions (Table 11-8-86). At the north Delta facilities and the alternate NBA intake, the screened intakes as designed would exclude this species. Decommissioning agricultural diversions would slightly reduce potential entrainment. Impacts of water operations on entrainment of river lamprey would be less than significant, and no mitigation would be required.

Table 11-8-86. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for Alternative 8

	Absolute Difference (Percent Difference)[a]	
Water Year	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All Years	-2,774 (-82%)	-2,668 (-81%)

[a] Number of fish lost, based on non-normalized data, for all months.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, Alternative 8 would reduce the quantity and quality of river lamprey spawning habitat relative to the NAA due to moderate to substantial increases in risk of dewatering in the Feather River and the American River, and due to substantial increases in exposure to critical water temperatures in the Feather River below Thermalito Afterbay.

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. Rapid reductions in flow can dewater redds leading to mortality. 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, American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin 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%. There would be negligible effects (≤5%) in the Sacramento River at Keswick and Red Bluff and in the Trinity River, a moderate increase (33%) in the Feather River, and increases in the American River at Nimbus Dam (23%) and the confluence (20%). There would be a small decrease in exposure (-8%) in the Stanislaus River that would have beneficial effects on spawning success (Table 11-8-87). These results indicate that project-related effects of Alternative 8 on flow would not have biologically meaningful negative effects on redd dewatering risk in the Sacramento River, Trinity River, and Stanislaus River, but would affect spawning conditions in the Feather River and the American River.

Table 11-8-87. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Sacramento River at Keswick	Difference	3	0
	Percent Difference	9%	0%
Sacramento River at Red Bluff	Difference	0	-2
	Percent Difference	0%	-5%
Trinity River downstream of Lewiston	Difference	-2	0
	Percent Difference	-3%	0%
Feather River Below Thermalito Afterbay	Difference	9	19
	Percent Difference	13%	33%
American River at Nimbus	Difference	24	15
	Percent Difference	44%	23%
American River at Sacramento River confluence	Difference	32	15
	Percent Difference	54%	20%
Stanislaus River at San Joaquin River confluence	Difference	-9	-4
	Percent Difference	-16%	-8%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 8 than under 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 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey "adults need… temperatures [that] do not exceed 25°C," although there is no mention of thermal requirements for eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs, significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs. The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data from the Bureau's temperature model. Each individual day or month starts a new "egg cohort" such that there are 12.320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from February 1 through June 30, and 405 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Spawning locations of river lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

For both thresholds, there would be few differences in egg cohort exposure between NAA and Alternative 8 at all sites (Table 11-8-88). The reduction of 43 cohorts (13% decrease) in the Sacramento River at Hamilton City for the 71.6ºF threshold is negligible to the population considering the total number of cohorts is 12,320. In the Feather River below Thermalito Afterbay, there would be 64 more cohorts (168% increase) exposed to the 71.6°F threshold under Alternative 8 relative to NAA and a small differences in cohorts (5 more cohorts, 250% increase) at the 77°F threshold. Overall, these results indicate that there would be no differences in egg exposure to elevated temperatures under Alternative 8, except in the Feather River at Thermalito Afterbay.

Table 11-8-88. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg Cohort Temperature Exposure

Location	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	280 (NA)	-43 (-13%)
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	93 (1,033%)	64 (168%)
American River at Nimbus	24 (480%)	-1 (-3%)
American River at Sacramento River Confluence	65 (232%)	11 (13%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	31 (3,100%)	-3 (-9%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	46 (NA)	10 (28%)
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	7 (NA)	5 (250%)
American River at Nimbus	10 (NA)	6 (150%)
American River at Sacramento River Confluence	16 (NA)	10 (167%)
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.

[a] 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 Alternative 8 than in EXISTING CONDITIONS or NAA.

NEPA Effects: Collectively, these results indicate that the effect would be adverse because it has the potential to substantially reduce spawning habitat and substantially reduce the number of fish as a result of egg mortality. Alternative 8 would reduce river lamprey egg survival due to increased risk of dewatering in the Feather River (33%) and the American River (to 23%), and due to increases in exposure to water temperatures above preferred thresholds in the Feather River below Thermalito Afterbay. Increased water temperatures would increase stress and reduce survival of lamprey eggs. 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. Even so, proposed mitigation (Mitigation Measure AQUA-184a through AQUA-184c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of river lamprey spawning habitat relative to Existing Conditions due to substantial increases in dewatering risk in the American River and substantial increases in exposure to critical water temperatures in the Feather River. Rapid reductions in flow can dewater redds leading to mortality. Effects of Alternative 8 on flow reductions during the river lamprey spawning period from February to June consist of negligible effects (≤5%) in the Sacramento River at Red Bluff and the Trinity River, small increases in redd cohort dewatering risk in the Sacramento River at Keswick (9%) and the Feather River (13%), and more substantial increases in the American River at Nimbus Dam (44%) and at the confluence with the Sacramento River (54%) (Table 11-8-87) that would affect spawning success. There would be a moderate decrease in exposure to flow reductions (-16%) in the Stanislaus River that would have beneficial effects on spawning success.

In the Sacramento River at Hamilton City, there would be 280 more cohorts (could not calculate relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 8 relative to Existing Conditions, although this represents a very small proportion of the total number of cohorts evaluated (12,320 cohorts)(Table 11-8-88) and, therefore, would not be biologically meaningful. There would be no differences between Existing Conditions and Alternative 8 at either location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 93 more cohorts (1,033% higher) exposed to the 71.6°F threshold under Alternative 8 relative to Existing Conditions, although there would be no difference at the Fish Barrier Dam. At the two locations in the American River, there would be 24 to 65 more cohorts (480% and 232% higher) exposed to the 71.6°F threshold under Alternative 8 relative to Existing Conditions. In the Stanislaus River at Riverbank, there would be31 more cohorts (3,100% higher) exposed to the 71.6°F threshold under Alternative 8 relative to Existing Conditions, although there would be no difference at the Knights Ferry. There would be no differences between Existing Conditions and Alternative 8 at any location examined in exposure of egg cohorts to the 77°F threshold, except for increases of 46 cohorts in the Sacramento River at Hamilton City, 10 cohorts in the American River at Nimbus, and 16 cohorts in the American River at the confluence with the Sacramento River.

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce spawning habitat and substantially reduce the number of fish as a result of egg mortality. Alternative 8 would increase risk of redd dewatering in the American River and would affect egg survival due to increases in water temperature in at least one location within each river examined. 7). Increased water temperatures would increase stress and reduce survival of lamprey eggs.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-184a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of Mitigation to Reduce Impacts to Spawning Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on spawning habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on spawning habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on spawning habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-184b: Conduct Additional Evaluation and Modeling of Impacts on River Lamprey Spawning Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to spawning habitat under Alternative 8. 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).

Mitigation Measure AQUA-184c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on River Lamprey Spawning Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-184a.

If feasible means are identified to reduce impacts on spawning habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on river lamprey habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on river lamprey would remain significant and unavoidable.

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

In general, Alternative 8 would reduce the quantity and quality of river lamprey rearing habitat relative to the NAA.

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. Effects of Alternative 8 on flow were evaluated in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. 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 Alternative 8 to NAA for the Sacramento River at Keswick (Table 11-8-89) predicted no effect (0%) or negligible effects (≤5%) attributable to the project in all flow reduction categories, which means that Alternative 8 would not affect spawning conditions at this location.

Table 11-8-89. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	2	0
-60%	6	3
-65%	6	3
-70%	3	3
-75%	-9	-3
-80%	6	-5
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%), a single small increase (7%) to 65% flow reductions that would not have biologically meaningful negative effects, and small to moderate decreases (to -16%) to larger flow reduction events that would have beneficial effects on spawning success (Table 11-8-90). These results indicate that project-related effects of Alternative 8 would be largely beneficial by reducing risk of ammocoete exposure and mortality for this location.

Table 11-8-90. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	6	2
-60%	7	0
-65%	8	7
-70%	6	-3
-75%	16	-5
-80%	-8	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons for the Trinity River indicate no effect (0%), negligible effects (<5%), and small increases (to 10%) in dewatering exposure to 80% and 85% flow reduction events attributable to the project (Table 11-8-91). These small increases would not be expected to have biologically meaningful negative effects on spawning success.

Table 11-8-91. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	36	3
-80%	51	9
-85%	44	10
-90%	52	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons in the Feather River indicate no effect (0%) or negligible effects (<5%) to the lower flow reduction categories (50% through 60% flow reductions) and decreases in ammocoete cohort exposure (from -11% to -100%, or from 69 to 0 cohorts exposed) to all higher flow reduction categories (Table 11-8-92). Therefore project-related effects of Alternative 8 on flow would have beneficial effects on spawning conditions at this location.

Table 11-8-92. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	-1	-1
-65%	-11	-11
-70%	-17	-17
-75%	-27	-27
-80%	-57	-54
-85%	-90	-92
-90%	-100	-100

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons for the American River at Nimbus Dam (Table 11-8-93) and at the confluence with the Sacramento River (Table 11-8-94) indicate no effect (0%) or negligible effects (<5%) attributable to the project for flow reduction events from 50% to 70%, and more substantial increases in exposure to higher flow reduction events (to 28% at Nimbus Dam and to 41% at the confluence). Increased risk of dewatering would be considered small (11%) to moderate (to 28%) for 75% through 85% flow reductions at Nimbus Dam; increased risk would be considered moderate (29%) to substantial (41%) for 85% and 80% flow reduction events, respectively, at the confluence. These would contribute incremental risk to ammocoete dewatering but not to the extent that would be considered to have biologically meaningful negative effects on spawning success in the American River.

Table 11-8-93. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	9	1
-70%	62	2
-75%	190	28
-80%	474	21
-85%	524	11
-90%	200	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Table 11-8-94. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	0
-70%	24	1
-75%	65	7
-80%	379	41
-85%	454	29
-90%	360	-1

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Comparisons in the Stanislaus River indicate no effect (0%), negligible effects (<5%), or small increases in exposure (to 10%) attributable to the project for all higher flow reduction categories (Table 11-8-95). Based on the small magnitude of increased exposure to only two flow reduction categories, project-related effects of Alternative 8 on flow would not have biologically meaningful negative effects on spawning conditions at this location.

Table 11-8-95. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the Confluence with the San Joaquin River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	36	3
-80%	51	9
-85%	44	10
-90%	52	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day or month starts a new "cohort" such that there are 18,730 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 380 cohorts for the other rivers using monthly data over the same period.

In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 8 would be similar to or lower than those under NAA (Table 11-8-96). Biologically meaningful exceptions include the Sacramento River at Hamilton, Trinity River at Lewiston, Feather River below Thermalito Afterbay, and Stanislaus River at Knights Ferry for the 71.6°F threshold, and the Sacramento River at Hamilton City, Feather River below Thermalito Afterbay, and American River at confluence for the 77°F threshold. In all cases, there would be another location within the river that would have similar or lower exceedances under Alternative 8.

Table 11-8-96. 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. A8_LLT	NAA vs. A8_LLT
71.6°F Threshold		
Sacramento River at Keswick[b]	1,224 (NA)	6 (0.5%)
Sacramento River at Hamilton City[b]	12,112 (NA)	2,617 (28%)
Trinity River at Lewiston	65 (NA)	15 (30%)
Trinity River at North Fork	110 (NA)	-50 (-31%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	190 (100%)	60 (19%)
American River at Nimbus	260 (289%)	15 (4%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	50 (NA)	25 (100%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick[b]	0 (NA)	0 (NA)
Sacramento River at Hamilton City[b]	1,502 (NA)	901 (60%)
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	130 (NA)	90 (225%)
American River at Nimbus	190 (NA)	-30 (-14%)
American River at Sacramento River Confluence	265 (NA)	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.

[a] Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.

[b] Based on daily data; all other locations use monthly data; 1922–2003.

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. Alternative 8 would increase exposure of river lamprey ammocoete cohorts to elevated water temperatures that would affect ammocoete survival in at least one location within each river evaluated. Effects of Alternative 8 on redd dewatering risk would vary by location, with negligible effects (<5%), small-scale increases in dewatering exposure (to 10%), and/or reductions in exposure (to -16%) that would have beneficial effects by reducing dewatering risk in the Sacramento River, Trinity River, Feather River, and Stanislaus River. Effects would be more variable in the American River, with more substantial increases in dewatering exposure to two to three dewatering events (to 28% at Nimbus Dam, to 41% at the confluence), that would not be considered to have biologically meaningful negative effects on spawning success in the American River. 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. Even so, proposed mitigation (Mitigation Measure AQUA-185a through AQUA-185c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of river lamprey rearing habitat relative to Existing Conditions. Comparisons for the Trinity River indicate no effect (0%) for flow reduction categories from 50% to 70%, and increases ranging from 26% to 59% for the higher flow reduction categories (Table 11-8-91). The substantial and persistent increases in dewatering exposure would affect spawning success in the Trinity River.

Comparisons for the Feather River indicate no effect or reductions in frequency of occurrence for all flow reduction categories, with reductions of -11% to -90% in ammocoete cohorts exposed to 65% to 90% flow reduction events and a reduction of 100% (decrease from 122 cohorts to 0) to 90% flow reduction events (Table 11-8-92). Reduced ammocoete cohort exposure to flow reductions would have beneficial effects on spawning success.

Comparisons for the American River indicate no effect (0%) and small increases (to 9%) to flow reduction events from 50% to 65%, and larger increases in frequency of occurrence to the larger flow reduction categories, with increases of 62% to 524% (from 25 to 156 cohorts) in ammocoete cohorts exposed flow reduction events at Nimbus Dam (Table 11-8-93) and increases of 24% to 454% (from 50 to 277 cohorts) for the confluence (Table 11-8-94). These persistent and substantial increases in ammocoete cohort exposure to flow reductions would have negative effects on spawning success in the American River.

Comparisons for the Stanislaus River indicate no effect in frequency of occurrence for ammocoete cohort exposures to flow reduction categories from 50% to 70%, and increases in exposure to the higher flow reduction categories ranging from 36% to 52% (Table 11-8-95). Increased ammocoete cohort exposure to these larger flow reductions would have negative effects on spawning success.

The number of ammocoete cohorts exposed to 71.6°F under Alternative 8 would be higher than those under Existing Conditions in all locations examined (Table 11-8-96). The number of ammocoete cohorts exposed to 77°F under Alternative 8 would be similar to the number under NAA, at all locations except the Sacramento River at Hamilton City, Feather River below Thermalito Afterbay and at both locations in the American River, all of which would be higher under Alternative 8.

Summary of CEQA Conclusion

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality. Effects of Alternative 8 would affect ammocoete cohort stranding through increases in flow reductions in the Trinity River (to 59%), American River (to 524%), and Stanislaus River (to 52%). Effects in the Sacramento River would include moderate increases in exposure to some flow reduction events but not to the extent that would cause biologically meaningful negative effects; effects in the Feather River would be beneficial by reducing dewatering events and therefore stranding potential. Exposure of ammocoetes to elevated water temperatures would increase by up to 1,340% under Alternative 8 relative to the CEQA baseline at all locations evaluated.

This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-185a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of Mitigation to Reduce Impacts to Rearing Habitat

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on rearing habitat in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on rearing habitat attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-185b: Conduct Additional Evaluation and Modeling of Impacts River Lamprey Rearing Habitat Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to rearing habitat under Alternative 8. 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).

Mitigation Measure AQUA-185c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on River Lamprey Rearing Habitat Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife 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-185a.

If feasible means are identified to reduce impacts on rearing habitat consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on river lamprey habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on river lamprey would remain significant and unavoidable.

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

In general, Alternative 8 would reduce the quantity and quality of river lamprey migration habitat relative to the NAA.

Macropthalmia

After 3 to 5 years river lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. River lamprey migration generally occurs September through November (USFWS unpublished data). The effects of water operations on seasonal migration flows for river lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of river lamprey during the likely migration period (September through November) were examined to predict how Alternative 8 may affect migration flows for outmigrating macropthalmia.

Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, the American River at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

Sacramento River

Comparisons for the Sacramento River at Red Bluff for September through November for Alternative 8 relative to NAA few occurrences of negligible effects (<5%) but primarily reductions in flow during September through November, ranging from -8% to -26%, including in drier water years when effects of flow reductions would be more critical for migration conditions. These persistent, small to moderate reductions in flow during the entire migration period and in all water year types would affect macropthalmia migration conditions in the Sacramento River.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for September through November for Alternative 8 compared to NAA indicate project-related effects consisting of a single occurrence of negligible effects (<5% difference during November in dry years) and moderate to substantial reductions in flow for the remaining months and water year types (to -57%). These persistent, moderate to substantial reductions in flow during the entire migration period and in all water year types would affect macropthalmia migration conditions in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November for Alternative 8 compared to NAA indicate much smaller project-related contribution to decreased flows, including during September in below normal years (to -16%) and critical years (-10%), during October in below normal years (-10%), and during November (to -18%) in all but wet and dry years. Project-related effects in drier water years when effects of flow reductions would be more critical for migration conditions consist of negligible effects (<5%), or small (to -10%) to moderate (-18%) decreases in flow. Persistent reductions in below normal (to -17%) and critical years (-10%, -2%, -18%) would affect migration conditions in drier water years.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River for September through November for Alternative 8 compared to NAA indicate negligible effects (<5% difference) for the entire migration period in all water years. These results indicate that project-related effects of Alternative 8 on flow would not affect macropthalmia migration conditions in the Stanislaus River.

Overall for macropthalmia migration, project-related effects of Alternative 8 on flow consist of moderate to substantial decreases in mean monthly flow during the macropthalmia migration period that would affect migration conditions in the Sacramento River and Feather River, and less substantial decreases in the American River that would be persistent enough in drier water years to have negative effects on migration conditions at that location as well. There would be no effect in the Stanislaus River.

Adults

Effects of Alternative 8 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above.

NEPA Effects: Collectively, these results indicate that the effect would be adverse because it has the potential to substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish. Effects of Alternative 8 on mean monthly flow during September through November consist primarily of moderate to substantial reductions (to -57%), including in drier water years, that would affect migration conditions in the Sacramento River at Red Bluff, the Feather River, and the American River at the confluence with the Sacramento River. There would be no effect in the Stanislaus River. 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. Even so, proposed mitigation (Mitigation Measure AQUA-186a through AQUA-186c) has the potential to reduce the severity of impact, although not necessarily to a not adverse level.

CEQA Conclusion: In general, Alternative 8 would reduce the quantity and quality of river lamprey migration habitat relative to Existing Conditions due to a predominance of small to substantial reductions in mean monthly flow in most months and water year types during the migration period that would affect migration conditions for macropthalmia and adults in all locations analyzed.

Macropthalmia

Sacramento River

Comparisons for the Sacramento River at Red Bluff for September through November for Alternative 8 relative to Existing Conditions indicate variable effects during September, with increases in mean monthly flow for wetter water year types (25 to 36%) and decreases for drier water year types (to -30%). Alternative 8 would cause reductions in flow (from -6% to -23%) during October in all water years and would have negligible effects (<5%) or cause small decreases in mean monthly flows for all water year types in November (-6 to -13%). The occurrence of moderate reductions in flow during September and October, followed by smaller reductions in November, particularly during drier years, would affect migration conditions in the Sacramento River.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for September through November for Alternative 8 relative to Existing Conditions indicate small (-9%) to substantial (-37%) reductions in mean monthly flow for all months and water year types with only one exception, an increase in flow (30%) during September in wet years. These results indicate the effects of Alternative 8 on flow would affect macropthalmia migration conditions in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November indicate small (-6%) to substantial (to -62%) reductions in mean monthly flow during September and November in all water year types, and negligible effects (<5%), or small increases (to 14%) or decreases (to -19%) during October. The predominance of decreased flows for Alternative 8 compared to Existing Conditions would affect migration conditions, with substantial decreases for dry and critical years in September (-43 and -62%, respectively) and November (-33 and -36%, respectively), with an additional decrease during dry years in October (-19%), and a small increase in critical years (11%) that would not be sufficient to offset the decreases in the other months.

Stanislaus River

Comparisons for the Stanislaus River at the confluence with the San Joaquin River for September through November for Alternative 8 relative to Existing Conditions indicate negligible effects (<5%) or small (-6%) to moderate (to -17%) reductions in mean monthly flow for all months and water year types. Effects in drier water years, when effects of flow reductions would be more critical for migration conditions, consist of negligible effects or small decreases (to -8%) that are not expected to have biologically meaningful negative effects on migration conditions.

Overall regarding macropthalmia migration, the effects of Alternative 8 on flows would include persistent, small to substantial flow reductions (to -30% in the Sacramento River, to -37% in the Feather River, to -62% in the American River, and to -17% in the Stanislaus River) for substantial portions of the river lamprey macropthalmia migration period that would have negative effects on migration conditions in all locations analyzed; effects in the Stanislaus River are not expected to be biologically meaningful based on the small magnitude of the flow reductions.

Adults

Effects of Alternative 8 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above.

Collectively, these results indicate that the impact would be significant because it has the potential to substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish. This is based on a predominance of small to substantial (to -62%) reductions in mean monthly flow in most months and water year types during the migration period that would affect migration conditions for macropthalmia and adults. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity of impact though not necessarily to a less-than-significant level.

Mitigation Measure AQUA-186a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of Mitigation to Reduce Impacts to Migration Conditions

Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have significant and unavoidable adverse effects on migration, this conclusion was based on the best available scientific information at the time and may prove to have been overstated. Upon the commencement of operations of CM1 and continuing through the life of the permit, the BDCP proponents will monitor effects on migration in order to determine whether such effects would be as extensive as concluded at the time of preparation of this document and to determine any potentially feasible means of reducing the severity of such effects. This mitigation measure requires a series of actions to accomplish these purposes, consistent with the operational framework for Alternative 8.

The development and implementation of any mitigation actions shall be focused on those incremental effects attributable to implementation of Alternative 8 operations only. Development of mitigation actions for the incremental impact on migration attributable to climate change/sea level rise are not required because these changed conditions would occur with or without implementation of Alternative 8.

Mitigation Measure AQUA-186b: Conduct Additional Evaluation and Modeling of Impacts on River Lamprey Migration Conditions Following Initial Operations of CM1

Following commencement of initial operations of CM1 and continuing through the life of the permit, the BDCP proponents will conduct additional evaluations to define the extent to which modified operations could reduce impacts to migration under Alternative 8. 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).

Mitigation Measure AQUA-186c: Consult with NMFS, USFWS, and CDFW to Identify and Implement Potentially Feasible Means to Minimize Effects on River Lamprey Migration Conditions Consistent with CM1

In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and Wildlife to identify and implement any feasible operational means to minimize effects on migration. Any such action will be developed in conjunction with the ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-186a.

If feasible means are identified to reduce impacts on migration consistent with the overall operational framework of Alternative 8 without causing new significant adverse impacts on other covered species, such means shall be implemented. If sufficient operational flexibility to reduce effects on river lamprey habitat is not feasible under Alternative 8 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact river lamprey would remain significant and unavoidable.

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

Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-189) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to river lamprey, and most would be at least slightly beneficial.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for river lamprey under Alternative 1A (Impact AQUA-190 through Impact AQUA-198) also appropriately characterize effects under Alternative 8.

The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and no mitigation is required.

Non-Covered Aquatic Species of Primary Management Concern

Construction and Maintenance of CM1

The effects of construction and maintenance of CM1 under Alternative 8 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of water conveyance facilities under Alternative 8 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-1) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 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. Additionally, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities on non-covered species of primary management concern would not be significant except potentially 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.

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water conveyance facilities on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. Also, California bay shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary distributions are upstream.

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be similar to those described in detail for Alternative 1A (see Alternative 1A, Impact AQUA-2) except that only three intakes would be maintained rather than five. Consequently, the effects would not be adverse.

CEQA Conclusion: As described above, these impacts would be less than significant.

Water Operations of CM1

The effects of water operations of CM1 under Alternative 8 include a detailed analysis of the following species:

- Striped Bass
- American Shad
- Threadfin Shad
- Largemouth Bass
- Sacramento tule perch
- Sacramento-San Joaquin roach – California species of special concern
- Hardhead – California species of special concern

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Striped bass eggs and larvae would be passively transported from upstream spawning grounds towards the proposed north Delta intakes. Although these intakes would be screened to exclude fish larger than 15mm, striped bass eggs or larvae in the vicinity of the screens would have the potential to be entrained.

Entrainment losses under Alternative 8 would be expected to be reduced compared to NAA since exports from the south Delta facilities would be reduced.

Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs (approximately 4–12% of diversions) would not increase entrainment and may provide a minor benefit.

Variations in striped bass survival rates during the first few months of life are moderated by a population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al. 2000). Therefore it would be expected that reduction in entrainment of juveniles and adults at the south Delta intakes would have a greater population impact than increases in entrainment of striped bass larvae and eggs at the proposed SWP/CVP north Delta intakes and the NBA intake. Furthermore, decommissioning of agricultural diversions may also reduce entrainment of striped bass. Also, restoration activities as part of the conservation measures should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that these habitat changes would result in at least a minor improvement in production of juvenile striped bass.

NEPA Effects: Overall, the effect on striped bass entrainment would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of striped bass would be the same as described immediately above. The changes in entrainment under Alternative 8 would not substantially reduce the striped bass population when other conservation measures are taken into account. The impact would be less than significant and no mitigation would be required.

American Shad

The majority of American shad spawning occurs upstream of the Delta but some spawning is believed to occur in the Delta along the Sacramento River (Stevens 1966). American shad eggs stay suspended in the water column and may gradually drift downstream towards the proposed north Delta intakes. The intakes of the proposed north Delta diversions and the NBA intake would be screened, but small life stages (eggs and larvae) would have the potential to be entrained. Most American shad spawning though occurs well upstream of the Delta.

American shad entrainment losses under Alternative 8 would be reduced compared to NAA due to reduced south Delta exports. Reduction or consolidation of agricultural diversions in ROAs would not increase entrainment and may provide a benefit to the species.

NEPA Effects: Overall, the effect on American shad under Alternative 8 would not be adverse, and would be slightly beneficial.

CEQA Conclusion: The impact of water operations on entrainment of American shad would be the same as described immediately above. The changes in entrainment under Alternative 8 would not substantially reduce the American shad population. The impact would be less than significant and no mitigation would be required.

Threadfin Shad

Threadfin shad are widely distributed throughout the Delta, however they are most abundant in the southeastern region of the Delta where areas of dense SAV in shallow water serve as important spawning and rearing habitat (Feyrer et al. 2009). The proposed SWP/CVP north Delta intakes and alternate NBA intake would be located well upstream of this region, which would limit potential entrainment. At the SWP/CVP south Delta facilities threadfin shad entrainment losses would be reduced due to reduced south Delta exports under Alternative 8. Reduction or consolidation of up to 12% of Delta agricultural diversions would further reduce the risk of threadfin shad entrainment.

NEPA Effects: Overall, entrainment would be reduced, which would benefit threadfin shad. The effect on threadfin shad would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of threadfin shad would be the same as described immediately above. Entrainment under Alternative 8 would be reduced providing a modest benefit to threadfin shad population. The impact would be less than significant and no mitigation would be required.

Largemouth Bass

At the SWP/CVP south Delta facilities, entrainment losses under Alternative 8 would be reduced compared to NAA because water exports would be decreased from the south Delta. Largemouth bass are predominantly distributed in the central and south Delta in areas of dense SAV, and thus would have minimal overlap with propose north Delta intake facilities and alternate NBA intake on the Sacramento River.

Agricultural diversions may be sources of entrainment for largemouth bass. Agricultural diversions are typically located nearshore, which is the habitat mainly used by largemouth bass. Reduction or consolidation of these agricultural diversions under the Plan would further reduce entrainment risk of largemouth bass.

NEPA Effects: Overall, the effect from Alternative 8 would not be adverse and would likely provide minor benefits to the species from reduced entrainment loss.

CEQA Conclusion: The impact of water operation on largemouth bass would be as described immediately above. Entrainment under Alternative 8 would be reduced and would be beneficial to the largemouth bass. The impact would be less than significant and no mitigation would be required.

Sacramento Tule Perch

At the SWP/CVP south Delta facilities, entrainment losses under Alternative 8 would be reduced compared to NAA, because less water would be exported from the south Delta under this Alternative. The proposed SWP/CVP north Delta intakes would be screened with state-of-the-art fish screens for fish less than 15 mm in size. Because Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively screened at the proposed north delta facilities. Reduction or consolidation of Delta agricultural diversions under the Plan would also reduce entrainment risk of Sacramento tule perch.

NEPA Effects: In summation, entrainment of Sacramento tule perch would be reduced compared to NAA and would provide a benefit to the species. The effect on entrainment from Alternative 8 would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. Entrainment under Alternative 8 would be reduced and would be beneficial to Sacramento tule perch. The impact would be less than significant and no mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento-San Joaquin roach would be the same as described immediately above. The impacts would be less than significant.

Hardhead

NEPA Effects: The effect of water operations on entrainment of hardhead under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of hardhead would be the same as described immediately above. The impacts would be less than significant.

California Bay Shrimp

NEPA Effects: The effect of water operations on entrainment of California bay shrimp under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. California bay shrimp do not occur in the vicinity of the intakes and there would be no effect.

CEQA Conclusion: The impact of water operations on entrainment of California bay shrimp would be the same as described immediately above. There would be no impact.

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Striped Bass

In general, Alternative 8 would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to the NAA.

Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-covered species of primary management concern.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA except dry years during June (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in critical years except during April and June (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater than flows under NAA during April and May in all water year types, and lower in June in all but wet years (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The reductions in June would be offset by substantial flow increases in the previous months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA throughout the period (up to 72% greater). (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the range would be greater than the percentage under NAA in all water year types (up to 33% greater) except critical years (6% lower) (Table 11-8-97). The increases have high relative percentages based on low numbers being compared and correspond to absolute increases from 7 to 21%.

Table 11-8-97. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	15 (35%)	10 (17%)
Above Normal	18 (40%)	21 (33%)
Below Normal	12 (28%)	10 (17%)
Dry	4 (8%)	7 (15%)
Critical	11 (29%)	-3 (-6%)
All	12 (27%)	9 (16%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 8 would generally be similar to or greater than flows under the NAA. Moderate flow reductions in the Feather River during June would be substantially offset by flow increases in the preceding months. Persistent, moderate to substantial flow increases in the locations analyzed would have a beneficial effect on habitat conditions. The percentage of months outside the 59°F to 68°F water temperature range would generally be greater under Alternative 8 than under the NAA in the Feather River, but there are no temperature related effects in any of the other rivers examined.

CEQA Conclusion: In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for striped bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows under Existing Conditions during April and May (up to 565% greater) in all water year types, and up to 35% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in above normal years during April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat conditions; these reductions as well as smaller reductions in drier water years would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be similar to or lower than flows under Existing Conditions during April and May (to 27% lower), including in drier water years, and generally similar to or greater than flows under Existing Conditions during June except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate reductions during the first two months of the period would have a small, localized effect.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June would be greater than the percentage under Existing Conditions in all water years (from 8% to 40% higher depending on water year type) (Table 11-8-97). The relative percentages are somewhat high based on low numbers being compared; the absolute percentage increase would range from 4% to 18%.

Collectively, these results indicate that the impact would not be significant because Alternative 8 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of striped bass. Therefore, no mitigation is necessary. Flows during the April through June spawning, incubation, and initial rearing period under Alternative 8 would generally be similar to or greater than flows under Existing Conditions. There would be small to moderate flow reductions for some months and water year types in the Feather River, the American River, and the Stanislaus River, and flows in the San Joaquin River would be lower under Alternative 8, although these flow reductions would not be biologically meaningful to striped bass due to their high migratory ability and widespread distribution in the Central Valley. The percentage of months outside the 59°F to 68°F water temperature range would always be greater under Alternative 8 than under Existing Conditions, although there would not be any temperature related effects in any of the other locations.

American Shad

In general, Alternative 8 would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in dry years during June (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in critical years during April and June (8% lower for both) Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater than flows under NAA during April and May in all water year types (up to 616% greater) and would be lower in all but wet years relative to NAA (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The reductions in June would be offset by substantial flow increases in the previous months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA throughout the period(up to 72% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be and no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the 60°F to 70°F water temperature range be similar or greater than the percentage under NAA by up to 27% (Table 11-8-98). Project-related increases are of moderate magnitude.

Table 11-8-98. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	9 (19%)	14 (26%)
Above Normal	15 (42%)	6 (12%)
Below Normal	21 (69%)	14 (27%)
Dry	15 (38%)	9 (17%)
Critical	6 (15%)	0 (0%)
All	13 (33%)	10 (19%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in American shad spawning or adult migration. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 8 would generally be similar to or greater than flows under the NAA. Moderate flow reductions in the Feather River during June would be substantially offset by flow increases in the preceding months. Persistent, moderate to substantial flow increases in the locations analyzed would have a beneficial effect on habitat conditions. The percentage of months outside the 60°F to 70°F water temperature range in the Feather River would almost always be greater under Alternative 8 than under NAA, although there would be no temperature related effects in any of the other rivers examined.

CEQA Conclusion: In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for American shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be greater than flows under Existing Conditions during April and May (up to 565% greater) in all water year types, and up to 35% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in above normal years during April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat conditions; these reductions as well as smaller reductions in drier water years would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be similar to or lower than flows under Existing Conditions during April and May (to 27% lower), including in drier water years, and generally similar to or greater than flows under Existing Conditions during June except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate reductions during the first two months of the period would have a small, localized effect but would not have biologically meaningful negative effects on the American shad population.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of the 60°F to 70°F water temperature range would be higher than the percentage under Existing Conditions in all water years (up to 69% higher) (Table 11-8-98). These increases correspond to absolute increases from 6% to 21%. Based on the small to moderate magnitude of the increases, and the fact that they would only occur in one of the locations analyzed, they would not have biologically meaningful negative effects on the American shad population.

Collectively, these results indicate that the impact would not be significant because Alternative 8 would not cause a substantial reduction in American shad adult migration and spawning habitat, and no mitigation is necessary. Flows during the April through June spawning, incubation, and initial rearing period under Alternative 8 would generally be similar to or greater than flows under Existing Conditions. There would be small to moderate flow reductions for some months and water year types in the Feather River, the American River, and the Stanislaus River, and flows in the San Joaquin River would be lower under Alternative 8, although these flow reductions would not be biologically meaningful to striped bass. The percentage of months outside the 60°F to 70°F water temperature range would always be greater under Alternative 8 than under Existing Conditions in the Feather River, but based on the small to moderate magnitude of the increases and the fact that the increase would only occur in the Feather River, they would not have biologically meaningful negative effects on the American shad population.

Threadfin Shad

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August threadfin shad spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June except in dry years during June relative to NAA (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to or lower than flows under NAA (to 18% lower) during July and August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions late in the spawning period would not have biologically meaningful effects.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April and in critical years during August (11% and 22% lower, respectively). (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA throughout the period, except in critical years during April and June relative to NAA (8% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than those under NAA during April and May (up to 616% greater), and lower during the rest of the period (up to 77% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during April through June (up to 105% greater), generally lower during July (up to 49% lower), and similar to NAA flows during August, with some exceptions (up to 13% lower). The flow reductions during July would be offset by substantial flow increases in the preceding months.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows during the period relative to NAA.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT below 68°F would be lower than the percentages under NAA in all water years (Table 11-8-99).

Table 11-8-99. Difference and Percent Difference in the Percentage of Months during April–August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F Water Temperature Threshold for Threadfin Shad Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-15 (-24%)	-2 (-5%)
Above Normal	-35 (-45%)	-5 (-13%)
Below Normal	-27 (-39%)	-3 (-7%)
Dry	-34 (-46%)	-4 (-11%)
Critical	-32 (-49%)	-3 (-10%)
All	-27 (-39%)	-3 (-8%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in spawning habitat. Flows in all rivers examined during the April through August spawning period under Alternative 8 would generally be similar to or greater than flows under the NAA. There would be isolated and/or small magnitude flow reductions in some locations that would not have biologically meaningful effects on the threadfin shad population. Moderate flow reductions in the Feather River during June through August would not be biologically meaningful to threadfin shad due to their high migratory ability and widespread distribution in the Central Valley. The percentage of months below the spawning temperature threshold in the Feather River under Alternative 8 would be similar to or lower than NAA. Also, there are no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT during April through July would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during August would generally be lower than flows under Existing Conditions by up to 19%.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during May and August (6% and 42% lower, respectively) and in wet years during July (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would nearly always be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater (up to 565% greater) than flows under Existing Conditions during April and May, and up to 77% lower during the rest of the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions during June through August would be offset by substantial flow increases in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in above normal years during April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in critical years during June (17% lower), and lower than flows under Existing Conditions during July and August (to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate to substantial flow reductions in drier water year types during July and August would have a localized effect on spawning conditions.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than Existing Conditions by up to 27% during April, May and July, but similar to or greater than flows under Existing Conditions during the rest of the period with some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water temperature threshold for threadfin shad spawning under A8_LLT would lower than the percentage under Existing Conditions in all water year types (Table 11-8-99).

Collectively, these results indicate that the impact would not be significant because Alternative 8 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers examined during the April through August spawning period under Alternative 8 would generally be similar to or greater than flows under Existing Conditions. There would be isolated and/or small magnitude flow reductions in some locations, and more persistent, substantial flow reductions late in the spawning period in the American River that would have a localized effect but would not have biologically meaningful effects on the threadfin shad population. The percentage of months below the suitable temperature threshold for spawning in the Feather River would be lower under Alternative 8 than under Existing Conditions. Also, there are no temperature-related effects in any other rivers examined.

Largemouth Bass

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in dry years during June (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in critical years during March, April, and June (8% lower for all three) and in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater (up to 365% greater) than flows under NAA during March through May in all water year types, and up to 39% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during April through June (up to 105% greater), and lower during March by up to 14% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the 59°F to 75°F water temperature range would be greater than the percentage under NAA (from 16% to 27% greater) except in critical years (45% lower) (Table 11-8-100). The increases are of relatively small magnitude and occur in the Feather River. As a result, the increases would not have biologically meaningful effects on the largemouth bass population.

Table 11-8-100. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (0%)	9 (16%)
Above Normal	0 (0%)	14 (27%)
Below Normal	0 (0%)	11 (24%)
Dry	-13 (-26%)	6 (16%)
Critical	-21 (-48%)	-10 (-45%)
All	-6 (-12%)	6 (14%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would almost always be similar to or greater than flows under Existing Conditions during the entire period, except in wet years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater (up to 565% greater) than flows under Existing Conditions during March through May, and lower during June (up to 35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in dry and critical years during March (6% and 14% lower, respectively), in above normal years during April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat conditions; these reductions as well as smaller reductions in drier water years would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions during March through May (to 30% lower) including in drier water years, and generally similar to or greater than flows under Existing Conditions during June, except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The small to moderate reductions during the first three months of the period would have a small, localized effect but would not have biologically meaningful negative effects on the striped bass population.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of the 59°F to 75°F water temperature range for largemouth bass spawning would be similar to or lower than the percentage under Existing Conditions in all water years (Table 11-8-100).

Sacramento Tule Perch

NEPA Effects: The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The impacts would be less than significant.

Sacramento-San Joaquin roach – California species of special concern

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in dry years during June (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA during March through June, except in critical years during March, April, and June (8% lower for all three) and in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater (up to 365% greater) than flows under NAA during March through May in all water year types, and up to 39% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The reductions in June would be substantially offset by the flow increases in the previous months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during April through June (up to 105% greater), and lower during March by up to 14% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT below 60.8°F would be slightly higher than the percentage under NAA in all water year types (up to 14% higher) except in critical years (11% lower) (Table 11-8-101). These are small increases that would not have biologically meaningful effects on spawning success.

Table 11-8-101. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-4 (-6%)	9 (14%)
Above Normal	-5 (-8%)	2 (5%)
Below Normal	0 (0%)	5 (11%)
Dry	-8 (-15%)	3 (6%)
Critical	-19 (-33%)	-4 (-11%)
All	-6 (-11%)	4 (8%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse***.***

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would almost always be similar to or greater than flows under Existing Conditions during the entire period, except in wet years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March and in critical years during May (6% lower in both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially greater (up to 565% greater) than flows under Existing Conditions during March through May, and lower during June (up to 35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in dry and critical years during March (6% and 14% lower, respectively), in above normal years during April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat conditions; these reductions as well as smaller reductions in drier water years would not have biologically meaningful effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions during March through May (to 30% lower) including in drier water years, and generally similar to or greater than flows under Existing Conditions during June, except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The small to moderate reductions during the first three months of the period would have a small, localized effect but would not have biologically meaningful negative effects on the Sacramento-San Joaquin roach population.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A8_LLT would be similar to or lower than the percentage under Existing Conditions in all water years (Table 11-8-101).

Hardhead – California Species of Special Concern

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA throughout the period, except in above normal years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally to be similar to or greater than flows under NAA throughout the period, except in critical years during April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would always be similar to or greater than flows under NAA throughout the period, regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the range would be lower than the percentage under NAA in dry and critical water years but higher in all other water year types (up to 13% higher) (Table 11-8-102). The percentage of months under A8_LLT outside the range would be lower than the percentage under NAA in critical water year types (15% lower) and similar to or greater than this percentage in all other water year types (up to 18% higher). These are relatively small increases that would not have biologically meaningful effects.

Table 11-8-102. Difference and Percent Difference in the Percentage of Months during April–May in Which Water Temperatures in the Feather River below Thermalito Afterbay Are Outside the 59°F to 64°F Water Temperature Range for Hardhead Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	5 (7%)	4 (5%)
Above Normal	9 (12%)	15 (18%)
Below Normal	10 (15%)	0 (0%)
Dry	-4 (-5%)	4 (6%)
Critical	-14 (-20%)	-8 (-15%)
All	2 (2%)	3 (4%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream spawning habitat conditions for hardhead relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in wet years during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially greater than flows under Existing Conditions throughout the period (up to 565% greater)(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions, except in above normal years during April (9% lower) and in wet and above normal years during May (21% and 29% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower relative to Existing Conditions by up to 27% throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the range would be lower than the percentage under Existing Conditions in dry and critical water years and higher in all other water year types (up to 15% higher) (Table 11-8-102). These are small increases that would not have a biologically meaningful negative effect on spawning success.

California Bay Shrimp

NEPA Effects: The effect of water operations on spawning habitat of California bay shrimp under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on spawning habitat of California bay shrimp would be the same as described immediately above. The impacts would be less than significant.

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

The discussion under Alternative 8, Impact AQUA-202 for striped bass also addresses the embryo incubation and initial rearing period. That analysis indicates that there is no adverse effect on striped bass rearing during that period. Other effects of water operations on rearing habitat for striped bass under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on striped bass rearing habitat would be less than significant.

American Shad

The effects of water operations on rearing habitat for American shad under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-5). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on American shad rearing habitat would be less than significant.

Threadfin Shad

The effects of water operations on rearing habitat for threadfin shad under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-5). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on threadfin shad rearing habitat would be less than significant.

Largemouth Bass

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June, with two small exceptions (to 9% lower), and flows under A8_LLT would be similar to or lower than flows under NAA (to 26% lower) during July through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Project-related flow reductions (A8_LLT compared to NAA) in drier water years, when effects would be more critical for habitat conditions, consist of small to moderate reductions in below normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical years (21% lower during October) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Based on the duration and magnitude of these reductions, there would be a localized effect on rearing conditions in below normal years that would not have biologically meaningful negative effects on the largemouth bass population.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April (11% lower), in critical years during August, October, and November (to 22% lower), and in wet years during November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in drier water years would be more critical for habitat conditions and would be limited to relatively infrequent, small to moderate reductions in critical years that would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than NAA throughout the year, except in critical years during April and June (8% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would be greater than flows under NAA during April and May (up to 616% greater) in all water years, and would be lower than flows under NAA (to 76% lower) during June through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of these months (June through November) except September and October.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA during April through June, and August through October (to 105% greater), with some exceptions (flow reductions to 14%), and similar to or lower than flows under NAA during November in all water years (to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively small-magnitude flow reductions and/or would not be persistent month to month and, therefore, would not have biologically meaningful negative effects.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA during April through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under NAA or A8_LLT (Table 11-8-103). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 8 and NAA.

Table 11-8-103. Difference and Percent Difference in the Percentage of Months during April–November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June, with isolated exceptions (to 11% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during July through November would be lower than flows under NAA (to 26% lower). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be persistent during July through November with small to moderate reductions in below normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical years (21% lower during October). Based on the duration and magnitude of these reductions, there would be a localized effect on rearing conditions in below normal years that would not have biologically meaningful negative effects on the largemouth bass population.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April (11% lower), in critical years during August and October through November (to 22% lower), and in wet years during

November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in drier water years would be more critical for habitat conditions and would be limited to relatively infrequent, small to moderate reductions in critical years that would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than NAA throughout the year, except in critical years during March, April, June, and December (5% to 8% lower), wet years during February (7% lower), and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater than those under NAA during January through May (up to 616% greater), and lower during the rest of the year (to 76% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of these months except September and October, but would be offset by much more substantial increases in flow in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or lower than flows under NAA during July through December (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions (to 25% lower) in below normal years during July and September through November, an isolated reduction in dry years during July (25% lower), and persistent, small to substantial reductions in critical years during July through September (49%, 13%, and 8% lower, respectively), November and December (to 17% lower). The fairly persistent, small to moderate reductions would have a localized effect on habitat conditions for portions of the year in specific water year types.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA throughout the year, except in below normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A8_LLT (Table 11-8-104). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 8 and NAA.

Table 11-8-104. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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.
[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 8 are generally similar to or greater than flows under the NAA in most months. There would be small to moderate flow reductions in drier water years in the Sacramento and Trinity rivers that would have localized effects for portions of the spawning and rearing periods, however, they would not be persistent enough or of sufficient magnitude in any single water year type to have biologically meaningful negative effects. There would also be substantial flow reductions during July through December in most water year types in the Feather River and the American River, however, these would be offset by more substantial increases in flow in the preceding months and would not be biologically meaningful to the largemouth bass population. The percentage of months outside the 86°F and 88°F temperature thresholds for adult and juvenile rearing conditions (respectively) in the Feather River under Alternative 8 would be similar to those under the NAA. The percentage of months outside the 59°F to 75°F threshold for spawning is greater under A8_LLT than NAA and would have a small, localized effect on spawning conditions, but based on the magnitude of the effect and occurrence at a single location, it would not have biologically meaningful negative effects on the largemouth bass population. There are no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions.

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June and in wetter water years during September, and would be similar to or lower than flows under Existing Conditions (to 30% lower) during July through November, including drier water years during September (Appendix

11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would consist of small to moderate reductions and/or isolated reductions that would have a localized effect during a portion of the July through November time-frame in specific water years.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT during April through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of relatively small flow reductions (to 14% lower), similar to flows under Existing Conditions during August and September except in critical years (42% and 42% lower, respectively), and similar to or lower than flows under Existing Conditions during October through November (to 39% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be more critical for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent, substantial reductions in critical years during August through November (25% to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized effect during these months in critical water years but would not have biologically meaningful effects on the largemouth bass population.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions throughout the April through November period, except in critical years during August and September (18% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially greater (up to 565% greater) than flows under Existing Conditions during April and May, and up to 77% lower during the rest of the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions would be offset by even more substantial increases in flow during the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during April through June and October, with the exception of small to moderate flow reductions in wetter water years (up to 34% lower) when effects on habitat conditions would be less critical, a relatively small flow reduction in critical years during June (17% lower) that would be offset by a substantial increase in the preceding month (72% greater), and small decreases in wet (7% lower) and dry years (16% lower) during October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during July through September and November would be lower by up to 53% relative to Existing Conditions, with persistent, moderate to substantial reductions in drier water year types that would have a localized effect during July through November.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than Existing Conditions during April through November (to 27% lower) except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to moderate flow reductions in drier water years, when effects would be more critical for habitat conditions, would be preceded by small to substantial reductions during January through March and would have a localized effect on rearing conditions throughout the period.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F water temperature threshold for year-round juvenile largemouth bass occurrence under Existing Conditions or A8_LLT (Table 11-8-103). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 8 and Existing Conditions.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during January through June and in wetter water years during September, and would be similar to or lower than flows under Existing Conditions (to 30% lower) during July through December, including drier water years during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would consist of small to moderate reductions and/or isolated reductions that would have a localized effect during a portion of the July through December time-frame in specific water years.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing Conditions during August and September except in critical years (42% and 42% lower, respectively), and similar to or lower than flows under Existing Conditions during October through December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during October and November would be up to 39% lower than flows under Existing Conditions. Flow reductions in drier water year types, when effects would be more critical for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent, substantial reductions in critical years during August through December (18% to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized effect during these months in critical water years but would not have biologically meaningful effects on the largemouth bass population.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows under Existing Conditions during January through May (up to 565% greater), and up to 77% lower during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under Existing Conditions during February through June (up to 72% greater) with isolated, relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24% lower in isolated, drier water years), and would be lower than flows under Existing Conditions in drier water years during January (to 32% lower), and during July through September, November and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent small to substantial flow reductions, including in drier water years, during most of the year would affect rearing conditions.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions by up to 36% throughout the year except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to moderate flow reductions, including in drier water years, when effects would be more critical for habitat conditions, would affect rearing conditions throughout the year.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F water temperature range for year-round adult largemouth bass occurrence under Existing Conditions or A8_LLT (Table 11-8-104). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 8 and Existing Conditions.

CEQA Conclusion: Collectively, these results indicate that the impact would be significant because Alternative 8 would cause a substantial reduction in largemouth bass habitat. In several locations, there would be isolated and/or small flow reductions in drier water years that would have a localized effect during a limited portion of the juvenile and adult rearing periods. There would be persistent, moderate to substantial flow reductions for much of the year in the Feather, American, and Stanislaus rivers that would have a biologically meaningful effect on the largemouth bass population. The percentages of years outside temperature thresholds in the Sacramento, Trinity, Feather, American and Stanislaus rivers for rearing adults and are generally similar April through November under Alternative 8 compared to Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These baselines differ in two ways. First, NAA includes the Fall X2 standard in wet above normal water years, whereas the Existing Conditions do not. Second, NAA is assumed to occur during the late long-term implementation period, whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 8 are due primarily to both the alternative and future climate change.

Sacramento Tule Perch

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June, with isolated exceptions (to 11% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during July through November would be lower than flows under NAA (to 26% lower). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be persistent during July through November with small to moderate reductions in below normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical years (21% lower during October). Based on the duration and magnitude of these reductions, there would be a localized effect on rearing conditions in below normal years that would not have biologically meaningful negative effects on the Sacramento tule perch population.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April (11% lower), in critical years during August and October through November (to 22% lower), and in wet years during November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in drier water years would be more critical for habitat conditions and would be limited to relatively infrequent, small to moderate reductions in critical years that would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than flows under NAA throughout the year, except in critical years during March, April, June, and December (5% to 8% lower), in wet years during February (7% lower), and in below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater than those under NAA during January through May (up to 616% greater), and lower during the rest of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of these months except September and October.

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during January through June (up to 105% greater) with isolated, small exceptions (to 14% lower), and similar to or lower than flows under NAA during July through December (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions (to 25% lower) in below normal years during July and September through November, an isolated reduction in dry years during July (25% lower), and persistent, small to substantial reductions in critical years during July through September (49%, 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly persistent, small to moderate reductions would have a localized effect on habitat conditions for portions of the year in specific water year types.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA throughout the year, except in below normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT exceeding the 72°F threshold would be higher than the percentage under NAA by 19% to 95% depending on water year type (Table 11-8-105).

The percentage of months under A8_LLT exceeding the 75°F threshold would be greater than the percentage under NAA in all water years (17% to 100% higher), with absolute differences between 1 and 6% (Table 11-8-105).

Table 11-8-105. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F Water Temperature Thresholds for Sacramento Tule Perch Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
72°F Threshold		
Wet	11 (500%)	12 (86%)
Above Normal	17 (NA)	16 (95%)
Below Normal	19 (NA)	16 (84%)
Dry	19 (NA)	13 (73%)
Critical	14 (333%)	3 (19%)
All	15 (1,146%)	12 (73%)
75°F Threshold		
Wet	6 (NA)	6 (100%)
Above Normal	4 (NA)	4 (100%)
Below Normal	6 (NA)	6 (100%)
Dry	5 (NA)	4 (82%)
Critical	8 (1,100%)	1 (17%)
All	6 (5,600%)	5 (79%)

NA = could not be calculated because the denominator was 0.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined during the year under Alternative 8 are generally similar to or greater than flows under the NAA in most months. There would be small to moderate flow reductions in drier water years in the Sacramento and Trinity rivers that would have localized effects for portion of the spawning and rearing periods, however, they would not be persistent enough or of sufficient magnitude in any single water year type to have biologically meaningful negative effects. There would also be substantial flow reductions during July through December in most water year types in the Feather River and the American River, however, these would be offset by more substantial increases in flow in the preceding months and would not be biologically meaningful to the Sacramento tule perch population. The percentages of years above suitable temperature thresholds under Alternative 8 in the Feather River are generally similar to or slightly greater than the percentages under the NAA. However, there are no temperature related effects in any of the other rivers examined.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the Sacramento tule perch rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during January through June and in wetter water years during September, and would be similar to or lower than flows under Existing Conditions (to 30% lower) during July through December, including drier water years during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would consist of small to moderate reductions and/or isolated reductions that would have a localized effect during a portion of the July through December time-frame in specific water years.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing Conditions during August and September except in critical years (42% and 42% lower, respectively), and similar to or lower than flows under Existing Conditions during October through December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during October and November would be up to 39% lower than flows under Existing Conditions. Flow reductions in drier water year types, when effects would be more critical for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent, substantial reductions in critical years during August through December (18% to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized effect during these months in critical water years but would not have biologically meaningful effects on the Sacramento tule perch population.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows under Existing Conditions during January through May (up to 565% greater), and up to 77% lower during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under Existing Conditions during February through June (up to 72% greater) with isolated, relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24% lower in isolated, drier water years), and would be lower than flows under Existing Conditions in drier water years during January (to 32% lower), and during July through September, November and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent small to substantial flow reductions, including in drier water years, during most of the year would affect rearing conditions.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions by up to 36% throughout the year except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to moderate flow reductions, including in drier water years, when effects would be more critical for habitat conditions, would affect rearing conditions throughout the year.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in Clear Creek or the San Joaquin River.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT exceeding 72°F would be similar to or greater than the percentage under Existing Conditions, by up to 500%, but with relatively small absolute increases (to 19%) that would not have biologically meaningful effects (Table 11-8-105).

The percentage of months under A8_LLT exceeding 75°F would be slightly higher than the percentage under Existing Conditions in all water years with a high relative increase in critical years (1,100% higher) based on the small numbers being compared, with absolute increases between 4 and 8% (Table 11-8-105). These are small increases that would not have biologically meaningful effects.

CEQA Conclusion: Collectively, these results indicate that the impact would be significant because Alternative 8 would cause a substantial reduction in Sacramento tule perch habitat. Flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would not have biologically meaningful negative effects on the Sacramento tule perch population. Reduced flows in other rivers would not have biologically meaningful effects on Sacramento tule perch. The percentages of years outside both temperature thresholds are slightly higher under Alternative 8 than under Existing Conditions and would not have biologically meaningful effects on spawning and rearing success. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas the Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 8 are due primarily to both the alternative and future climate change.

Sacramento-San Joaquin Roach

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June, with isolated exceptions (to 11% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during July through November would be lower than flows under NAA (to 26% lower). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be persistent during July through November with small to moderate reductions in below normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical years (21% lower during October). Based on the duration and magnitude of these reductions, there would be a localized effect on rearing conditions in below normal years that would not have biologically meaningful negative effects on the Sacramento-San Joaquin roach population.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April (11% lower), in critical years during August and October through November (to 22% lower), and in wet years during November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in drier water years would be more critical for habitat conditions and would be limited to relatively infrequent, small to moderate reductions in critical years that would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than NAA throughout the year, except in critical years during March, April, June, and December (5% to 8% lower), wet years during February (7% lower), and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater than those under NAA during January through May (up to 616% greater), and lower during the rest of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of these months except September and October, but would be offset by much more substantial increases in flow in the preceding months.

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during January through June (up to 105% greater) with isolated, small exceptions (to 14% lower), and similar to or lower than flows under NAA during July through December (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions (to 25% lower) in below normal years during July and September through November, an isolated reduction in dry years during July (25% lower), and persistent, small to substantial reductions in critical years during July through September (49%, 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly persistent, small to moderate reductions would have a localized effect on habitat conditions for portions of the year in specific water year types.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA throughout the year, except in below normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A8_LLT (Table 11-8-106). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 8 and NAA.

Table 11-8-106. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay at Exceed the 86°F Water Temperature Range for Sacramento-San Joaquin Roach Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in spawning and juvenile and adult Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under Alternative 8 are generally similar to or greater than flows under the NAA in most months. There would be small to moderate flow reductions in drier water years in the Sacramento and Trinity rivers that would have localized effects for portions of the spawning and rearing periods, however, they would not be persistent enough or of sufficient magnitude in any single water year type to have biologically meaningful negative effects. There would also be substantial flow reductions during July through December in most water year types in the Feather River and the American River, however, these would be offset by more substantial increases in flow in the preceding months and would not be biologically meaningful to the roach population. The percentage of months outside temperature thresholds are generally similar to or lower under Alternative 8 than under the NAA, except below the 60.8 °F threshold where exceedances would generally be higher (up to14% higher) but would not have biologically meaningful negative effects.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during January through June and in wetter water years during September, and would be similar to or lower than flows under Existing Conditions (to 30% lower) during July through December, including drier water years during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would consist of small to moderate reductions and/or isolated reductions that would have a localized effect during a portion of the July through December time-frame in specific water years.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing Conditions during August and September except in critical years (42% and 42% lower, respectively), and similar to or lower than flows under Existing Conditions during October through December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during October and November would be up to 39% lower than flows under Existing Conditions. Flow reductions in drier water year types, when effects would be more critical for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent, substantial reductions in critical years during August through December (18% to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized effect during these months in critical water years but would not have biologically meaningful effects on the Sacramento-San Joaquin roach population.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows under Existing Conditions during January through May (up to 565% greater), and up to 77% lower during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under Existing Conditions during February through June (up to 72% greater) with isolated, relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24% lower in isolated, drier water years), and would be lower than flows under Existing Conditions in drier water years during January (to 32% lower), and during July through September, November and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent small to substantial flow reductions, including in drier water years, during most of the year would affect rearing conditions.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions by up to 36% throughout the year except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to moderate flow reductions, including in drier water years, when effects would be more critical for habitat conditions, would affect rearing conditions throughout the year.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or A8_LLT (Table 11-8-106). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 8 and Existing Conditions.

CEQA Conclusion: Collectively, these results indicate that the impact would be significant because Alternative 8 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects on the roach population. Reduced flows in other rivers would not have biologically meaningful effects on roach. The percentages of years outside both temperature thresholds are generally lower under Alternative 8 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 8 are due primarily to both the alternative and future climate change.

Hardhead

In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under NAA during December through June, with isolated exceptions (to 11%

lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during July through November would be lower than flows under NAA (to 26% lower). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would be persistent during July through November with small to moderate reductions in below normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical years (21% lower during October). Based on the duration and magnitude of these reductions, there would be a localized effect on rearing conditions in below normal years that would not have biologically meaningful negative effects on the hardhead population.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or greater than flows under NAA, except in above normal years during April (11% lower), in critical years during August and October through November (to 22% lower), and in wet years during November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in drier water years would be more critical for habitat conditions and would be limited to relatively infrequent, small to moderate reductions in critical years that would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater than NAA throughout the year, except in critical years during March, April, June, and December (5% to 8% lower), wet years during February (7% lower), and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater than those under NAA during January through May (up to 616% greater), and lower during the rest of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of these months except September and October.

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under NAA during January through June (up to 105% greater) with isolated, small exceptions (to 14% lower), and similar to or lower than flows under NAA during July through December (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions (to 25% lower) in below normal years during July and September through November, an isolated reduction in dry years during July (25% lower), and persistent, small to substantial reductions in critical years during July through September (49%, 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly persistent, small to moderate reductions would have a localized effect on habitat conditions for portions of the year in specific water year types.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would always be similar to or greater than flows relative to NAA throughout the year, except in below normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the range would be similar to or lower than the percentage under NAA in all water years (Table 11-8-107).

Table 11-8-107. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-8 (-11%)	-5 (-8%)
Above Normal	-11 (-16%)	-7 (-11%)
Below Normal	-9 (-13%)	2 (3%)
Dry	-8 (-11%)	-0.5 (-1%)
Critical	-10 (-15%)	-3 (-6%)
All	-9 (-13%)	-3 (-5%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 8 would not cause a substantial reduction in spawning and juvenile and adult hardhead rearing. Flows in all rivers examined during the year under Alternative 8 are generally similar to or greater than flows under the NAA in most months. There would be small to moderate flow reductions in drier water years in the Sacramento and Trinity rivers that would have localized effects for portion of the spawning and rearing periods, however, they would not be persistent enough or of sufficient magnitude in any single water year type to have biologically meaningful negative effects. There would also be substantial flow reductions during July through December in most water year types in the Feather River and the American River, however, due to the migration ability and widespread distribution of hardhead in the Central Valley, flows reductions in these two rivers would not be biologically meaningful to the hardhead population. The percentages of years outside the 59°F to 64°F temperature threshold are slightly higher under Alternative 8 than under the NAA, but generally lower for the 65°F to 82.4°F threshold, and would not have biologically meaningful effects on spawning or rearing success.

CEQA Conclusion: In general, Alternative 8 would reduce the quality and quantity of upstream habitat conditions for hardhead relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or greater than flows under Existing Conditions during January through June and in wetter water years during September, and would be similar to or lower than flows under Existing Conditions (to 30% lower) during July through December, including drier water years during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would consist of small to moderate reductions and/or isolated reductions that would have a localized effect during a portion of the July through December time-frame in specific water years.

In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July would generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing Conditions during August and September except in critical years (42% and 42% lower, respectively), and similar to or lower than flows under Existing Conditions during October through December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during October and November would be up to 39% lower than flows under Existing Conditions. Flow reductions in drier water year types, when effects would be more critical for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent, substantial reductions in critical years during August through December (18% to 42% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized effect during these months in critical water years but would not have biologically meaningful effects on the hardhead population.

In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August and September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than those under Existing Conditions during January through May (up to 565% greater), and up to 77% lower during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, would consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows under Existing Conditions during February through June (up to 72% greater) with isolated, relatively small magnitude exceptions (to 34% lower in isolated, wetter water year and to 24% lower in isolated, drier water years), and would be lower than flows under Existing Conditions in drier water years during January (to 32% lower), and during July through September, November and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to substantial flow reductions, including in drier water years, during most of the year would affect rearing conditions.

In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would generally be lower than under Existing Conditions by up to 36% throughout the year except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The persistent, small to moderate flow reductions, including in drier water years, when effects would be more critical for habitat conditions, would affect rearing conditions throughout the year.

Flow rates in the San Joaquin River under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months in which year-round in-stream temperatures would be outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be lower than the percentage under Existing Conditions in all water years (Table 11-8-107).

CEQA Conclusion: Collectively, these results indicate that the impact would be significant because Alternative 8 would cause a substantial reduction in hardhead habitat. Flows would be substantially lower during portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects on hardhead. Reduced flows in other rivers would not have biologically meaningful effects on hardhead. The percentages of years outside both temperature thresholds are generally lower or slightly higher under Alternative 8 than under Existing Conditions and would not have biologically meaningful effects on spawning or rearing success. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the Existing Conditions and Alternative 8 are due primarily to both the alternative and future climate change.

California Bay Shrimp

NEPA Effects: The effect of water operations on rearing habitat of California bay shrimp under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. These effects would not be adverse.

CEQA Conclusion: As described above the impacts on rearing habitat of California bay shrimp would be less than significant.

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-covered species of primary management concern.

Striped Bass

Adult striped bass migrate up the Delta via the Sacramento River to reach suitable spawning habitat upstream. It is assumed that this migration period occurs around the same timing as spawning.

Flows in the Sacramento River downstream of the north Delta diversion facilities would be reduced relative to NAA. Flows would be similar to NAA in April and May, but reduced by 18% in June. Sacramento River flows are highly variable inter-annually, and striped bass are still able to migrate upstream the Sacramento River during lower flow years.

NEPA Effects: The effect of reduced Sacramento flows under Alternative 8 would not be adverse.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (13–26% lower compared to Existing Conditions in May and June) would not interfere substantially with movement of spawning striped bass through the Delta. No mitigation would be required.

American Shad

Adult American shad migrate up the Delta to reach suitable spawning habitat upstream around March-May. American shad migrate up the Sacramento River while some shad spawn in the San Joaquin River basin. Flows in the Sacramento River below the north Delta diversion facilities would be reduced relative to NAA during March–May. Monthly flows on average would be similar to NAA in April and May, but reduced 16% in March. Flows from the San Joaquin River at Vernalis would be unchanged under Alternative 8. Sacramento River flows are highly variable inter-annually, and American shad are still able to migrate upstream the Sacramento River during lower flow years.

NEPA Effects: Overall, the impact to American shad migration habitat conditions would not be adverse under Alternative 8.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because the changes in flow (reduced 4–15% lower compared to Existing Conditions) would not interfere substantially with movement of American shad from the Delta to upstream spawning habitat. No mitigation would be required.

Threadfin Shad

NEPA Effects: Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats. Threadfin shad found in the Delta to not actively migrate upstream to spawn. Therefore there is no effect on migration habitat conditions.

CEQA Conclusion: Impacts would be as described immediately above and would be less than significant because flow changes in the Delta under Alternative 8 would not alter movement patterns for threadfin shad. No mitigation would be required.

Largemouth Bass

NEPA Effects: Largemouth bass are non-migratory fish within the Delta. Therefore they do not use the Delta as migration habitat corridor. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes under Alternative 8 would not affect largemouth movements within the Delta. No mitigation would be required.

Sacramento Tule Perch

NEPA Effects: Similar to largemouth bass, Sacramento tule perch are a non-migratory species and do not use the Delta as a migration corridor as they are a resident Delta species. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes would not affect Sacramento tule perch movements within the Delta. No mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 1A, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to the NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

Hardhead

NEPA Effects: For hardhead the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 1A, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to the NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for hardhead would not be significant and no mitigation is required.

California Bay Shrimp

NEPA Effects: Because California bay shrimp occur primarily in saline and low salinity waters the overall flow effects on them would not be adverse.

CEQA Conclusion: Because California bay shrimp occur primarily in saline and low salinity water the overall flow effects on them would be less than significant and no mitigation would be required.

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

The effects of restoration measures under Alternative 8 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-7 under delta smelt for a discussion of the likely effects of construction of restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of the construction of restoration measures under Alternative 8 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-7).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-7, these effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of the construction of restoration measures would be less than significant.

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-8 under delta smelt for a discussion of the potential effects of contaminants associated with restoration measures on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. For a detailed discussion, please see Alternative 1A, Impact AQUA-8.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-8, these effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of contaminants associated with restoration measures would be less than significant.

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

Refer to Impact AQUA-9 under delta smelt for a discussion of the potential effects of restored habitat conditions on non-covered species of primary management concern. Although there are minor differences, the overall effects are similar. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. For a detailed discussion, please see Alternative 1A, Impact AQUA-8.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-207, the different effects on non-covered species of primary management concern range from slightly beneficial to beneficial.

CEQA Conclusion: As described immediately above, the impacts of restored habitat conditions would range from slightly beneficial to beneficial.

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of methylmercury management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-10, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of methylmercury management would be less than significant.

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

NEPA Effects: The potential effects of invasive aquatic vegetation management on non-covered species of primary management concern under Alternative 8 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. The effect on them will not be adverse.

CEQA Conclusion: Refer to Impact AQUA-11 under delta smelt for a discussion of the potential effects of invasive aquatic vegetation management on non-covered species of primary management concern. There are minor differences and the effects are similar except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch use the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on them will not be significant and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

The effects of other conservation measures under Alternative 8 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved oxygen management on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of dissolved oxygen management under Alternative 8 would be similar to those described for

NEPA Effects: As concluded for Alternative 1A, these effects would be beneficial.

CEQA Conclusion: As described immediately above, the impacts of oxygen level management would be beneficial.

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

NEPA Effects: Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of predatory fish (striped bass and largemouth bass) and predator management on non-predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of this management will not be adverse.

CEQA Conclusion: Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the potential effects of predatory fish and predator management on non-predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of this management will not be significant. No mitigation is required.

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

NEPA Effects: Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of nonphysical fish barriers on non-covered species of primary management concern. The potential effects of nonphysical fish barriers under Alternative 8 would be similar to those described for Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-14. The effects would be similar except for Sacramento-San Joaquin roach and hardhead which are unlikely to be present in their vicinity. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of nonphysical fish barriers would be less than significant.

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

NEPA Effects: Refer to Impact AQUA-15 under delta smelt for a discussion of the potential effects of illegal harvest reduction on non-covered species of primary management concern. The potential effects of illegal harvest reduction under Alternative 8 would be similar to those described for Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-15. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of illegal harvest reduction would be less than significant.

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

NEPA Effects: The potential effects of conservation hatcheries on non-covered species of primary management concern under Alternative 8 would be similar to those described for Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be no effect.

CEQA Conclusion: As described immediately above, conservation hatcheries would have not impact.

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

NEPA Effects: Refer to Impact AQUA-17 under delta smelt for a discussion of the potential effects of stormwater treatment on non-covered species of primary management concern. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The potential effects of stormwater treatment under Alternative 8 would be similar to those described for Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-17. These effects would be beneficial.

CEQA Conclusion: As described immediately above, the impacts of stormwater management would be beneficial.

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

NEPA Effects: Refer to Impact AQUA-18 under delta smelt for a discussion of the potential effects of removal/relocation of nonproject diversions on non-covered species of primary management concern. The potential effects of removal/relocation of nonproject diversions under Alternative 8 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-18). The effects would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which are unlikely to be present near these diversions. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of removal/relocation of nonproject diversions would be less than significant.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 8 would not be substantially reduced when compared to the NAA.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 8 would reduce the quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; Operational Scenario G)

Construction activities under Alternative 9 could affect environmental conditions in the Sacramento River where the Delta Cross Channel (DCC) gates would be modified to include fish screens, and possibly a new gate, and where the Georgiana Slough screened diversion is constructed. In-water construction would affect environmental conditions at several other locations in the Delta: where 12 additional operable gates and five barge landings would be constructed; where several waterways would be dredged to increase channel capacity in order to convey required flows; where levees would be constructed or modified; and where canals, bridges, and pump stations would be constructed. Table 11-9-1 lists the in-water and near-water construction activities under Alternative 9 that could directly affect fish and the area affected (see Chapter 3, *Description of Alternatives*, for a detailed description of construction activities).

Alternative 9 includes the activities and facilities listed in Table 11-9-1 below and their impact lengths and/or affected areas.

In addition to construction of the conveyance elements of Alternative 9, construction occurring during implementation of numerous conservation measures would affect aquatic habitats. The conservation measures involving in-water construction would be similar to those identified and analyzed under Alternative 1A. Under Alternative 9, impacts on fish could result from temporary changes in water quality (e.g., turbidity and accidental spills); exposure to construction related noise (e.g., pile driving); direct physical injury during construction; and temporary and permanent changes in spawning and rearing habitat area, migration habitat conditions, and predation.

Operations under Alternative 9 would result in changes in flow and potentially changes in water quality, habitat, impingement, entrainment, and predation. The operable barriers also would restrict fish movement in the Delta by reducing fish entry into the conveyance corridor or, in the case of the Mokelumne River and San Joaquin River Separate Fish Movement Corridors, by providing fish passage that would minimize fish entrainment through the DCC and south Delta intakes, respectively.

The Sacramento River channel and bank would be affected by construction of the two fish-screened gates at the DCC and Georgiana Slough. Operable barriers would be installed to minimize fish movement into the Separate Water Supply Corridor, reduce flood potential downstream of the DCC, and allow floodwaters to continue to pass down Georgiana Slough and improve water quality.

Each of the operable barriers on DCC and Georgiana Slough would include 2,800-foot-long, fish-screened gates on the Sacramento River, with a capacity of 7,500 cfs. The Georgiana Slough gate also would have a navigation lock and channel.

1 **Table 11-9-1. In-Water and Near-Water Construction Activities under Alternative 9**

Activity or Facility	Temporary In-Water Footprint (Acres)	Permanent In-Water Footprint (Acres)	Dredging (Acres)	Rock Bank Protection (Lineal feet)
Operable Gates				
Mokelumne River near Lost Slough[a]	0.11	0.11	1.29	400
Meadows Slough near Sacramento River[b]	0.17	0.17	1.93	400
Snodgrass Slough north of Delta Cross Channel[a]	0.40	0.40	4.59	400
Delta Cross Channel at Sacramento River[b]	3.21	5.25	–	–
Georgiana Slough at Sacramento River[b]	3.21	5.25	–	–
Threemile Slough at Sacramento River[b]	0.48	0.48	5.51	400
San Joaquin River at head of Old Rivera[a]	0.92	0.92	10.56	400
Middle River South of Victoria Canal[a]	0.26	0.26	2.94	400
Victoria Canal / North Canal – Type[c]	0.40	0.40	4.59	400
Woodward Canal / North Victoria Canal[c]	0.34	0.34	3.86	400
Railroad Cut – Type[c]	0.21	0.21	2.39	400
Connection Slough[c]	0.31	0.31	3.49	400
Franks Tract[c]	0.88	0.88	10.10	400
Fisherman's Cut[c]	0.46	0.46	5.23	400
Channel Enlargements				
Between Mildred Island and Railroad Cut–Middle River	0	0	0.11	
Between Railroad Cut and Woodward Canal – Middle River	0	0	0.10	
Between Woodward Canal and Victoria Canal– Middle River	0	0	0.07	
Victoria Canal	0	0	0.19	
Culvert Siphons				
Old River Culvert Siphon	1.69	0		
West Canal Culvert Siphon	1.11	0		
New Canals				
Coney Island Canal	0	0	0	0
CCF Intertie Canal	0	0	0	0
Levees				
Near River's End Marina	0	0	0	0
Pumping Plants				
Middle River	0.05			
Old River	0.05			
Barge Landings				
Webb Tract Landing 1	0.34	0		
Webb Tract Landing 2	0.34	0		
Bacon Island Landing	0.34	0		
Woodward Island Landing 1	0.34	0		
Woodward Island Landing 2	0.34	0		
Bridges				
Levee road on north bank Mokelumne River	0	0	0	
River road at proposed channel connection with Meadows Slough	0	0	0	
CCF maintenance road	0	0	0	
Herdlyn Road at the proposed Intertie Canal	0	0	0	
Total	**15.9**	**15.5**	**56.9**	**4,800**

[a] Type I Gate.
[b] Type II Gate.
[c] Type III Gate.

2

Operable barriers to be installed in the Mokelumne River region would provide a migration channel between the Mokelumne and Cosumnes Rivers and the Sacramento River, and would prevent fish from migrating into the DCC system. The operable barrier to be installed in Threemile Slough would reduce the possibility of higher-salinity Delta water entering the San Joaquin River system and being conveyed into the Separate Water Supply Corridors. The Threemile Slough operable barrier also would minimize the potential for fish migration from the Sacramento River into the San Joaquin River. The operable barriers included on the San Joaquin River, Middle River, False River, and Franks Tract would prevent fish from migrating into the Separate Water Supply Corridors.

Construction of the fish screens, operable barriers, and culvert siphons would require in-water work and construction of cofferdams. In-water work at most locations would need to occur during low water periods for driving steel sheeting to construct cofferdams and performing any work activities in the water (e.g., excavation using a dragline). Once the cofferdams are completed and the enclosure is in place, work can continue (e.g., dewatering, excavation, pile driving, and concreting) inside the cofferdam for the remainder of the year.

Pile driving (e.g., for cofferdams and foundation piles) would occur during construction of the fish screens, operable barriers, culvert siphons, pumping plants, and bridges. The details regarding the types, numbers, and locations of piles to be driven are not available at this time. DWR intends to install sheet piles and foundation piles by vibratory methods, but impact driving may be required for some pile installation. The use of impact pile driving is dependent on site-specific geologic conditions, which have not yet been evaluated at the construction locations.

Type I barriers would use bottom-hinged navigable gates in locations where the majority of the waterway width requires gates and where depth is less than 20 feet. Type II barriers involve the use of unnavigable radial gates for flow control and navigable wicket or miter gates for the operable portions; these would be used where waterway depth exceeds 20 feet. Type III barriers also would use bottom-hinged navigable gates for operable portions (like Type I) but would use a rock wall for the fixed portion. This type of barrier would be used where gates are required only for recreational boat passage and where flood neutrality is not an issue.

The Obermeyer gates for Type I and III barriers could be constructed within existing waterways either wet or dry. The dry construction scenario is the same as described below for the Type II barriers. Constructing the Obermeyer gates in-the-wet would require the gates to be prefabricated offsite, with concrete sills attached prior to being transported to the site. The site would be dredged, and the sheet piles and H-piles could be installed while the gates are being fabricated. Once the site is prepared, the sills with the gates attached would be lifted in place using either catamarans made of Flexi-floats or barge-mounted cranes. The sills would be set on the piles and between sheet pile cut-off walls. Underwater grout would be used to connect the concrete sills to the preinstalled foundations.

The Type II barriers would be constructed in multiple stages during summer low-flow periods. A closed steel sheet pile cofferdam would be constructed across part of the waterway, leaving the remainder of the waterway open to pass natural flows. The structure would be constructed within the cofferdam after dewatering. The configuration of the cofferdam would include the upstream and downstream retaining walls adjacent to the main structure. When part of the structure is completed, the cofferdam would be removed and a new cofferdam installed for the next adjacent section to be constructed. Water flowing in the channel would pass through completed structure bays and through any open natural channel that is not blocked by cofferdam. It is possible that some of the longer structures could require multiple construction seasons to complete. However, construction through the winter high-flow periods is not anticipated. Additional temporary cofferdams may also be required upstream and downstream of the deeper gate bays after the entire structure is completed, in order to facilitate dewatering for installation of the gate panels in each bay.

The Type III barrier rock wall would be constructed by placing rock from a barge with a crane. DWR routinely installs such barriers across waterways in the south Delta for agriculture and fish benefits.

Five temporary barge unloading facilities would be constructed under Alternative 9 to facilitate the transport of equipment and materials to and from the construction sites. The temporary landings would be located at Bacon Island, Woodward Island (two sites), and Webb Tract (two sites). The landings on Bacon Island and Woodward Island are the same locations as those in Alternative 1A. The Webb Tract landings would be located on the northwest corner and on the eastern side of Webb Tract. It was assumed that the docks for the temporary unloading facilities would be piling support structures as described for Alternative 1A.

A work area of up to 15 acres could be required in the vicinity of each barrier structure. This area would be needed for temporary storage of materials (e.g., sheet piling and foundation piling), concrete form fabrication, possible field fabrication of miter or radial gate panels, stockpiles, office trailers, shops, and construction equipment maintenance. The proposed Middle River South Delta Improvement Program barrier would consist of a 2.4-acre staging area, a 4.52-acre spoil area, a 0.5-acre stockpile area, and 1.6 acres in Middle River.

The duration for construction of the Threemile Slough Barrier with Obermeyer gates was estimated at 8 months, assuming that the gates are pre-ordered and that the off-site precast sills are built concurrently with the onsite dredging and pile driving operations.

Some excavation (dredging) would be required for several hundred feet upstream and downstream of all gate structures to transition the sides of the existing channel to the required depth and width of the gate structures. It is anticipated that the conformed cut bottom upstream and downstream would be protected by riprap to control erosion.

Each gate bay would be inspected annually at the end of the wet season for accumulation of sediment on the bottom that could impede gate operation. Sediment should be removed during summer, by suction or mechanical removal.

Alternative 9 would include construction of a 4,000-foot segment of new levees at Old River, isolating Old River from the Tracy Fish Collection Facility and connecting CCF to the fish facility. Setback levees on the south side of Victoria Canal also would be constructed to accommodate the dredged and expanded canal under this conveyance alternative. New levees would be constructed around pumping plants and operation equipment for the operable barriers. New levees or levee modifications constructed for the separate corridor conveyance would be designed to meet similar flood protection levels as the existing levee.

The Separate Corridors Alternative would require approximately 4 years to construct. Installation of the DCC and Georgiana Slough fish screens would each be constructed in two phases, lasting 2 years for each phase. The construction duration of the other operable barriers would range between 1.5 and 2.5 years, spaced over the 4 year construction period. Channel enlargement would occur over approximately 3.5 years. Culvert siphons would require approximately 2 years each. Levee and new canal construction would last from 3 to 3.5 years, respectively.

There is a potential that some of the in-water work associated with construction cofferdams for the operable gates would need to occur through the November timeframe because of the need to construct the cofferdams during the dry season (August through November timeframe). If in-water work is required outside of the expected in-water work window (June 1 through October 31), DWR would consult with the appropriate resource agencies (NMFS, USFWS, and DFG) to obtain permissions.

Delta Smelt

Construction and Maintenance of CM1

Small numbers of delta smelt eggs, larvae, and adults could be present in the north and west Delta in June during construction of DCC and Georgiana Slough facilities and the operable gates in the west Delta (refer to Table 11-6 for the temporal and spatial distribution of fish in the Delta). During construction of the operable gates and barge unloading facilities in the east Delta, small numbers of delta smelt eggs, larvae, and spawners could be present in June. During construction of the operable gates, barge unloading facilities, culvert siphons, and channel dredging in the south Delta, juveniles and adults are present during the construction months of June to October, with the majority of fish occurring in September and October. All of these construction and maintenance sites occur entirely within designated delta smelt critical habitat.

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 critical habitat would be similar to but greater than those described under Impact AQUA-1 under Alternative 1A. Alternative 9 would have more impact locations because of the construction of fourteen operable gates (Table 11-9-1). Alternative 9 would have two diversions at the DCC and Georgiana Slough facilities while Alternative 1A would have five intakes. Alternative 9 would have one less barge landing (five total) than Alternative 1A. Alternative 9 would have a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water construction locations, the potential for noise effects is greater proportional to the increased number of sites compared to Alternative 1A. Similarly, the increased dredging will have proportionally greater effects. The effects related to temporary increases in turbidity, accidental spills, and disturbance of contaminated sediments would be similar to Alternative 1A and the implementation of the mitigation measures 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; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*) would be available to avoid and minimize potential effects. Additional details on underwater noise, in-water work activities, and the loss of spawning, rearing, or migration habitat are provided below.

Underwater Noise

Alternative 9 would require pile driving to install the cofferdams, gate foundations, and barge unloading facilities. DWR proposes to use vibratory methods to install sheet pile for cofferdams at the DCC and Georgiana Slough facilities, the other operable gates, the culvert siphons, and the piles to support the temporary docks at the barge unloading facilities.

The evaluation of underwater noise effects is discussed in detail under Section 11.3.1.1 Potential Impacts Resulting from Construction and Maintenance of Water Conveyance Facilities – *Underwater Noise*. The potential for pile driving under Alternative 9 to expose delta smelt to underwater noise exceeding the interim injury threshold criteria of 183 dB $SEL_{cumulative}$ (for fish smaller than 2 grams) is much greater than under the other alternatives due to the number of sites where pile driving would be required, the broader distribution of the sites within the Delta, and the potential need for pile driving over two or more in-water work windows at some sites. Should impact driving be needed for installation of the piles, underwater noise would exceed criteria as illustrated in Table 11-10 (Length, Width, and Area of Water bodies Potentially Exposed to Impact Pile Driving Noise above the 183 dB $SEL_{cumulative}$ Level) and Table 11-11 (Species and Duration of Exposure to Impact Pile Driving during Cofferdam Installation). As with the other alternatives, these tables reflect the assumption that impact pile driving would be required up to about 30% of the time.

Delta smelt eggs would not experience underwater sound generated from pile driving because the locations of the Alternative 9 in-water facilities are not considered suitable habitat for this life stage of the species; therefore, effects would not occur.

There is a slight potential for adult or larval delta smelt to be in the vicinity of the DCC and Georgiana Slough, other operable gates, siphon culverts, pumping stations, channel dredging, and the barge unloading facilities during in-water construction in the Delta (in June and between June and July, respectively). Delta smelt tend to occupy the west Delta and would be in very low abundance in the north, east, and south Delta during this time; therefore, fish densities within areas affected by pile driving would be exceedingly low. Most adult delta smelt complete their spawning cycle and die by mid- to late June. Larval delta smelt, which move with the currents utilize tidal cycles to move downstream to the low-salinity zone, could potentially drift through areas affected by underwater sound; however, their distribution during this time is predominately in the west Delta rather than the north and south Delta, where most of the pile driving could occur.

Alternative 9 includes three operable gates and two barge unloading facilities in the west Delta (gates at Threemile Slough, head of Old River, and Franks Tract; two barge unloading facilities on Webb Tract). There is a moderate possibility that delta smelt could be present in these areas of the west Delta.

Individual larval delta smelt that are present in an area affected by underwater sound from impact pile driving above the 183-dB $SEL_{cumulative}$ injury threshold level (for fish smaller than 2 grams), and proximate to an impact-driven pile, could experience an adverse effect, such as injury or mortality. Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize the effects from underwater noise on delta smelt.

In-Water Work Activities

Construction activities under Alternative 9 would have greater potential to injure or kill delta smelt than Alternative 1A because of the greater in-water construction activities, including installation of sheet pile cofferdams at the DCC and Georgiana Slough facilities, the other operable gates, pumping stations, culvert siphons, piles at each barge unloading facility, dredging of the Middle River and Victoria Canal, and placement of riprap to protect the streambanks adjacent to the facilities from erosion.

The timing of cofferdam and riprap installation for the intakes (June through August) would avoid most of the spawning season (January through June, with peak numbers in the north Delta during February through May) when delta smelt are most likely to be present (see Table 11-4). The culvert siphons would be built during the low-flow season (August through November). Delta smelt juveniles and adults could be present in the east and south Delta during June and July, so most would be avoided during the August to November construction period. Effects would be minimized by implementation of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*.

Loss of Spawning, Rearing, or Migration Habitat

The temporary and permanent loss of habitat, including designated critical habitat, would be substantially greater for Alternative 9 than Alternative 1A. Temporary loss of delta smelt rearing and migration habitat would occur within the footprints of the cofferdams used to construct the DCC and Georgiana Slough facilities, the other operable gates, pumping stations, culvert siphons, and the footprints of the barge landing docks. Permanent loss of delta smelt rearing and migration habitat would occur within the footprints of the DCC and Georgiana Slough facilities, the other operable gates, pumping stations, culvert siphons, and dredged areas. Together, the in-water footprint of operable gates would cover 15.5 acres and associate dredging would affect 56.5 acres, culvert siphons would cover 2.8 acres, and barge landings would cover 1.7 acres. Approximately 4,800 linear feet of river bank would be affected by rock bank protection. All of these habitat areas are designated critical habitat for delta smelt. Permanent habitat lost by installation of the other facilities is included in Table 11-9-1. The area dredged for channel enlargement in the Middle River and Victoria channel totals approximately 0.5 acre. Effects would be minimized by implementation of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments* (*Environmental Training*; *Erosion and Sediment Control Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; and *Barge Operations Plan*).

NEPA Effects: The potential construction related effects of Alternative 9 would be greater than those under Alternative 1A (see Impact AQUA-1) due to construction of operable gates, culvert siphons, barge landings, and channel enlargements. Effects of in-water construction activities would not be adverse because construction would typically occur during the approved in-water work window, and implementation of 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; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*)—as well as the species' tolerance to turbidity—would minimize the effects of construction activities on turbidity, accidental spills, onsite and offsite sediment transport to surface waters, and re-suspension and redistribution of potentially contaminated sediments.

The timing of pile installation and implementation of the avoidance and minimization measures included in Mitigation Measures AQUA-1a and AQUA-1b (see Alternative 1A, Impact AQUA-1) would minimize adverse effects from impact pile driving (e.g., injury or mortality) on delta smelt. Implementation of environmental commitments *Fish Rescue and Salvage Plan* and Barge *Operations Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B) would also minimize the potential effects of construction activities on delta smelt.

The effect of temporary and permanent rearing and migration habitat loss for delta smelt is also not adverse due to the relatively small areas occupied by the gates, barge landings, and culvert siphons. The low abundance of delta smelt in the vicinity of these facilities during construction, the low quality of the habitat affected by construction, and implementation of environmental commitment *Barge Operations Plan* (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments*) would also minimize the potential effects on delta smelt from construction activities. Overall, the effects of Alternative 9 on delta smelt or designated critical habitat would not be adverse.

***CEQA Conclusion*:** Although Alternative 9 affects a larger in-water area than Alternative 1A, the impact of construction of the water conveyance facilities on delta smelt or critical habitat would be less than significant except for construction noise associated with pile driving. There are more construction sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on delta smelt 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.

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-2). As concluded in Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt.

***CEQA Conclusion*:** Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the maintenance of water conveyance facilities on delta smelt would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt

Water Exports from SWP/CVP South Delta Facilities

Overall, operational activities under Alternative 9 would benefit delta smelt by substantially reducing entrainment losses at the south Delta facilities for adults and juveniles compared to NAA. Because of the divergent changes in Old River and Middle River flows under Alternative 9, the impacts are assessed qualitatively rather than with the OMR proportional entrainment index. The

Old River corridor, currently a major pathway for entrainment, would no longer convey water to those facilities and therefore delta smelt in the north and central Delta regions would experience much less pumping effects (reverse OMR flows) or south Delta entrainment. The small proportion of the delta smelt population that moves up the mainstem San Joaquin River into the east Delta would encounter southward conveyance flows between the mouth of the Mokelumne River and Middle River.

Water Exports from SWP/CVP North Delta Intake Facilities

In general, the potential for delta smelt entrainment is low because the north Delta intakes are upstream of most delta smelt occurrence. Water exports from the Sacramento River would come through new fish-screened intakes at DCC and Georgiana Slough near Walnut Grove. The risk of entrainment into the north Delta water supply corridor is currently low because delta smelt (mainly adults) occur infrequently in the north Delta. This low entrainment risk would be further reduced by fish screens on the intake designed to meet criteria to prevent entrainment and impingement of juvenile delta smelt.

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 models was 1.3% under Alternative 9 compared to 2.0% under NAA, a 37% relative decrease (Table 11-9-2). Fish screens would prevent entrainment of adults and juveniles.

Table 11-9-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 9 and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A9_LLT	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
2.1	2.0	1.3	-0.84 (-40%)	-0.73 (-37%)

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 under Alternative 1A, Impact AQUA-1 reduced entrainment toward the south Delta facilities would result in overall reduced predation losses of Delta smelt.

Predation loss at the north Delta intakes would be limited because few delta smelt occur that far upstream. Predators may aggregate near the physical barriers placed along the corridors, but the effect may not be substantially greater than NAA because predators are already abundant in the interior and south Delta. Overall, the effect would be beneficial for delta smelt because fewer delta smelt would be lost to predation compared to Existing Conditions at the south Delta facilities.

NEPA Effects: Under Alternative 9 overall potential entrainment of delta smelt would be reduced at the south Delta SWP/CVP facilities and the NBA. 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. The effect of Alternative 9 on delta smelt is considered to be beneficial due to the substantial entrainment reductions.

CEQA Conclusion**:** As described above, Alternative 9 would result in a substantial reduction in delta smelt proportional entrainment and predation loss at the south Delta facilities. The risk of entrainment and predation losses at the north Delta intake facilities is low due to low abundance of delta smelt in the vicinity, while entrainment would be minimized by fish screens. Overall, Alternative 9 would benefit delta smelt due to a substantial reduction in entrainment of delta smelt. Therefore, the impact would be beneficial and no mitigation would be required.

Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt

The effects of operations under Alternative 9 on abiotic spawning habitat would be the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning timing, would not change across Alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes.

NEPA Effects: The effect of Alternative 9 operations on spawning would not be adverse, because there would be little change in abiotic spawning conditions for delta smelt.

CEQA Conclusion**:** As described above, operations under Alternative 9 would not reduce abiotic spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the impact would be less than significant, and no mitigation would be required.

Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt

NEPA Effects: The potential effects of water operations and associated habitat restoration would be similar to those described for Alternative 8, Impact AQUA-5. Under Alternative 9, the abiotic habitat index without habitat restoration would be similar to the NAA. Habitat restoration under Alternative 9 may substantially increase the abiotic habitat index across all water year types (20–27% greater than the NAA), assuming 100% habitat use (Figure 11-9-1, Table 11-9-3).

CEQA Conclusion**:** The average delta smelt abiotic habitat index would increase under Alternative 9 without restoration (21% greater) and with restoration (53% greater) compared to Existing Conditions (Figure 11-9-1, Table 11-9-3). Overall, the impact on delta smelt rearing habitat would be beneficial because of the substantial increase in abiotic habitat under Alternative 9 even without habitat restoration actions. No mitigation would be required.

Table 11-9-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 9 and Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type

	Without Restoration		With Restoration	
Water Year	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
All	851 (21%)	-35 (-1%)	2,109 (53%)	1,224 (25%)
Wet	2,175 (46%)	-21 (0%)	4,063 (86%)	1,866 (27%)
Above Normal	1,668 (44%)	0 (0%)	3,163 (83%)	1,495 (27%)
Below Normal	-152 (-4%)	-4 (0%)	847 (20%)	995 (25%)
Dry	-215 (-6%)	-123 (-4%)	596 (17%)	687 (20%)
Critical	0 (0%)	0 (0%)	655 (22%)	655 (22%)

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

NEPA Effects: The effects of operations under Alternative 9 on turbidity and water temperature would be the same as described for Alternative 1A (Impact AQUA-6). Alternative 9 would not affect the first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta water temperatures would not change across alternatives, because they would be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes under BDCP operations. There would be no substantial change in the number of stressful or lethal condition days under Alternative 9.

Unlike the other alternatives, Alternative 9 includes 16 physical barriers that would limit movement of delta smelt, particularly the barriers in the east Delta (Middle River and Old River) and north Delta (DCC and Georgiana). The barriers may alter migration pathways for spawning adults entering the Delta from the west, and juvenile and adult smelt that would be in the east Delta and south Delta under the NAA. However, limiting some migration pathways might reduce the risk of entrainment at the south Delta facilities.

CEQA Conclusion: As described above, operations under Alternative 9 would not substantially alter the turbidity cues associated with winter flush events that may initiate migration, nor would there be appreciable changes in water temperatures. The physical barriers would limit smelt movement into suboptimal habitat regions. The impact on migrating delta smelt would be less than significant, and no mitigation would be required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through Impact AQUA-9) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt

Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta Smelt

Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to delta smelt, and most would be at least slightly beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on delta smelt are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for delta smelt under Alternative 1A (Impact AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)

Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)

Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)

Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)

Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)

Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)

Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)

Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)

Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on delta smelt for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on delta smelt, for the reasons identified for Alternative 1A, and no mitigation is required.

Longfin Smelt

Construction and Maintenance of CM1

Longfin smelt are not expected to occur in the construction areas during the in-water construction window (expected to be June through October) (see Table 11-4). While there might still be a slight risk of effects from construction activities, longfin smelt are pelagic species and are less likely to be present in the construction zones than other fish species.

Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

The potential effects of construction of water conveyance facilities on longfin smelt would be similar to but greater than those described under Alternative 1A, Impact AQUA-19. Alternative 9 would have more impact locations because of the construction of fourteen operable gates (Table 11-9-1). Alternative 9 would have two diversions at the DCC and Georgiana Slough facilities while Alternative 1A would have five intakes. There would be one less barge landing under Alternative 9 (five total) compared to Alternative 1A. Alternative 9 would have a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water construction locations the potential for noise effects is greater proportional to the increased number of sites compared to Alternative 1A. Similarly, the increased dredging will have proportionally greater effects. The effects related to temporary increases in turbidity, accidental spills, disturbance of contaminated sediments and in-water work activities 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* (*Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*) would be available to avoid and minimize potential effects. Additional details on underwater noise and the loss of spawning, rearing, or migration habitat are provided below.

Underwater Noise

Underwater sound generated by impact pile driving in or near surface waters can potentially harm longfin smelt. Potential effects on longfin smelt from impact pile driving would be similar to those described for delta smelt (see Alternative 1A, Impact AQUA-1). Because of the overall low densities of larval longfin smelt expected in all pile driving locations, the relatively low incidence of impact pile driving expected, and implementation of the avoidance and minimization measures included in Mitigation Measures AQUA-1a and AQUA-1b, the potential for longfin smelt to experience an adverse effect from impact pile driving (e.g., injury or mortality) would be very low.

Loss of Spawning, Rearing, or Migration Habitat

As described above for delta smelt in Alternative 1A, Impact AQUA-1, above, in-water construction would temporarily or permanently alter habitat conditions in the vicinity of the construction activities. As noted above, juvenile longfin smelt are not likely to occur in the construction areas during the typical in-water construction window (see Table 11-6). Most longfin smelt spawning is believed to take place in the Sacramento River near or downstream of Rio Vista, and downstream of

Medford Island on the San Joaquin River (Wang 1986). Therefore, fish passage and migration would not be affected by Alternative 9 facilities.

As described in Alternative 1A, Impact AQUA-1, there would be in-water and over-water structures at the five barge landings for several years each while the tunnel is constructed. The barge landings would each occupy approximately 15,000 square feet of shoreline habitat within their respective delta channels. Implementation of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments* (*Barge Operations Plan*) would minimize potential effects on longfin smelt habitat from construction and operations of the barge landings.

NEPA Effects: The potential effects of construction activities on longfin smelt would be similar to but greater than those described for Alternative 1A (see Impact AQUA-19) because of more construction locations. In-water construction activities would be scheduled to occur during the approved in-water work windows, when the least numbers of longfin smelt would be present in or near the construction areas. In addition, longfin smelt typically do not occur as far upstream as the construction areas. With implementation of environmental commitments, effects of construction activities on turbidity, accidental spills, onsite and offsite sediment transport to surface waters, and re-suspension and redistribution of potentially contaminated sediments would be minimized (see Impact AQUA-1 for delta smelt and 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; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*).

Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize adverse effects from impact pile driving (e.g., injury or mortality).

The effect of temporary and permanent rearing and migration habitat loss for longfin smelt would not be adverse due to the relatively small areas occupied by the construction and barge landing sites, the low abundance of longfin smelt in the vicinity of these facilities during construction, the low quality of the habitat affected by construction, and implementation of environmental commitment *Barge Operations Plan* (described under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*). Overall, potential effects on longfin smelt from construction activities would not be adverse.

CEQA Conclusion**:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as described in Alternative 1A, Impact AQUA-19, the impact of construction of the water conveyance facilities on longfin smelt would be less than significant except for construction noise associated with pile driving. There are more construction sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on delta smelt 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.

Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-20).

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-20, the effect on longfin smelt would not be adverse.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-20 for longfin smelt, the impact of the maintenance of water conveyance facilities on longfin smelt would be less than significant and 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

Under Alternative 9, Old River would no longer convey water or entrained fish to the south Delta facilities. Middle River, the new main conveyance channel to the south Delta facilities, would be screened at DCC and Georgiana Slough. These new fish screens would prevent entrainment of adult and juvenile longfin smelt but not larvae. However, spawning rarely occurs that far upstream except in very dry years, so only a very small population portion would be vulnerable.

For larval longfin smelt, entrainment risk was simulated using particle tracking modeling. Entrainment loss of longfin smelt larvae to the south Delta facilities under the wetter starting distribution was 3.1% for Alternative 9 compared to 1.6% for NAA, an 82% increase in relative terms (Table 11-9-4). Under the drier starting distribution, average entrainment was 3.3% under Alternative 9 compared to 2.2% for NAA, a 45% relative increase. Entrainment risk for larval longfin smelt to the south Delta facilities would be increased under Alternative 9 relative to NAA.

Table 11-9-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 9 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Starting Distribution	EXISTING CONDITIONS	NAA	A9_LLT	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wetter	1.9	1.6	3.1	1.22 (65%)	1.40 (82%)
Drier	2.5	2.2	3.3	0.75 (30%)	1.02 (45%)

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of longfin smelt at the north Delta would be extremely low because this species is not expected to occur this far upstream. Further, state-of-the-art fish screens on the intakes at Georgiana Slough and DCC screening would exclude juvenile and adult longfin smelt.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Overall, larval entrainment under Alternative 9 would be low, and similar compared to NAA. Average entrainment loss as modeled by PTM under the wetter starting distribution was 0.15% under Alternative 9 compared to 0.08% under NAA, an 87% relative increase (Table 11-9-5). Under the drier starting distribution, average entrainment was 0.18% under Alternative 9 compared to 0.11% under NAA, a 72% increase in relative terms. Overall, entrainment of larval longfin smelt under Alternative 9 to the NBA is expected to be low and similar to NAA.

Table 11-9-5. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct under Alternative 9 and Baseline Scenarios

	Percent Particles Entrained			Difference (and Relative Difference)	
Distribution	EXISTING CONDITIONS	NAA	A9_LLT	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wetter	0.20	0.08	0.15	-0.05 (-26.3%)	0.07 (86.7%)
Drier	0.25	0.11	0.18	-0.06 (-26.2%)	0.08 (71.5%)

In summation, under Alternative 9 potential entrainment of adult and juvenile longfin smelt would be substantially reduced at the south Delta facilities. Potential entrainment of larval longfin smelt would be slightly greater at the south Delta facilities compared to NAA and rare at the north Delta facilities as this species does not generally occur that far upstream. Larval longfin smelt entrainment at the NBA would change negligibly compared to NAA.

Predation Associated with Entrainment

Pre-screen losses of longfin smelt at the SWP/CVP facilities are believed to be high. Because the entrances to the DCC and Georgiana Slough would be screened and the Old River fish corridor would be isolated from the south Delta export pumping under Alternative 9, juvenile and adult longfin smelt entrainment to the south Delta would be decreased. Thus pre-screen predation losses at the SWP/CVP south Delta facilities would also be reduced. Predation loss at the proposed north Delta intakes would be limited because longfin smelt rarely occur that far upstream. There would potentially be predators attracted to the operable barriers intended to isolate the Old River fish migration corridor from the Middle River water conveyance corridor. Predators though are already abundant in the central and south Delta. In conclusion, the effect under Alternative 9 would not be adverse and may provide a benefit because of the likely reduction in combined entrainment and predation loss associated with the proposed operational design.

NEPA Effects: The overall effects of Alternative 9 on entrainment and entrainment-related predation of longfin smelt would be beneficial.

CEQA Conclusion**:** The results of the PTM model indicate that larval longfin smelt entrainment at the south Delta would increase about 1% relative to Existing Conditions. Larval entrainment would also increase at the NBA, but the difference would be negligible.

South Delta entrainment would be reduced under Alternative 9, thus entrainment-related predation loss would also be reduced. Predation losses at the north Delta intakes would be limited because longfin smelt rarely occur in that vicinity. There would be potential increased predation in the vicinity of the operable barriers that isolate the Old River from the Middle River, but the isolation of and the increased flows in Old River would help mitigate potential predation losses.

In conclusion, the impact for entrainment and predation loss on longfin smelt under Alternative 9 would provide a benefit because of the likely reductions in combined entrainment and predation loss.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

NEPA Effects: Predicted average relative longfin smelt abundance under Alternative 9 would be increased 6–8% relative to NAA. In wet water years, relative abundance would be increased 12–15% compared to NAA.

Table 11-9-6. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl[a]

	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
WY Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
All	-1,238 (-24%)	239 (6%)	-4,009 (-28%)	747 (8%)
Wet	-4,901 (-27%)	1,463 (12%)	-20,341 (-31%)	5,807 (15%)
Above Normal	-2,749 (-32%)	83 (1%)	-9,762 (-37%)	283 (2%)
Below Normal	-1,125 (-26%)	174 (6%)	-3,499 (-31%)	522 (7%)
Dry	-356 (-17%)	137 (8%)	-973 (-20%)	364 (10%)
Critical	-155 (-16%)	-20 (-2%)	-361 (-19%)	-47 (-3%)
	Shading indicates a relative abundance decrease of 10% or greater.			

[a] Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

During January-June, Delta outflows would be similar (<10% difference) to NAA. Longfin smelt may benefit from habitat restoration actions (CM2 and CM4), intended to provide additional food production and export to longfin smelt rearing areas. This potential benefit is not reflected in the X2-longfin smelt abundance regression.

CEQA Conclusion: Flows at Rio Vista under Alternative 9 would be similar (<10% difference) to Existing Conditions during the longfin smelt spawning period. Therefore the impact from Alternative 9 on spawning habitat would be less than significant because flow conditions would be largely similar to Existing Conditions.

In general, under Alternative 9 water operations, the quantity and quality of longfin smelt rearing habitat would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 9 (which is under LLT conditions that include future sea level rise and climate change) and Existing Conditions may therefore either overstate the effects of Alternative 9 or indicate significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 9.

Relative longfin smelt abundance averaged across all water year types would be reduced by 24–28% compared to Existing Conditions. Longfin smelt abundances would be reduced most substantially in wet (27–31%), above normal (32–37%) and below normal (26–31%) water year types. In drier water year types, longfin smelt abundance would be reduced by 16–20% compared to Existing Conditions. Delta outflows would be increased in January and February by 10%, but reduced by 15% in May and June relative to Existing Conditions. Several habitat restoration conservation measures (CM2 and CM4) may improve the quality of spawning and rearing habitat for longfin smelt by increasing suitable habitat area and food production in the Delta.

Collectively, the results of the Impact AQUA-22 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce modeled population indices of longfin smelt, contrary to the NEPA conclusion set forth above.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for longfin smelt. This impact is found to be less than significant and no mitigation is required.

In addition to the above assessment, with implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced larval entrainment would further reduce potential impacts, and could result in slightly beneficial effects.

Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of Mitigation to Reduce Impacts to Spawning and Rearing Habitat

Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts on Longfin Smelt Rearing Habitat Following Initial Operations of CM1

Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

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

Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

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)

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for longfin smelt under Alternative 1A (Impact AQUA-25 through Impact AQUA-27) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt

Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin Smelt

Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to longfin smelt, and most would be at least slightly beneficial. Specifically for AQUA-26, the effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for longfin smelt under Alternative 1A (Impact AQUA-28 through Impact AQUA-36) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)

Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt (CM13)

Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)

Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)

Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)

Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)

Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)

Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)

Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on longfin smelt for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on longfin smelt, for the reasons identified for Alternative 1A, and no mitigation is required.

Winter-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

The potential effects of construction of water conveyance facilities on Chinook salmon would be similar to but greater than Alternative 1A, Impact AQUA-37. Alternative 9 would have more impact locations because of the construction of fourteen operable gates (Table 11-9-1). Alternative 9 would have two diversions at the DCC and Georgiana Slough facilities while Alternative 1A would have five intakes. There would be one less barge landing under Alternative 9 (five total), compared to Alternative 1A. Alternative 9 would have a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water construction locations the potential for noise effects is greater proportional to the increased number of sites compared to Alternative 1A. Similarly, the increased dredging will have proportionally greater effects. The effects related to temporary increases in turbidity, accidental spills, in-water work activities and disturbance of contaminated sediments would be similar to Alternative 1A and the same environmental commitments and mitigation measures would be available to avoid and minimize potential effects (see Impact AQUA-1 and 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; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*). Additional details on underwater noise, and the loss of spawning, rearing, or migration habitat are provided below.

Underwater Noise

Underwater sound generated by impact pile driving in or near surface waters can potentially harm fish, including Chinook salmon (see Alternative 1A, Impact AQUA-1 for delta smelt). Table 11-6 illustrates the species and life stages of Chinook salmon present in the north, east, and south Delta during the in-water construction window (expected to be June 1–October 31). Winter-run Chinook salmon eggs and fry would not experience underwater sound because the construction locations are not considered suitable habitat for these two life stages of this species, and they would not be present during the in-water construction period. Therefore, these life history stages would not be affected.

Adult winter-run Chinook salmon would generally not be present near the construction areas during the in-water construction period (expected to be June 1 through October 31) except that adult migration can extend into June. Juvenile winter-run Chinook salmon would likely only occur in the north Delta area the late portion of the window (September–October).

Installation of sheet piles would occur over an 8-hour period in a day and would be quiet between sheet pile-driving events. As noted above, if all piles in a day can successfully be installed with a vibratory hammer, underwater noise would not be expected to injure salmon. Although some avoidance of the area may occur, the activity would not be expected to delay upstream or downstream migrations of salmon.

All Chinook salmon potentially present during installation of cofferdams and piles are expected to be greater than 2 grams in size; therefore, the 187-dB $SEL_{cumulative}$ injury threshold would be appropriate for Chinook salmon. Exceedance of this criterion over some distance of the river would likely be substantial if impact driving is required. As noted above, there are no effective methods to attenuate sound from impact driving of sheet pile because the sheets need to be interlaced, and individual sheets cannot be isolated. Attenuation devices could be used if impact pile driving is required for installation of individual piles, such as for the barge landings.

Table 11-10 illustrates the estimated area where the cumulative SEL threshold would be exceeded if impact pile driving is required. Table 11-11 indicates the number of days of impact driving for the various life history stages of Chinook that would be present near the pile driving sites during the June through October period assuming 5-day work weeks and impact driving being required for 30% of the days.

Adult Chinook salmon are large and have the mobility to avoid injurious exposure to underwater noise from pile driving. They may experience short delays in migration past the construction sites in the Sacramento River when pile driving is occurring; however, pile driving would occur only intermittently through 8 hours per day, and minor migration delays would not affect their ability to successfully reach spawning grounds. Therefore, the potential for adult Chinook salmon to experience an adverse effect (e.g., injury or mortality, or migratory disturbance) would be low because of their size, ability to move away from the underwater sound, and their potentially low to moderate temporal and spatial migration distribution around the facility construction areas.

Individual Chinook salmon that are present in an area affected by underwater sound from impact pile driving above the 187-dB $SEL_{cumulative}$ injury threshold level, and proximate to an impact-driven pile, could experience an adverse effect, such as injury or mortality. Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize the effects from underwater noise on Chinook salmon.

Loss of Spawning, Rearing, or Migration Habitat

As noted in Alternative 1A, Impact AQUA-1 for delta smelt, in-water construction would temporarily or permanently alter habitat conditions in the vicinity of the construction activities. Alternative 9 facilities would alter habitat as shown in Table 11-9-1. The mainstem Sacramento River and Georgiana Slough is designated as critical habitat for all runs of Chinook salmon, providing migration and rearing habitat. No suitable Chinook salmon spawning habitat is found in the vicinity of the proposed in-water work; therefore, construction would not affect Chinook salmon spawning habitat. Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible waterways and therefore would not affect Chinook salmon.

Permanent loss of Chinook salmon rearing and migration habitat would occur within the footprints of the DCC and Georgiana Slough facilities, the other operable gates, pumping stations, culvert siphons, and dredged areas.

The affected habitat associated with installation of the DCC, Georgiana Slough, and other gates is currently armored levee bank with limited riparian vegetation that has low value for salmonid rearing. However, the mainstem Sacramento River is designated as critical habitat for all runs of Chinook salmon, providing migration habitat for adult and juvenile life stages and rearing habitat for fry, presmolt, and smolt juvenile life stages. At each of the gate structures on the Sacramento River, fish screens would be installed across the channel openings. The total temporary in-water footprint area enclosed would be approximately 15.9 acres and the permanent in-water footprint area would be slightly less at about 15.5 acres (see Table 11-9-1). The armored levee bank habitat that would be permanently lost would be replaced by the fish screen structures. Some riparian trees and shrubs that currently grow on the levee banks would be lost, slightly reducing cover and shade, and the input of leaves and insects falling into the river from overhanging vegetation. However, bank armoring and lack of physical structure currently limit the quality of this habitat. Approximately 4,800 linear feet of river bank would be affected. The area dredged for channel enlargement in the Middle River and Victoria Channel totals approximately 0.5 acre.

No suitable Chinook salmon spawning habitat is found in the vicinity of the proposed in-water work; therefore, construction would not affect Chinook salmon spawning habitat. Because the habitat areas affected by construction of the Alternative 9 facilities are relatively small, and are primarily migration and poor-quality rearing habitat, the effects on Chinook salmon would not be adverse at the population level.

NEPA Effects: Overall, the effects of water conveyance facility construction under Alternative 9 on Chinook salmon are not expected to be adverse.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-37 for Chinook salmon, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. There are more construction sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on Chinook salmon 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.

Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Winter-Run ESU)

NEPA Effects: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A, Impact AQUA-38. As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse for Chinook salmon.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 9 would substantially reduce entrainment of winter-run Chinook salmon compared to NAA, due to screening at the DCC and head of Georgiana Slough, which would exclude outmigrating juvenile winter-run Chinook salmon from leaving the Sacramento River and entering the central Delta through these channels. Furthermore the Old River channel would no longer be subject to impacts from water exports at the SWP/CVP south Delta export facilities under Alternative 9, reducing the potential for entrainment loss for salmon that enter the central Delta via Three Mile Slough or the western San Joaquin River. Limited numbers of winter-run Chinook salmon juveniles would be entrained at the south Delta facilities by entering the water conveyance corridor at the mouth of the Middle River. The effect would be beneficial.

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of winter-run Chinook salmon would be minimal because the north Delta intakes at Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would be some risk of injury from impingement associated with these north Delta intakes. Overall the impact would be similar to those described for Alternative 1A, Impact AQUA-39, except there would be two 7,500 cfs screens instead of five 3,000 cfs screens. The effect would be beneficial.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Entrainment to the NBA would be the same as described for delta smelt under Alternative 1A, Impact AQUA-3.

Agricultural Diversions

Since juvenile winter-run Chinook salmon would be prevented from entering the interior Delta via state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be exposed to entrainment loss to agricultural diversions in the central Delta. The effect would not be adverse.

Predation Associated with Entrainment

Under Alternative 9, predation related to water operations would include changes in predation risk at the south Delta facilities (particularly CCF). Chinook salmon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Because substantially fewer fish would be entrained to the CCF and SWP facilities due to the screened intakes located on the DCC and Georgiana Sloughs and numerous operable barriers limiting fish movement into conveyance channels, predation loss at the south Delta facilities would be substantially decreased under Alternative 9.

NEPA Effects: The overall effect on entrainment and entrainment-related predation of Chinook salmon under Alternative 9 would be beneficial.

CEQA Conclusion**:** Entrainment loss would be reduced at the south Delta facilities because the north Delta intakes at the entrances to the DCC and Georgiana Slough would be screened, preventing juvenile winter-run salmon migrating down the Sacramento River from entering the designated water conveyance corridor. Furthermore the north Delta screens would prevent salmon from entering the interior Delta, thus reducing entrainment risk to Delta agricultural diversions. Entrainment to the NBA dual conveyance system would be the same as described for Alternative 1A. Because south Delta entrainment would be reduced, pre-screen predation loss would also be reduced. Predation loss at the north Delta intakes would be minor, representing less than 0.2% of the winter-run juvenile Chinook salmon population.

Overall, the impact of water operations on winter-run Chinook salmon would be beneficial because of the reduction in entrainment and pre-screen predation loss at the south Delta facilities. 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 9 would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to the 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 A9_LLT throughout the period would nearly always be similar to or greater than flows under NAA, except in above normal years during August (7% lower for both locations). These results indicate that there would be no biologically meaningful flow-related effects of Alternative 9 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 A9_LLT would be similar to storage under NAA for all water year types (Table 11-9-7).

Table 11-9-7. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-37 (-1%)	-3 (-0.1%)
Above Normal	-86 (-2%)	0 (0%)
Below Normal	-249 (-6%)	-51 (-1%)
Dry	-559 (-15%)	-115 (-3%)
Critical	-592 (-24%)	-8 (-0.4%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run 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 9 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-10. There would be no difference in levels of concern between NAA and Alternative 9.

Table 11-9-8. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided by NMFS and Used in the BDCP Effects Analysis

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
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
Feather River			
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
American River			
Watt Avenue Bridge	May–Oct	65	Juvenile steelhead rearing

Table 11-9-9. Number of Days per Month Required to Trigger Each Level of Concern for Water Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided 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

Table 11-9-10. Differences between Baseline and Alternative 9 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern[a]	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
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.

[a] For definitions of levels of concern, see Table 11-9-9.

Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type during May through September (Table 11-9-11). Total degree-days under Alternative 9 would be up to 6% lower than under NAA during May and September and up to 7% higher during June through August.

Table 11-9-11. Differences between Baseline and Alternative 9 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 Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	1,192 (316%)	-10 (-1%)
	Above Normal	356 (167%)	1 (0%)
	Below Normal	479 (219%)	16 (2%)
	Dry	152 (82%)	-262 (-44%)
	Critical	420 (190%)	10 (2%)
	All	2,600 (214%)	-244 (-6%)
June	Wet	769 (200%)	58 (5%)
	Above Normal	214 (145%)	-15 (-4%)
	Below Normal	382 (275%)	30 (6%)
	Dry	603 (321%)	69 (10%)
	Critical	625 (156%)	75 (8%)
	All	2,594 (206%)	218 (6%)
July	Wet	686 (132%)	80 (7%)
	Above Normal	296 (365%)	26 (7%)
	Below Normal	554 (377%)	98 (16%)
	Dry	1,184 (420%)	256 (21%)
	Critical	1,725 (209%)	-61 (-2.3%)
	All	4,444 (240%)	398 (7%)
August	Wet	2,050 (294%)	87 (3%)
	Above Normal	781 (191%)	122 (11%)
	Below Normal	1,106 (417%)	71 (5%)
	Dry	1,719 (257%)	109 (5%)
	Critical	2,482 (167%)	-137 (-3%)
	All	8,138 (231%)	251 (2%)
September	Wet	550 (75%)	-159 (-11%)
	Above Normal	371 (52%)	-29 (-3%)
	Below Normal	1,088 (146%)	-58 (-3%)
	Dry	2,604 (204%)	8 (0%)
	Critical	1,914 (92%)	23 (1%)
	All	6,530 (118%)	-215 (-2%)

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be similar to or lower than mortality under NAA except in below normal and dry water years (30% and 7%, respectively), although the absolute increase in these water years would be only 1% (Table 11-9-12). Therefore, the increase in mortality from NAA to A9_LLT, although relatively large, would be negligible at an absolute scale to the winter-run population.

Table 11-9-12. 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. A9_LLT	NAA vs. A9_LLT
Wet	1 (289%)	0.05 (3%)
Above Normal	2 (348%)	-0.03 (-1%)
Below Normal	1 (142%)	1 (30%)
Dry	6 (416%)	1 (7%)
Critical	39 (145%)	-5 (-7%)
All	8 (171%)	-0.5 (-4%)

SacEFT predicts that the percentages of years with good spawning availability, measured as weighted usable area, and redd scour risk under A9_LLT would be identical to those under NAA (Table 11-9-13). SacEFT predicts that the percentage of years with good egg incubation conditions under A9_LLT would be 7% lower (5% on an absolute scale) than under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A9_LLT would be similar to NAA. These results indicate that there would be no biologically meaningful effects of Alternative 9 on spawning or egg incubation habitat.

Table 11-9-13. 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. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-26 (-45%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-28 (-29%)	-5 (-7%)
Redd Dewatering Risk	3 (12%)	-1 (-3%)
Juvenile Rearing WUA	-21 (-42%)	4 (16%)
Juvenile Stranding Risk	11 (55%)	0 (0%)

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 not be adverse because it does not have the potential to substantially reduce suitable spawning or egg incubation habitat. There are no effects that would cause biologically meaningful effects to the winter-run population.

CEQA Conclusion**:** In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). On both Sacramento River locations, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, with few exceptions (up to 27% lower).

Shasta Reservoir storage volume at the end of May under A9_LLT would be similar to Existing Conditions in wet and above normal water years and lower than storage volume under Existing

Conditions in below normal, dry, and critical water years (6%, 15%, and 24% lower, respectively) (Table 11-9-7). This indicates that there would be a small to moderate effect of Alternative 9 on flows during the spawning and egg incubation period.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the May through September winter-run 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 Existing Conditions and Alternative 9 during June. Mean monthly water temperature would be up to 11% higher under Alternative 9 in May and July through September depending on month, water year type, and location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. The number of years classified as "red" would increase by 67% under Alternative 9 relative to Existing Conditions (Table 11-9-10).

Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type during May through September (Table 11-9-11). Total degree-days under Alternative 9 would be up to 240% higher than under Existing Conditions during May through September. The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 142% to 416% greater than mortality under Existing Conditions depending on water year type (Table 11-9-12). However, only in dry (6% higher) and critical (39% higher) years would the increase be >5% of the winter-run population and, therefore, biologically meaningful. These results indicate that Alternative 9 would cause increased winter-run Chinook salmon mortality in the Sacramento River in drier years.

SacEFT predicts that there would be a 45% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-13). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A9_LLT would be identical to the percentage of years under Existing Conditions. SacEFT predicts that the percentage of years with good egg incubation conditions under A9_LLT would be 29% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A9_LLT would be 12% greater than the percentage of years under Existing Conditions. These results indicate that Alternative 9 would cause small to moderate reductions in spawning WUA and egg incubation conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Egg mortality (according to the Reclamation egg mortality model) in drier years, during which winter-run Chinook salmon would already be stressed due to reduced flows and increased temperatures, would be up to 39% greater due to Alternative 9 compared to the Existing Conditions (Table 11-9-12). Egg incubation conditions according to the SacEFT model are predicted to be 29% lower than under Existing Conditions. Further, the extent of spawning habitat would be 45% lower due to

Alternative 9 compared to Existing Conditions (Table 11-9-13), which represents a substantial reduction in spawning habitat and, therefore, in adult spawning and redd carrying capacity.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Winter-Run ESU)

In general, Alternative 9 would not affect the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to the NAA.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing habitat. Flows under A9_LLT would generally be similar to or greater than flows under NAA, except during the month of October (up to 13% lower) and in above normal years during August (7% lower).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run juvenile rearing 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 9 in any month or water year type throughout the period at either location. SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A9_LLT would be 16% greater than the percentage of years under NAA (Table 11-9-12). The percentage of years with good (low) juvenile stranding risk under A9_LLT is predicted to be similar to that the percentage under NAA. These results indicate that the quantity of juvenile rearing habitat in the Sacramento River would be higher under A9_LLT relative to NAA, and habitat quality would be similar to conditions under NAA.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A9_LLT would be 5% higher than under NAA.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Differences in flows are generally small and inconsistent among months and water year types. In addition, effects on juvenile stranding risk are negligible.

CEQA Conclusion**:** In general, Alternative 9 would not reduce the quantity and quality of rearing habitat for fry and juvenile winter-run Chinook salmon relative to Existing Conditions.

Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, with some exceptions (up to 25% lower).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the August through December winter-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 9 in August through October depending on month, water year type, and location, and up to 5% higher during November and December at Bend Bridge.

SacEFT predicts that the percentage of years with good juvenile rearing habitat availability, measured as weighted usable area, under A9_LLT would be 42% lower than under Existing Conditions (Table 11-9-13). In addition, the percentage of years with good (low) juvenile stranding risk under A9_LLT is predicted to be greater than under Existing Conditions. This indicates that the quantity of juvenile rearing habitat in the Sacramento River would be lower under A9_LLT relative to Existing Conditions, but the quality juvenile rearing habitat would improve.

SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A9_LLT would be 20% higher than under Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Although flows are generally comparable between Alt 9 and Existing Conditions, there would be a large reduction in predicted rearing habitat extent according to SacEFT (Table 11-9-13). Further, habitat-related mortality would be 20% greater under Alt 9 relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water

demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on juvenile rearing habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon (Winter-Run ESU)

In general, Alternative 9 would not affect migration conditions for juvenile winter-run Chinook salmon relative to the NAA.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined for the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). A reduction in flow may reduce the ability of juvenile winter-run to migrate effectively down the Sacramento River. Flows under A9_LLT would generally be similar to flows under NAA throughout the period, except during October, in which flows would be up to 13% lower depending on water year type.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration 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 9 in any month or water year type throughout the period at either location.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August). A reduction in flows may reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the upper Sacramento River. Flows under A9_LLT would generally be similar to or greater than those under NAA with few exceptions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 9 in any month or water year type throughout the period at either location.

Through-Delta

Juveniles

Fish screens at the DCC and Georgiana Slough would improve survival of outmigrating winter-run juveniles by preventing straying into the interior Delta. Studies of acoustic tagged smolts found lower survival on the longer interior Delta migration route (Perry et al. 2010).

During the juvenile winter-run Chinook salmon emigration period (November to early May), mean monthly flows in the Sacramento River at Rio Vista under Alternative 9 would be similar (<5% difference) averaged across years compared to NAA during most months, and slightly reduced (6% to 7% decrease) in April and May. Flows would be reduced up to 17% and 18% in April of dry and below normal years.

The fish screens to be constructed at the mouths of the DCC and Georgiana Slough may attract piscivorous fish around these structures. By way of comparison, potential predation losses for Alternative 5, which has one longer intake for the north Delta diversion facility ranged from 0.3% up to 4% of the annual winter-run production from the Sacramento River basin (see Impact AQUA-42 for Alternative 5). Potential predation losses for Alternative 9 would be minimal by comparison, given the less extensive screen.

Fourteen new operable barriers would be installed as part of Alternative 9 at various locations in the Delta such as the San Joaquin River downstream of Old River, Middle River, Woodward Cut, Railroad Cut, Connection Slough and at the mouth of Old River. There is the risk of predatory fish aggregating at these locations and preying on juvenile salmonids as they migrate past. However, predators are already abundant in the south and central regions of the Delta, so the effect of adding the new structures would have to be determined. Under Alternative 9, increased flows in the Old River channel would increase salmon migration speed and reduce exposure to many of these structures and any associated predators.

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon as modeled by the DPM would average 36% across all years, 49% in wetter years and 29% in drier years compared to NAA (Table 11-9-14). Juvenile survival would increase slightly by 2.4% across all years (a 7% relative increase). Overall, Alternative 9 would not have an adverse effect on winter-run Chinook salmon juvenile survival due to minor differences in survival across all water years.

Table 11-9-14. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 9

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wetter Years	46.3	46.1	48.6	2.2 (5%)	-.06 (-1%)
Drier Years	28.0	27.1	29.0	1.0 (4%)	11.1 (-4%)
All Years	34.9	34.2	36.3	1.5 (4%)	-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

The proportion of Sacramento River flows at Collinsville decreased less than 10% under Alternative 9 during the December through June migration period for winter-run adults (Table 11-9-15). Sacramento River flows would still represent 59–65% of flows during the adult winter-run migration period. Therefore it is expected that olfactory cues would be adequate and not substantially affected by flow operations under Alternative 9.

Overall the impact would not be adverse.

Table 11-9-15. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Chinook Migration Period for Alternative 9

Month	EXISTING CONDITIONS	NAA	A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River					
September	60	65	60	0	-5
October	60	68	59	-1	-9
November	60	66	57	-3	-9
December	67	66	59	-8	-7
January	76	75	65	-11	-10
February	75	72	63	-12	-9
March	78	76	66	-12	-10
April	77	75	64	-13	-9
May	69	65	57	-12	-10
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	3.9	3.6	3.8
October	0.2	0.3	6.2	6.0	5.9
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.0	5.1	5.0
January	1.6	1.7	7.3	5.7	5.6
February	1.4	1.5	8.2	6.8	6.7
March	2.6	2.8	8.9	6.3	6.1
April	6.3	6.6	14.2	7.9	7.6
	Shading indicates 10% or greater absolute difference.				

NEPA Effects: Collectively, these results indicate that Alternative 9 operations would not adversely affect upstream or through-Delta migration conditions. Due to similarities in migration flows and water temperatures between Alternative 9 and the NAA, upstream habitat and movement conditions are not substantially reduced, for juvenile or adult winter-run Chinook salmon. Through-Delta juvenile survival under Alternative 9, would be similar to NAA, averaged across all years. Despite minor reduction is through-Delta flows, during the adult migration period, the olfactory cues would be adequate and not substantially affected by flow operations under Alternative 9.

CEQA Conclusion: In general, Alternative 9 would not affect migration conditions for winter-run Chinook salmon relative to Existing Conditions.

Upstream of the Delta

Flows in the Sacramento River upstream of Red Bluff were examined during the July through November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. Flows under A9_LLT for juvenile migrants would nearly always be similar to or greater than flows under Existing Conditions, except during November, in which flows would be up to 22% greater depending on water year type.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the July through November winter-run juvenile emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 9 in July through October depending on month, water year type, and location. There would be a 5% increase in mean monthly water temperature between Existing Conditions and Alternative 9 during November of below normal years at Bend Bridge.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run Chinook salmon upstream migration period (December through August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*. Flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions with few exceptions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the December through August winter-run upstream migration 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 Existing Conditions and Alternative 9 during December through June, except for a 5% increase under Alternative 9 in May of wet years at Bend Bridge. Mean monthly water temperature would be up to 13% higher under Alternative 9 in July through August depending on month, water year type, and location

Through-Delta

Juveniles

As described above, through-Delta survival by emigrating juvenile winter-run Chinook salmon would increase slightly averaged across all water years (1.8% greater survival, a 5% relative increase) compared to Existing Conditions (Table 11-9-14). Juveniles may also encounter increased predation risk at the two screens in the north Delta and at the fourteen new operable barriers at various locations, but the overall effect of this predation would not likely be significant compared to Existing Conditions.

Adults

Attraction flows for migrating adult winter-run Chinook salmon, as measured as the proportion of Sacramento River flows at Collinsville from December to June, would decrease 6-13% compared to Existing Conditions. Since Sacramento River flows would still constitute a large proportion (57% to 6%) of the total flows at Collinsville, Alternative 9 is not expected to significantly affect upstream migration. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-42 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, when compared to the CEQA baseline, the alternative could substantially reduce migration habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects in Alternative 9. Water temperatures in the Sacramento River would be higher during a large portion of juvenile winter-run migration period. There would be minimal effect on through-Delta migration and survival.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow and reservoir storage outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-43 through Impact AQUA-45) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Winter-Run ESU)

Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run ESU)

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to winter-run Chinook salmon, and most would be at least slightly beneficial. Specifically for AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-46 through Impact AQUA-54) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run ESU) (CM12)

Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Winter-Run ESU) (CM13)

Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-Run ESU) (CM14)

Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Winter-Run ESU) (CM15)

Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU) (CM16)

Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU) (CM17)

Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU) (CM18)

Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run ESU) (CM19)

Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Winter-Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Spring-Run Chinook Salmon

Construction and Maintenance of CM1

Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

The construction-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs and would be the same as those described for winter-run Chinook salmon under Alternative 9, Impact AQUA-37. This conclusion also applies to juvenile spring-run Chinook that would be present in early June to August and would potentially be affected by construction activities.

NEPA Effects: As concluded under Alternative 9, Impact AQUA-37, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Chinook salmon.

CEQA Conclusion**:** As described in Alternative 9, Impact AQUA-37, for winter-run Chinook salmon, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. There are more construction sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on winter-run Chinook salmon 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.

Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

The maintenance-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs and would be the same as those described for winter-run Chinook salmon under Alternative 9, Impact AQUA-38.

NEPA Effects: As concluded under Alternative 9, Impact AQUA-38 for winter-run Chinook salmon, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 9 would substantially reduce entrainment of spring-run Chinook salmon compared to the NAA, due to screening of the DCC and Georgiana intakes. Furthermore the Old River channel would no longer be subject to impacts from water exports at the SWP/CVP south Delta facilities under Alternative 9, reducing the potential for entrainment loss. Limited numbers of spring-run Chinook salmon juveniles would be entrained at the south Delta facilities by entering the water conveyance corridor at the mouth of the Middle River.

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of spring-run Chinook salmon would be minimal because the north Delta intakes at Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would still be a risk of injury from impingement associated with these north Delta intakes. Overall the impact would be similar to those described for Alternative 1A, Impact AQUA-57.

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.

Delta Agricultural Diversions

Since juvenile spring-run Chinook salmon would be prevented from entering the interior Delta via state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be exposed to entrainment loss to agricultural diversions in the Delta.

Predation Associated with Entrainment

The effects of predation associated with entrainment would be the same for all four ESUs. Please refer to the discussion of predation for winter-run Chinook salmon under Alternative 9 (Impact AQUA-39). As discussed for Impact AQUA-39, the effect on Chinook salmon would not be adverse.

NEPA Effects: Overall, the effects of entrainment and entrainment-related predation would be beneficial for spring-run Chinook salmon.

CEQA Conclusion**:** Entrainment loss would be reduced at the south Delta facilities because the north Delta intakes at the entrances to the DCC and Georgiana Slough would be screened, preventing juvenile spring-run salmon migrating down the Sacramento River from entering the designated water conveyance corridor. Furthermore the north Delta screens would prevent salmon from entering the interior Delta, thus reducing entrainment risk to Delta agricultural diversions. Entrainment to the NBA dual conveyance system would be the same as described for Alternative 1A. Because south Delta entrainment would be reduced, pre-screen predation loss would also be reduced. Predation loss at the north Delta intakes would be minor, representing about 0.2% of the spring-run juvenile Chinook salmon population.

Overall, the impact of water operations on spring-run Chinook salmon would be beneficial significant because of the reduction in entrainment and pre-screen predation loss at the south Delta facilities. No mitigation would be required.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 9 would not affect spawning and egg incubation habitat for spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon spawning and incubation period (September through January) under A9_LLT would generally be similar to or greater than those under NAA, except during October (up to 13% lower) and dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir storage volume at the end of September influences flows downstream of the dam during the spring-run spawning and egg incubation period (September through January). Storage volume at the end of September would be similar to storage under NAA in all water year types (Table 11-9-16).

Table 11-9-16. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Shasta Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-537 (-16%)	-25 (-1%)
Above Normal	-568 (-18%)	47 (2%)
Below Normal	-334 (-12%)	20 (1%)
Dry	-537 (-22%)	-26 (-1%)
Critical	-407 (-34%)	-25 (-3%)

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon 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 9 in any month or water year type throughout the period at either location.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-10 for Bend Bridge and in Table 11-9-17 for Red Bluff. There would be no difference in levels of concern between NAA and Alternative 9 at Bend Bridge. At Red Bluff, there would be 4 (24%) more years and 3 (33%) fewer years with an “orange” and “yellow” level of concern, respectively, under Alternative 9.

Table 11-9-17. Differences between Baseline and Alternative 9 Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Red Bluff, October through April

Level of Concern[a]	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Red	36 (300%)	0 (0%)
Orange	11 (183%)	4 (24%)
Yellow	-4 (-31%)	-3 (-33%)
None	-43 (-84%)	-1 (-13%)

[a] For definitions of levels of concern, see Table 11-9-9.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 9 would be up to 6% lower than those under NAA during May and September and up to 7% higher during June through August (Table 11-9-11). At Red Bluff, total degree-days under Alternative 9 would be similar to those under NAA during all months from October through April (Table 11-9-18).

Table 11-9-18. Differences between Baseline and Alternative 9 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. A9_LLT	NAA vs. A9_LLT
October	Wet	1,172 (456%)	3 (0%)
	Above Normal	545 (210%)	68 (9%)
	Below Normal	653 (312%)	-53 (-6%)
	Dry	1,086 (221%)	15 (1%)
	Critical	979 (163%)	56 (4%)
	All	4,435 (244%)	89 (1%)
November	Wet	87 (8,700%)	-3 (-3%)
	Above Normal	62 (NA)	1 (2%)
	Below Normal	36 (NA)	-12 (-25%)
	Dry	163 (2,038%)	12 (8%)
	Critical	112 (2,800%)	2 (2%)
	All	460 (3,538%)	0 (0%)
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	19 (211%)	-2 (-7%)
	Dry	64 (457%)	0 (0%)
	Critical	27 (2,700%)	0 (0%)
	All	124 (517%)	-1 (-1%)
April	Wet	265 (230%)	4 (1%)
	Above Normal	206 (147%)	-23 (-6%)
	Below Normal	253 (320%)	23 (7%)
	Dry	336 (181%)	16 (3%)
	Critical	153 (1,275%)	2 (1%)
	All	1,213 (228%)	22 (1%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be similar to (<5% on an absolute scale) mortality under NAA in all water years (Table 11-9-19).

Table 11-9-19. 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. A9_LLT	NAA vs. A9_LLT
Wet	15 (149%)	0.4 (1%)
Above Normal	19 (146%)	-2 (-7%)
Below Normal	27 (227%)	-2 (-6%)
Dry	55 (277%)	-2 (-3%)
Critical	25 (34%)	3 (3%)
All	28 (125%)	-1 (-1%)

SacEFT predicts that there would be an 11% decrease in the percentage of years with good spawning availability, measured as weighted usable area, there would be no difference between A9_LLT and NAA (Table 11-9-20). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A9_LLT relative to NAA. SacEFT predicts no difference in the percentage of years with good (lower) egg incubation conditions under A9_LLT relative to NAA. SacEFT predicts that there would be a 9% increase in the percentage of years with good (lower) redd dewatering risk between A9_LLT, relative to NAA.

Table 11-9-20. 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. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-52 (-60%)	0 (0%)
Redd Dewatering Risk	-12 (-24%)	3 (9%)
Juvenile Rearing WUA	-2 (-9%)	-2 (-9%)
Juvenile Stranding Risk	-8 (-42%)	-3 (-21%)

WUA = Weighted Usable Area.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A9_LLT would nearly always be similar to or greater than flows under NAA throughout the spring-run spawning and egg incubation period, except in critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A9_LLT would be the same or of lower magnitude than that under NAA in all water year types (Table 11-9-21).

Water temperatures were not modeled in Clear Creek.

Table 11-9-21. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	66 (99%)	99 (99%)

NA = could not be calculated because the denominator was 0.

[a] 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.

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) where spring-run Chinook primarily spawn during September through January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_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.

Oroville Reservoir storage volume at the end of September influence flows downstream of the dam during the spring-run spawning and egg incubation period. Storage volume at the end of September would be similar to storage under NAA in all water year types. (Table 11-9-22). This indicates that the majority of reduction in storage volume would be due to climate change rather than Alternative 9.

Table 11-9-22. Difference and Percent Difference in September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-1,017 (-35%)	-3 (-0.2%)
Above Normal	-816 (-34%)	-25 (-2%)
Below Normal	-605 (-30%)	4 (0.3%)
Dry	-337 (-25%)	16 (2%)
Critical	-202 (-21%)	-14 (-2%)

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month over the egg incubation period compared to the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel during October through January were identical between A9_LLT and NAA (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). Therefore, there would be no effect of Alternative 9 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 9 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 11-9-23). The percent of months exceeding the threshold under Alternative 9 would generally be lower (up to 11% lower on an absolute scale) than the percent under NAA during September through November and similar during the other two months.

Table 11-9-23. Differences between Baseline and Alternative 9 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
September	0 (0%)	0 (0%)	6 (7%)	21 (29%)	31 (76%)
October	54 (244%)	56 (750%)	43 (700%)	41 (1,650%)	35 (1,400%)
November	64 (2,600%)	56 (4,500%)	38 (3,100%)	30 (NA)	16 (NA)
December	2 (NA)	1 (NA)	1 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A9_LLT					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-2 (-3%)	-11 (-13%)
October	-10 (-11%)	-2 (-4%)	-6 (-11%)	-6 (-13%)	-2 (-6%)
November	0 (0%)	-2 (-4%)	-10 (-20%)	-2 (-8%)	-9 (-35%)
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.

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 11-9-24). Total degree-months would be similar between NAA and Alternative 9 during all months of the period.

Table 11-9-24. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, September through January

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
September	Wet	21 (19%)	-4 (-3%)
	Above Normal	13 (30%)	3 (6%)
	Below Normal	29 (48%)	-2 (-2%)
	Dry	85 (123%)	-3 (-2%)
	Critical	63 (97%)	1 (1%)
	All	211 (61%)	-5 (-1%)
October	Wet	89 (1,780%)	-7 (-7%)
	Above Normal	37 (370%)	2 (4%)
	Below Normal	50 (714%)	-4 (-7%)
	Dry	80 (1,143%)	0 (0%)
	Critical	47 (588%)	6 (12%)
	All	303 (819%)	-3 (-1%)
November	Wet	59 (NA)	3 (5%)
	Above Normal	29 (967%)	4 (14%)
	Below Normal	32 (3,200%)	-2 (-6%)
	Dry	49 (NA)	-2 (-4%)
	Critical	31 (NA)	3 (11%)
	All	201 (5,025%)	7 (4%)
December	Wet	1 (NA)	0 (0%)
	Above Normal	2 (NA)	1 (100%)
	Below Normal	4 (NA)	1 (33%)
	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.

NEPA Effects: Based on these results, it is concluded that the effect would not be adverse because habitat would not be substantially reduced. There would be negligible effects of Alternative 9 on reservoir storage, instream flows, and water temperatures in all rivers evaluated.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation habitat for spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows during September would generally be greater than or similar to those under Existing Conditions, except in dry and critical years during September (25% and 18% lower, respectively), above normal and critical years during October (10% and 11% lower, respectively), and wet years during December (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Shasta Reservoir storage volume at the end of September would be 12% to 34% lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the September through January spring-run Chinook salmon spawning period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 9 during September and October would be 6% greater than those under Existing Conditions, but not different in other months during the period. At Red Bluff, temperatures under Alternative 9 during October would be 5% greater than those under Existing Conditions, but would not be different in other months during the period.

The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September At Bend Bridge and October through April at Red Bluff) and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-10 for Bend Bridge and in Table 11-9-17 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years with a "red" level of concern under Alternative 9 relative to Existing Conditions. At Red Bluff, there would be 300% and 183% increases in the number of years with "red" and "orange" levels of concern under Alternative 9 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge during May through September and at Red Bluff during October through April. At Bend Bridge, total degree-days under Alternative 9 would be up to 118% to 240% higher than those under Existing Conditions depending on the month (Table 11-9-11). At Red Bluff, total degree-days under Alternative 9 would be 228% to 3,538% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-9-18).

The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 34% to 277% greater than mortality under Existing Conditions, depending on water year type (Table 11-9-19).

SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-20). SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 60% decrease in the percentage of years with good (lower) egg incubation conditions under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 24% decrease in the percentage of years with good (lower) redd dewatering risk under A9_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation conditions for spring-run Chinook salmon under A9_LLT would be poor relative to Existing Conditions.

Clear Creek

Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period (September through January) under A9_LLT would generally be similar to or greater than flows under Existing Conditions, except in critical years during September and November (38% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

The potential risk of spring-run Chinook salmon 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 reduction in flows under A9_LLT would be similar to or lower magnitude than that under Existing Conditions, except in above normal water years (27 and 67 cfs lower, respectively) (Table 11-9-21).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River low-flow channel under A9_LLT are not different from Existing Conditions during the spring-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

Oroville Reservoir storage volume at the end of September would be 21% to 35% lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-22).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during October through January were identical between A9_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 9 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*). Temperatures under Alternative 9 would be 7% to 10% greater than those under Existing Conditions in all months during the period except September.

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 11-9-23). The percent of months exceeding the threshold under Alternative 9 would be similar to or up to 64% higher (absolute scale) than under Existing Conditions during September through November. There would be almost no difference in the percent of months exceeding the threshold between Existing Conditions and Alternative 9 during December and January.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during September through January (Table 11-9-24). Total degree-months exceeding the threshold under Alternative 9 would be 61% to 5,052% greater than those under Existing Conditions during September through November. There would be essentially no difference in total degree-months between Existing Conditions and Alternative 9 during December and January.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth above. There would be increases in reservoir storage, instream flows, and water temperatures in the Sacramento and Feather Rivers under Alternative 9 that would have substantial effects on spring-run spawning and egg incubation conditions. SacEFT and the Reclamation egg mortality model predict reductions in habitat conditions and survival under Alternative 9. Flow reductions in Clear Creek under Alternative 9 would increase the risk of redd dewatering there.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows and reservoir storage in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-Run ESU)

In general, Alternative 9 would not affect the quantity and quality of rearing habitat for fry and juvenile spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than those under NAA throughout the period.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the November through March spring-run Chinook salmon juvenile rearing 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 9 in any month or water year type throughout the period at either location. As reported in Impact AQUA-40, May Shasta storage volume under A9_LLT would be similar to storage under NAA for all water year types (Table 11-9-7).

As reported in Impact AQUA-58, September Shasta storage volume under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-16).

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A9_LLT would be lower than that under NAA (9% lower) (Table 11-9-20). The percentage of years with good (lower) juvenile stranding risk conditions under A9_LLT would be 21% lower than under NAA. Both correspond to negligible absolute values; thus, there would be no effects on juvenile rearing habitat predicted by SacEFT.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A9_LLT would be 7% greater under A9_LLT than that under NAA.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A9_LLT would generally be similar to or greater than flows under NAA, except for a 6% decrease for below normal years in March(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during November through June were reviewed to determine flow-related effects on larval and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A9_LLT would not differ from those under NAA. In the high-flow channel, flows under A9_LLT would be mostly similar to or greater than flows under NAA during November through June, with some exceptions (up to 22% lower).

May Oroville storage under A9_LLT would be similar to storage under NAA in all water year types, indicating that the difference relative to NAA is primarily a result of climate change (Table 11-9-25).

As reported in Impact AQUA-58, September Oroville storage volume would be similar to storage under NAA in all water year types (Table 11-9-22).

Table 11-9-25. Difference and Percent Difference in May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-57 (-2%)	-11 (0%)
Above Normal	-184 (-5%)	-28 (-1%)
Below Normal	-380 (-12%)	-27 (-1%)
Dry	-560 (-20%)	-40 (-2%)
Critical	-351 (-19%)	-35 (-2%)

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during November through June (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 9 in any month or water year type throughout the period at either location.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-9-26). The percent of months exceeding the threshold under Alternative 9 would generally be similar to or lower (up to 16% lower on an absolute scale) than the percent under NAA.

Table 11-9-26. Differences between Baseline and Alternative 9 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 63°F Threshold, May through August

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
May	4 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
June	27 (49%)	35 (127%)	31 (625%)	12 (NA)	4 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	44 (113%)
August	0 (0%)	12 (14%)	35 (60%)	44 (157%)	33 (338%)
NAA vs. A9_LLT					
May	-2 (-40%)	-2 (-100%)	-1 (-100%)	0 (NA)	0 (NA)
June	-6 (-7%)	-16 (-21%)	-11 (-24%)	-9 (-41%)	-1 (-25%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-10 (-11%)
August	0 (0%)	0 (0%)	-6 (-6%)	-9 (-11%)	-14 (-24%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-9-27). Total degree-months under Alternative 9 would be similar to or slightly lower than those under NAA depending on the month.

Table 11-9-27. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Feather River above Thermalito Afterbay, May through August

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	3 (NA)	-1 (-25%)
	All	6 (NA)	-2 (-25%)
June	Wet	30 (200%)	1 (2%)
	Above Normal	17 (121%)	0 (0%)
	Below Normal	23 (177%)	1 (3%)
	Dry	31 (135%)	-2 (-4%)
	Critical	24 (400%)	-1 (-3%)
	All	124 (175%)	-2 (-1%)
July	Wet	42 (35%)	1 (1%)
	Above Normal	19 (43%)	-1 (-2%)
	Below Normal	26 (44%)	-2 (-2%)
	Dry	35 (49%)	-1 (-1%)
	Critical	34 (65%)	2 (2%)
	All	157 (45%)	0 (0%)
August	Wet	35 (39%)	2 (2%)
	Above Normal	18 (72%)	0 (0%)
	Below Normal	28 (74%)	-1 (-1%)
	Dry	50 (125%)	-3 (-3%)
	Critical	36 (86%)	-4 (-5%)
	All	167 (71%)	-6 (-2%)

NA = could not be calculated because the denominator was 0.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because habitat would not be substantially reduced. There would be negligible effects of Alternative 9 on reservoir storage, instream flows, and water temperatures in all rivers evaluated.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of rearing habitat for spring-run Chinook salmon relative to Existing Conditions.

Sacramento River

Flows were evaluated during the November through March larval and juvenile spring-run Chinook salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during December were generally lower by up to 15% under A9_LLT than under Existing Conditions. Flows under A9_LLT during the remaining 4 months of the rearing period would be generally similar to or up to 28% greater than those under Existing Conditions, except in March of below normal years, when they were 20% lower.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the November through March spring-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 9.

SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under A9_LLT would be 9% lower than that under Existing Conditions (Table 11-9-20). The percentage of years with good (lower) juvenile stranding risk conditions under A9_LLT would be 42% lower than under Existing Conditions.

SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A9_LLT would be 28% lower than under Existing Conditions.

Clear Creek

Flows in Clear Creek during the November through March rearing period under A9_LLT would generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not model in Clear Creek.

Feather River

Relatively constant flows in the low-flow channel throughout this period under A9_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A9_LLT would generally be lower (up to 55% lower) during October through February, and generally similar to or greater than flows under Existing Conditions during the rest of the year, with some exceptions (up to 56% lower).

May Oroville storage volume under A9_LLT would be similar to Existing Conditions in wet years and 5% to 20% lower than Existing Conditions in all other water year types (Table 11-9-25).

As reported in Impact AQUA-58, September Oroville storage volume would be 21% to 35% lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-22).

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were evaluated during the November through June juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 9 would be 5% to 11% greater than those under Existing Conditions during November through March, but similar (<5% difference) during April through June.

The percent of months exceeding the 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-9-26). The percent of months exceeding the threshold under Alternative 9 would be similar to those under Existing Conditions during May, but up to 20% greater during June through August.

Total degree-months exceeding 63°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during May through August (Table 11-9-27). Total degree-months under Alternative 9 would be similar to those under Existing Conditions during May, but 45% to 175% higher during June through August.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat. Reservoir storage in the Feather River and flows in the high-flow channel would be lower and water temperatures would be higher under Alternative 9. Year-round flows and water temperatures in Clear Creek, the Sacramento River, and the low-flow channel of the Feather River would be similar between Existing Conditions and Alternative 9. However, juvenile stranding in the Sacramento River is predicted to be higher under Alternative 9 by SacEFT.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on fry and juvenile rearing habitat for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon (Spring-Run ESU)

Upstream of the Delta

In general, Alternative 9 would not affect migration conditions for spring-run Chinook salmon relative to the NAA.

Sacramento River

Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through May juvenile Chinook salmon spring-run migration period. Flows under A9_LLT during December through May would nearly always be similar to or greater than flows under NAA except in dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT during April through August would nearly always be similar to or greater than flows under NAA except in above normal water years during August (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 9 in any month or water year type throughout the period.

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A9_LLT would nearly always be similar to or greater than flows under NAA except in below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A9_LLT would always be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November under A9_LLT would be similar to or greater than flows under NAA throughout the period, except during November in above normal and critical years (6% lower for both), December in above normal years (5% lower), and January in critical years (9% lower).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows under NAA, except in dry and critical water years during July.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration 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 9 in any month or water year type throughout the period.

Through-Delta

Juveniles

As described above in Impact AQUA-42, fish screens at the DCC and Georgiana Slough would prevent outmigrating spring-run juveniles straying from the Sacramento River into the interior Delta, resulting in greater survival.

Mean monthly flows at Rio Vista under Alternative 9 during the outmigration period (November–January peak, extending through April) averaged across all years would be similar (<7% difference) to NAA, but reduced in drier water year types (4–28% less than NAA). Based on the DPM, through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 9 would average 32% across all years, 26% in drier years, and 42.6% in wetter years. Under Alternative 9, juvenile survival would be 2% greater (a 6–9% relative increase) than NAA (Table 11-9-28). Potential predation losses at the fish screens at DCC and Georgiana Slough would be minor, as described above in Impact AQUA-42. There is the risk of predatory fish aggregating at the fourteen new operable barriers installed (locations described above) and preying on juvenile salmonids as they migrate past. However, predators are already abundant in the south and central regions of the Delta, so the effect of adding the new structures would have to be determined. Under Alternative 9, increased flows in the Old River channel would increase salmon migration speed and reduce exposure to many of these structures and any associated predators.

The effect on spring-run Chinook would not be adverse due to minor differences in modeled survival.

Table 11-9-28. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Alternative 9

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Month	EXISTING CONDITIONS	NAA	A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wetter Years	42.1	40.4	42.8	0.7 (2%)	2.4 (6%)
Drier Years	24.8	24.3	26.5	1.7 (7%)	2.2 (9%)
All Years	31.3	30.3	32.6	1.4 (4%)	2.3 (8%)

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

During the adult spring-run migration, the proportion of Sacramento River flows in the Delta under Alternative 9 would be similar to NAA. In June, the attraction flows would be similar compared to NAA. Although the proportion of Sacramento River flows would be reduced during certain months of the adult migration, Sacramento River flows would still represent 57–66% of Delta outflows. Therefore, olfactory cues would still be strong for spring-run adult Chinook salmon. Flows at Rio Vista under Alternative 9 would be increased (9–28%) relative to Alternative 1A. Rio Vista flows under Alternative 1A were determined to not have an adverse effect on adult migration.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 does not have the potential to substantially interfere with the movement of fish. Reservoir storage and flows in all rivers examined would be reduced infrequently such that the reductions would not have a biologically meaningful effect on the spring-run population. Further, water temperatures in these rivers would not differ substantially between NAA and Alternative 9.

CEQA Conclusion: In general, Alternative 9 would not affect migration conditions for spring-run Chinook salmon relative to the Existing Conditions.

Upstream of the Delta

Sacramento River

Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-run Chinook salmon migration period under A9_LLT would nearly always be similar to or greater than flows under Existing Conditions except in wet water years during December and May (8% and 20% lower, respectively) and in below normal water years during March (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through May juvenile Chinook salmon spring-run emigration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-run Chinook salmon upstream migration period under A9_LLT would generally be similar to or greater than Existing Conditions except in wet years during May and August (20% and 7% lower, respectively) and in critical years during July and August (9% and 13% lower, respectively).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the April through August adult spring-run Chinook salmon upstream migration 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 Existing Conditions and Alternative 9 during April through July. Mean monthly water temperatures under Alternative 0 would be 6% greater relative to Existing Conditions during August.

Clear Creek

Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run migration period under A9_LLT would nearly always be similar to or greater than flows under Existing Conditions except in critical years during November (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream migration period under A9_LLT would nearly always be similar to or greater than flows under Existing Conditions except in critical water years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperatures were not modeled in Clear Creek.

Feather River

Flows were examined for the Feather River at the confluence with the Sacramento River during the November through May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during March under A9_LLT would generally be lower than flows under Existing Conditions by up to 15%. Flows during the rest of the period would generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to 27% lower).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the November through May juvenile spring-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alterative 9 would be 5% greater than those under Existing Conditions in November and December, but similar during January through May.

Flows were examined for the Feather River at the confluence with the Sacramento River during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April, May, and August under A9_LLT would generally be similar to or greater than flows under Existing Conditions with some exceptions, during which flows would be up to 32% lower. Flows during June and July under A9_LLT would generally be lower by up to 35% than flows under Existing Conditions.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 9 would be similar to those under Existing Conditions during all months of the migration period

Through-Delta

Juveniles

Mean monthly Sacramento River flows at Rio Vista under Alternative 9 would be similar to Existing Conditions in November to April (8% decreased to 6% increased). May flows would decrease on average 23% across all water years, and decrease up to 32% in wet years. As described above, Alternative 9 would result in a slight increase in through-Delta survival by emigrating juvenile spring-run Chinook salmon across all years (1.4% increase, a 4% relative increase) compared to Existing Conditions, mainly due to slight increase in drier years (1.7% increase). Furthermore, screening of the DCC and Georgiana Slough would prevent Sacramento River basin juvenile salmon from entering the interior Delta, thus improving migration survival. There is the risk of predatory fish aggregating at the two new fish screens and the fourteen new operable barriers installed (locations described above in Impact AQUA-42 for Alternative 9) and preying on juvenile salmonids as they migrate past. However, predators are already abundant in the south and central regions of the Delta, so the effect of adding the new structures would have to be determined. Under Alternative 9, increased flows in the Old River channel would increase salmon migration speed and reduce exposure to many of these structures and any associated predators.

Overall the impact on outmigration for juvenile Chinook salmon would be less than significant survival due to minor differences in survival across all water years and no mitigation would be required.

Adults

During the adult spring-run migration, the proportion of Sacramento River flows in the Delta would be reduced in March–May (12–13% compared to Existing Conditions). However, olfactory cues would remain strong as Sacramento River flows at Collinsville would still represent 57–66% of Delta outflow. As discussed in Impact AQUA-42 for Alternative 1A, these incremental changes are not expected to substantially affect adult migration. No mitigation would be required.

Summary of CEQA Conclusion

Collectively, these results indicate that the effect would be less than significant because Alternative 9 does not have the potential to substantially interfere with the movement of fish. Reservoir storage and flows in all rivers examined would be reduced infrequently such that the reductions would not have a biologically meaningful effect on the spring-run population. Further, water temperatures in these rivers would not differ substantially between Existing Conditions and Alternative 9. Through-Delta survival of migrating juveniles would be similar or slightly increased, and adult attraction flows would not be substantially changed. Overall the effect is considered less than significant. No mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-61 through Impact AQUA-63) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Spring-Run ESU)

Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to spring-run Chinook salmon, and most would be at least slightly beneficial. Specifically for AQUA-62, the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-64 through Impact AQUA-72) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run ESU) (CM12)

Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Spring-Run ESU) (CM13)

Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-Run ESU) (CM14)

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (CM15)

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (CM16)

Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU) (CM17)

Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU) (CM18)

Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run ESU) (CM19)

Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Spring-Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of CM1

The construction- and maintenance-related effects of Alternative 9 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 (Impact AQUA-37 through Impact AQUA-42).

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

The construction-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs and would be the same as those described for winter-run Chinook salmon under Alternative 9, Impact AQUA-37.

NEPA Effects: As concluded under Alternative 9, Impact AQUA-37, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 9, Impact AQUA-37, for winter-run Chinook salmon, the impact of the construction of water conveyance facilities on Chinook salmon would be less than significant except for construction noise associated with pile driving. There are more construction sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on Chinook salmon 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.

Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

The maintenance-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs and would be the same as those described for winter-run Chinook salmon.

NEPA Effects: As concluded under Alternative 9, Impact AQUA-38 for winter-run Chinook salmon, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described in Alternative 9, Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late Fall–Run ESU)

Alternative 9 would substantially reduce entrainment losses of juvenile fall-run and late fall-run Chinook salmon compared to baseline conditions due to screening which would exclude juvenile Chinook salmon. San Joaquin River basin fall-run Chinook salmon juveniles would benefit from isolating the fish migration corridor through Old River from the water conveyance corridor via the Middle River. Rerouting Mokelumne River fall-run Chinook salmon juveniles through Lost Slough and into the Sacramento River near Walnut Grove would reduce their potential to enter the water conveyance channel at the mouth at the Middle River on the San Joaquin River and thus decrease entrainment loss at the south Delta export facilities.

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of fall-run Chinook salmon would be minimal because the north Delta intakes at Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would still be a risk of injury from impingement associated with these north Delta intakes. Overall the impact would be similar to those described for Alternative 1A, Impact AQUA-75.

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-75. Since Sacramento River basin juvenile fall-run Chinook salmon would be prevented from entering the interior Delta via state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be exposed to entrainment loss to agricultural diversions in the Delta.

Predation Associated with Entrainment

The effects of predation associated with entrainment would be the same for all four ESUs. Please refer to the discussion of predation in Alternative 1A, Impact AQUA-39 for winter-run Chinook salmon. As discussed for Impact AQUA-39, the effect on Chinook salmon would not be adverse.

NEPA Effects: Overall, the effects of entrainment and entrainment-related predation would be beneficial for fall- or late-fall run Chinook salmon.

CEQA Conclusion: The impact and conclusion would be the same as discussed immediately above because entrainment would be substantially reduced. Thus the impact would be beneficial and no mitigation would be required.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall–run Chinook salmon relative to the 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 A9_LLT would generally be greater than or similar to NAA throughout the period, except during October (up to 13% lower) and in dry and critical years during January (7% and 11% lower, respectively).

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Alternative 9 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-17. There would be 3 (33%) fewer years with a "yellow" level of concern under Alternative 9 relative to NAA.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 9 would be similar to those under NAA throughout the period (Table 11-9-18).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be lower than or similar to mortality under NAA in all water year types (Table 11-9-29). These results indicate that climate change would increase fall-run Chinook salmon egg mortality, but Alternative 9 would have negligible effects.

Table 11-9-29. 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. A9_LLT	NAA vs. A9_LLT
Wet	9 (97%)	-0.2 (-1%)
Above Normal	10 (95%)	-1 (-3%)
Below Normal	11 (102%)	-0.3 (-1%)
Dry	17 (114%)	0 (0%)
Critical	10 (34%)	0.3 (1%)
All	11 (82%)	-0.2 (-1%)

SacEFT predicts that there would be a 20% increase in the percentage of years with good spawning availability for fall-run Chinook salmon, measured as weighted usable area, under A9_LLT relative to NAA (Table 11-9-30). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under A9_LLT relative to NAA. SacEFT predicts that there would be a negligible difference between A9_LLT and NAA. SacEFT predicts that there would be negligible changes in the percentage of years with good (lower) redd dewatering risk under A9_LLT relative to NAA.

Table 11-9-30. 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. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-6 (-13%)	7 (20%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-23 (-24%)	2 (3%)
Redd Dewatering Risk	1 (4%)	1 (4%)
Juvenile Rearing WUA	7 (21%)	0 (0%)
Juvenile Stranding Risk	-11 (-33%)	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 A9_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, end of September Shasta Reservoir storage under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-16).

The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be would be similar to mortality under NAA in all water years, including below normal water years in which, although there would be a 5% relative increase, the absolute increase would be <1% of the late fall–run population (Table 11-9-31).

Table 11-9-31. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	4 (206%)	-0.05 (-1%)
Above Normal	4 (162%)	-1 (-9%)
Below Normal	4 (290%)	0.3 (5%)
Dry	5 (188%)	0.2 (3%)
Critical	3 (151%)	0.1 (2%)
All	4 (197%)	0 (0%)

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Alternative 9 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-17. There would be 6 (14%) and 4 (50%) fewer years with a "red" and "yellow" level of concern, respectively, under Alternative 9 relative to NAA.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 9 would be similar to those under NAA during all months of the period (Table 11-9-18).

SacEFT predicts a negligible difference under A9_LLT relative to NAA in the percentage of years with good spawning availability for late fall–run Chinook salmon, measured as weighted usable area, (Table 11-9-32). SacEFT predicts that there would be no difference in the percentage of years with good egg incubation conditions between A9_LLT and NAA. SacEFT predicts that there would be 5% more years with good conditions relative to NAA.

Table 11-9-32. 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. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-3 (-6%)	1 (2%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-2 (-3%)	3 (5%)
Juvenile Rearing WUA	12 (27%)	-6 (-10%)
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 A9_LLT would always be similar to or greater than flows under NAA throughout the period.

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 magnitude of the greatest monthly reduction in Clear Creek flows during September through February under A9_LLT would be similar to or lower than the reduction under NAA for all water year types (Table 11-9-33).

Table 11-9-33. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	66 (99%)	99 (99%)

NA = could not be calculated because the denominator was 0.

[a] 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.

Feather River

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels 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 in the low-flow channel under A9_LLT would be identical to those under NAA. Flows in the high-flow channel under A9_LLT would generally be lower than those under NAA during October (up to 14% lower), and generally similar to or greater than flows under NAA during the rest of the period, except for above normal water years during November and December (10% and 9% lower, respectively) and in critical water years during November and January (6% and 22% lower, respectively).

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel during November through January were identical between A9_LLT and NAA (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). Therefore, there would be no effect of Alternative 9 on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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 Alternative 9 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 at Gridley was evaluated during October through April (Table 11-9-34). The percent of months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute scale) than the percent under NAA.

Table 11-9-34. Differences between Baseline and Alternative 9 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
October	2 (3%)	12 (14%)	21 (29%)	43 (106%)	58 (313%)
November	52 (1,400%)	36 (2,900%)	25 (NA)	12 (NA)	4 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	2 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (367%)	16 (433%)	7 (600%)	6 (NA)	4 (NA)
April	12 (18%)	17 (30%)	35 (112%)	32 (186%)	20 (178%)
NAA vs. A9_LLT					
October	0 (0%)	-1 (-1%)	-2 (-3%)	-5 (-6%)	-1 (-2%)
November	-6 (-10%)	-4 (-9%)	-7 (-23%)	-6 (-33%)	-2 (-40%)
December	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-1 (-33%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-22%)	-9 (-30%)	-2 (-22%)	-1 (-17%)	0 (0%)
April	-7 (-8%)	-6 (-8%)	-7 (-10%)	-10 (-17%)	-7 (-19%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-9-35). Total degree-months would be similar between NAA and Alternative 9 for all months of the period.

Table 11-9-35. Differences between Baseline and Alternative 9 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. A9_LLT	NAA vs. A9_LLT
October	Wet	100 (137%)	-2 (-1%)
	Above Normal	37 (84%)	1 (1%)
	Below Normal	48 (87%)	-1 (-1%)
	Dry	72 (136%)	1 (1%)
	Critical	46 (112%)	2 (2%)
	All	304 (114%)	2 (0.4%)
November	Wet	38 (NA)	1 (3%)
	Above Normal	22 (1,100%)	3 (14%)
	Below Normal	22 (2,200%)	1 (5%)
	Dry	28 (NA)	-3 (-10%)
	Critical	20 (2,000%)	2 (11%)
	All	131 (3,275%)	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	1 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	2 (NA)	0 (0%)
	All	3 (NA)	0 (0%)
March	Wet	5 (NA)	0 (0%)
	Above Normal	3 (300%)	1 (33%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	23 (575%)	0 (0%)
	Critical	17 (425%)	0 (0%)
	All	67 (670%)	-1 (-1%)
April	Wet	36 (257%)	-2 (-4%)
	Above Normal	25 (109%)	-2 (-4%)
	Below Normal	23 (58%)	-2 (-3%)
	Dry	41 (84%)	0 (0%)
	Critical	30 (103%)	-1 (-2%)
	All	154 (99%)	-8 (-3%)

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A9_LLT would be similar to mortality under NAA in all water years (Table 11-9-36).

Table 11-9-36. 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. A9_LLT	NAA vs. A9_LLT
Wet	20 (1,436%)	1 (4%)
Above Normal	12 (1,094%)	0 (0%)
Below Normal	13 (736%)	0 (0%)
Dry	19 (875%)	1 (3%)
Critical	24 (492%)	1 (2%)
All	18 (858%)	0 (2%)

American River

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 A9_LLT would generally be similar to or greater than flows under NAA, except for during the month of October (up to 18% lower), above normal water years during November (5% lower) and dry water years during January (5% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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 Alternative 9 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-9-37). The percent of months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute scale) than the percent under NAA.

Table 11-9-37. Differences between Baseline and Alternative 9 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
November	47 (103%)	52 (191%)	53 (391%)	47 (1,900%)	33 (2,700%)
December	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (220%)	15 (200%)	11 (450%)	9 (700%)	5 (NA)
April	25 (35%)	25 (40%)	26 (57%)	30 (92%)	25 (91%)
NAA vs. A9_LLT					
November	0 (0%)	-6 (-7%)	-7 (-10%)	-7 (-13%)	-6 (-15%)
December	0 (0%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-1 (-33%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-20%)	-10 (-31%)	-2 (-15%)	-2 (-20%)	0 (0%)
April	-1 (-1%)	-6 (-7%)	-9 (-11%)	-10 (-14%)	-5 (-9%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-9-38). Total degree-months would be similar between NAA and Alternative 9 for all months.

Table 11-9-38. Differences between Baseline and Alternative 9 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. A9_LLT	NAA vs. A9_LLT
November	Wet	82 (328%)	0 (0%)
	Above Normal	32 (291%)	-4 (-9%)
	Below Normal	45 (563%)	2 (4%)
	Dry	53 (408%)	2 (3%)
	Critical	38 (238%)	0 (0%)
	All	251 (344%)	1 (0%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	2 (NA)	0 (0%)
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	11 (367%)	0 (0%)
	Dry	24 (600%)	-1 (-3%)
	Critical	19 (190%)	-1 (-3%)
	All	73 (384%)	-4 (-4%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	39 (108%)	-2 (-3%)
	Dry	43 (57%)	-2 (-2%)
	Critical	36 (61%)	1 (1%)
	All	208 (94%)	-5 (-1%)

NA = could not be calculated because the denominator was 0.

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 monthly reduction in American River flows during November through January under A9_LLT would be 7% to 9% greater in magnitude than under NAA in dry and critical water years and lower in magnitude in other water years (Table 11-9-39).

Table 11-9-39. 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[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-16 (-73%)	9 (19%)
Above Normal	15 (50%)	25 (63%)
Below Normal	-11 (-59%)	16 (34%)
Dry	-1 (-2%)	-3 (-7%)
Critical	8 (15%)	-4 (-9%)

[a] 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.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A9_LLT would be similar to mortality under NAA in all water years (Table 11-9-40).

Table 11-9-40. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	24 (159%)	0.4 (1%)
Above Normal	23 (219%)	1 (2%)
Below Normal	23 (184%)	1 (2%)
Dry	17 (103%)	1 (2%)
Critical	10 (47%)	0 (0%)
All	20 (132%)	0.4 (1%)

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River 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 A9_LLT would be similar to flows under NAA throughout the period.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 9 throughout the October through January period (Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 A9_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 A9_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect would not be adverse because habitat conditions are not substantially reduced. There are no reductions in flows under Alternative 9 or increases in temperatures that would translate into adverse biological effects on fall-run Chinook salmon.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall–run Chinook salmon relative to Existing Conditions.

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A9_LLT would generally be greater than or similar to Existing Conditions throughout the period, except in above normal and critical water years during October (10% and 11% lower, respectively) and in wet years during December (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Storage volume at the end of September would be 12% to 34% lower under A9_LLT relative to Existing Conditions (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Red Bluff 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 Existing Conditions and Alternative 9 during the period, except during October, in which temperatures would be 5% higher under Alternative 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 increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-17. There would be 300% and 183% increases in the number of years with “red” and “orange” levels of concern under Alternative 9 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 9 would be 228% to 3,538% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-9-18).The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 34% to 114% greater than mortality under Existing Conditions, which is a 9% to 17% increase on an absolute scale (Table 11-9-29).

SacEFT predicts that there would be a 13% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-30). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 24% decrease in the percentage of years with good (lower) egg incubation conditions under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 4% increase in the percentage of years with good (lower) redd dewatering risk under A9_LLT relative to Existing Conditions.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during 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 A9_LLT would generally be greater than or similar to flows under Existing Conditions, except in below normal years during March (11% lower) and wet years during May (20% lower).

Storage volume at the end of September would be 12% to 34% lower under A9_LLT relative to Existing Conditions (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-17. There would be 300% and 183% increases in the number of years with “red” and “orange” levels of concern under Alternative 9 relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under Alternative 9would be 228% to 3,538% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-9-18).The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 151% to

290% greater than mortality under Existing Conditions (Table 11-9-31). However, absolute differences in the percent of the late-fall population subject to mortality would be negligible in all but dry years, in which there is a 5% increase.

SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-32). SacEFT predicts that there would be a 7% decrease in the percentage of years with good (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be no difference in the percentage of years with good (lower) egg incubation conditions under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a negligible difference in the percentage of years with good (lower) redd dewatering risk between A9_LLT and Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir under A9_LLT during the September through February fall-run spawning and egg incubation period would nearly always be similar to or greater than flows under Existing Conditions, except in critical water years during November (6% lower).

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 occurred. The greatest monthly reduction in Clear Creek flows during September through February under A9_LLT would be similar to or of lower magnitude than those under Existing Conditions in wet, below normal, and critical water year types and 27% and 67% lower than Existing Conditions in above normal and dry water year types, respectively (Table 11-9-33).

Feather River

Fall-Run

Flows in the low-flow channel during October through January under A9_LLT would be identical to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow channel under A9_LLT would generally be lower by up to 43% than flows under Existing Conditions throughout the period.

The potential risk of redd dewatering in the Feather River low-flow channel 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. Minimum flows in the low-flow channel were identical between A9_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 9 on redd dewatering in the Feather River low-flow channel.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under A9_LLT would be 492% to 1,436% greater than mortality under Existing Conditions (Table 11-9-36).

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow 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*). Mean monthly water temperatures under Alternative 9 relative to Existing Conditions would be 7% to 10% higher in the low-flow channel and 6% to 8% higher in the high-flow channel, depending on month.

The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley was evaluated during October through April (Table 11-9-34). The percent of months exceeding the threshold under Alternative 9 would similar to or up to 58% higher (absolute scale) than the percent under Existing Conditions during all months except December through February, during which there would be no difference in the percent of months exceeding the threshold.

Total degree-months exceeding 56°F were summed by month and water year type at Gridley during October through April (Table 11-9-35). Total degree-months under Alternative 9 would be 99% to 3,275% higher than total degree-months under Existing Conditions, except during December through February, when there would be no differences.

American River

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 A9_LLT would generally be lower than flows under Existing Conditions throughout the period (up to 28% lower).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge 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*). Mean monthly temperatures under Alternative 9 would be 5% to 12% greater than those under Existing Conditions depending on month.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-9-37). The percent of months exceeding the threshold under Alternative 9 would be up to 52% greater (absolute scale) than the percent under Existing Conditions during November, March, and April and similar to the percent under Existing Conditions during December through February.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-9-38). Total degree-months under Alternative 9 would be 94% to 384% greater than total degree-months under Existing Conditions during November, March and April and similar to total degree months under Existing Conditions during December through February. 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 monthly reduction in American River flows during October through January under A9_LLT would be of lower magnitude in all water year types other than above normal years, in which the magnitude of the greatest monthly reduction would be 50% greater under A9_LLT than under Existing Conditions.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under A9_LLT would be 47% to 219% greater than mortality under Existing Conditions, which would be 10% to 24% higher on an absolute scale (Table 11-9-40).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin 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 A9_LLT would generally be lower by up to 16% than those under Existing Conditions throughout the period.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would not be different from those under Existing Conditions during October, but 6% higher during November through January.

San Joaquin River

Flows in the San Joaquin River at Vernalis 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 A9_LLT would be up to 8% lower than Existing Conditions in most water years during October, similar to Existing Conditions in November and December (each month with one water year greater than 5% lower), and up to 11% higher than Existing Conditions during January.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta 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 A9_LLT would be up to 14% lower than flows under Existing Conditions during October and November, up to 15% greater than flows under Existing Conditions during December, and similar to flows under Existing Conditions during January.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA conclusion set forth above. There would be flow reductions and water temperature increases under Alternative 9 in the Sacramento, Feather and American Rivers that would affect the fall-run population. Further, the Reclamation egg mortality model and SacEFT predict moderate to substantial negative effects of Alternative 9 on fall-run Chinook salmon.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 9 would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to the NAA.

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the Sacramento River upstream of Red Bluff under A9_LLT would generally be greater than or similar to flows under NAA, except in dry and critical water years during January (7% and 11% lower, respectively).

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile rearing period. As reported in Impact AQUA-156, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 9 in any month or water year type throughout the period.

SacEFT predicts that the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A9_LLT would be identical to the percentage of years under NAA (Table 11-9-30). SacEFT predicts that there would be a 10%

increase in the percentage of years with "good" (lower) juvenile stranding risk under A9_LLT relative to NAA.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A9_LLT would be similar to mortality under NAA.

Late Fall-Run

Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).Flows throughout the year under A9_LLT would be generally similar to or greater than those under NAA, except during October (up to 13% lower) and exceptions in some water years during the rest of the period (up to 21% lower).

Shasta Reservoir storage at the end of September and May would affect flows during the late fall–run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be similar to storage under NAA in all water year types (Table 11-9-16).

As reported in Impact AQUA-40, Shasta storage at the end of May under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-7).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 9 in any month or water year type throughout the period. SacEFT predicts that there would be a 10% decrease in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A9_LLT relative to NAA (Table 11-9-32). SacEFT predicts that there would be no change relative to NAA.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A9_LLT would be similar to mortality under NAA.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would nearly always be similar to or greater than flows under NAA, except in below normal water years during March (6% lower).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under A9_LLT would not differ from those under NAA. In the high-flow channel, flows under A9_LLT would be mostly similar to or greater than flows under NAA during December through June with some exceptions during which flows would be up to 22% lower under A9_LLT.

As reported in Impact AQUA-59, May Oroville storage volume under A9_LLT would be similar to storage under NAA, indicating that the difference relative to NAA is primarily a result of climate change (Table 11-9-25).

As reported in Impact AQUA-58, September Oroville storage volume would be similar to that under NAA in all water year types (Table 11-9-22).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing 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 9 in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would nearly always be similar to or greater than flows under NAA except in dry years during January and critical years during April (5% lower for both).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing 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 9 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the Sacramento River for Alternative 9 are not different from those under NAA, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA and Alternative 9 throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis for Alternative 9 are not different from those under NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Mokelumne River

Flows in the Mokelumne River at the Delta for Alternative 9 are not different from those under NAA, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Taken together, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat for fish. Changes in flow rates and water temperatures are generally small and infrequent under Alternative 9. Therefore, there would be no biologically meaningful effects to fall-run Chinook salmon.

CEQA Conclusion: In general, the quantity and quality of larval and juvenile rearing habitat for fall-/late fall–run Chinook salmon would not be affected by Alternative 9, relative to the CEQA baseline.

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would almost always be greater than or similar to flows under Existing Conditions, except in below normal water years during March (11% lower) and wet water years during May (20% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 34% lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-16).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

SacEFT predicts that there would be a 21% increase in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-30). SacEFT predicts that there would be a 33% reduction in the percentage of years with “good” (lower) juvenile stranding risk under A9_LLT relative to Existing Conditions.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A9_LLT would be 7% lower than mortality under Existing Conditions.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during the period would generally be similar to or greater than those under Existing Conditions, except in wet water years during May (20% lower).

Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows throughout the period under A9_LLT were generally similar to or greater than those under Existing Conditions, with some exceptions (up to 25% lower).

As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 34% lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-16).

As reported in Impact AQUA-40, end of May Shasta storage under A9_LLT would be similar to Existing Conditions in wet and above normal water years, but lower by 6% to 24% in all other water years (Table 11-9-7).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

SacEFT predicts that there would be a 27% increase in the percentage of years with good juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-32). SacEFT predicts that there would be a 36% reduction in the percentage of years with "good" (lower) juvenile stranding risk under A9_LLT relative to Existing Conditions.

SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A9_LLT would be 6% higher than mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to or greater than flows under Existing Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under A9_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows under A9_LLT would be mostly lower (up to 55%) during December through February and generally similar to or greater than flows under Existing Conditions during the rest of the period, except in below normal and dry years during March (39% and 18% lower, respectively) and wet years during May and June (35% and 21% lower, respectively).

As reported under Impact AQUA-59, May Oroville storage volume under A9_LLT would be lower than Existing Conditions by 5% to 20% depending on water year type, except in wet years, in which storage would be similar to Existing Conditions (Table 11-9-25).

As reported in Impact AQUA-58, September Oroville storage volume would be 21% to 35% lower under A9_LLT relative to Existing Conditions depending on water year type (Table 11-9-22).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 9 would be 5% to 10% higher than those under Existing Conditions during December through March, but not different from those under Existing Conditions during April through June. In the high-flow channel, mean monthly water temperatures under Alternative 9 would be 5% to 8% higher than those under Existing Conditions during December through February, but not different from those under Existing Conditions during March through June.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis* Flows under A9_LLT would generally be lower during January and May (up to 26% lower) and similar to or greater than flows under Existing Conditions during the rest of the period, except in critical years during February (16% lower) and above normal years during April (9% lower).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 9 would be up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions in all months during the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under Existing Conditions during January and February and lower by up to 15% during March through May.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to flows under Existing Conditions during January through March and lower by up to 18% than flows under Existing Conditions during April and May.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA conclusion set forth above. Flow reductions in the Feather, American, and Stanislaus Rivers and temperature increases in the Sacramento, Feather, and American Rivers would be sufficiently high and frequent to cause biologically meaningful effects to fall-run Chinook salmon. Reductions in flows and temperature increases in these rivers can alter the quantity and quality of habitat for rearing larval and juvenile fall-run.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 9 would not affect migration conditions for fall-/late fall–run Chinook salmon relative to the NAA.

Upstream of the Delta

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February through May under A9_LLT would be similar to or greater than flows under NAA throughout the February through May juvenile fall-run migration period regardless of water year type Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A9_LLT would always be similar to or greater than those under NAA during September, but flows would generally be lower during October (up to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration 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 9 in any month or water year type throughout the period.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A9_LLT would generally be similar to or greater than flows under NAA, except in dry and critical years during January compared to NAA (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A9_LLT would almost always be similar to or greater than those under NAA, except in dry and critical years during January (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants during February through May. Flows under A9_LLT would nearly always be similar to or greater than those under NAA, except in below normal years during March (6% lower).

Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (September through October) under A9_LLT would generally be similar to or greater than those under NAA, except in critical years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were examined during the fall-run juvenile migration period (February through May). Flows under A9_LLT would nearly always be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult migration period. Flows during September under A9_LLT would generally be similar to or greater than flows under NAA. Flows during October would generally be lower than those under NAA by up to 17% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration 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 9 in any month or water year type throughout the period.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would nearly always be similar to or greater than flows under NAA, except in critical years during April (5% lower). Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT during September would be similar to or greater than flows under NAA. Flows during October compared to NAA would be generally lower during October (up to 18% lower) although 12% higher in dry years.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 9 in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through March juvenile fall-run Chinook salmon migration 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 9 in any month or water year type throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration 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 9 in any month or water year type throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

Analysis). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period. Flows under A9_LLT would be similar to those under NAA in all months and water year types throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Fall-Run

Juveniles

Fall-run Chinook salmon juveniles typically migrate out as young-of-the-year fish, smaller than the other runs. During the fall-run juvenile Chinook salmon outmigration (February–May), Sacramento River flows at Rio Vista would generally be similar to NAA, although slightly decreased in April (6% less) and May (7% less) when averaged across water year types. Screening of the DCC and Georgiana Slough would prevent downstream migrating juveniles from entering the interior delta, thereby improving migration success. Based on DPM modeling, through-Delta survival by Sacramento River juvenile fall-run Chinook salmon under Alternative 9 would be 28% averaged across years, an increase of 3.4% (14% relative increase) compared to NAA, with similar increases in both wetter and drier water year types (Table 11-9-41).

Table 11-9-41. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Alternative 9

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Type	EXISTING CONDITIONS	NAA	A9	EXISTING CONDITIONS vs. A9	NAA vs. A9
Sacramento River					
Wetter Years	34.5	31.1	35.0	0.5 (1%)	3.9 (13%)
Drier Years	20.6	20.8	23.9	3.3 (16%)	3.1 (15%)
All Years	25.8	24.7	28.1	2.3 (9%)	3.4 (14%)
Mokelumne River					
Wetter Years	17.2	15.7	14.6	-2.6 (-15%)	-1.2 (-7%)
Drier Years	15.6	15.9	15.2	-0.4 (-3%)	-0.8 (-5%)
All Years	16.2	15.9	14.9	-1.3 (-8%)	-0.9 (-6%)
San Joaquin River[a]					

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).
[a] DPM results are anomalous for Alternative 9 San Joaquin River juveniles.

Predation losses of Sacramento juvenile fall-run Chinook associated with the Georgiana Slough and DCC fish screens or with the fourteen operable barriers around the Delta are expected to be minimal, as discussed above for Impact-AQUA-42. Overall, Alternative 9 would not have an adverse effect on Sacramento River fall-run Chinook salmon survival due to expected slight increase in through-Delta survival.

Adults

During the adult fall-run migration through the Delta from September-December, flows at Rio Vista During the adult fall-run migration through the Delta from September-December, the proportion of Sacramento River flows in the Delta decreased 5% to 9% compared to NAA (Table 11-9-15). The reductions are small compared with the change in dilution (>20%) reported to cause a significant change in migration by Fretwell (1989). Sacramento River flows would still represent 57% to 60% of Delta outflows and would provide strong olfactory cues for adults from the Sacramento River. Therefore the impact on adult fall-run upstream migration under Alternative 9 would not be adverse.

Late Fall Run

Juveniles

During the late fall-run juvenile Chinook salmon outmigration through the Delta (October to February), average flows at Rio Vista under Alternative 9 would be similar to NAA (<5% difference) in November to February, and reduced 17% in October. Fish screens at the DCC and Georgiana Slough would prevent late fall-run juveniles from leaving the Sacramento River and entering the interior Delta. Migration routes through the interior Delta are associated with reduced survival for tagged smolts (Perry et al. 2010). Based on the DPM, through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 9 would average 28.2% across all years, which is 5.3% greater (23% relative increase) compared to NAA (Table 11-9-42). Potential predation losses at the fish screens at DCC and Georgiana Slough and at the fourteen operation barriers would be minor, as described above in Impact AQUA-42.

In conclusion, the effect of Alternative 9 on migration success for late-fall juvenile salmon would not be adverse.

Table 11-9-42. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon under Alternative 9

	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
Year Type	EXISTING CONDITIONS	NAA	A9	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9
Wetter Years	28.8	27.3	33.3	4.6 (16%)	6.0 (22%)
Drier Years	18.8	20.2	25.2	6.4 (34%)	5.0 (25%)
All Years	22.5	22.9	28.2	5.7 (25%)	5.3 (23%)

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

The adult late fall–run migration is from November through March, peaking in January through March. The proportion of Sacramento River water in the Delta would be reduced 7–10% relative to NAA throughout the adult late fall–run migration period. As discussed in further detail in Impact AQUA-42 for Alternative 1A, the proportion of Sacramento River flows in the Delta would still represent 57–66% of Delta outflows, thus providing strong olfactory cues.

San Joaquin River

Fall-Run

Juveniles

Outmigration conditions for San Joaquin River basin fall-run Chinook salmon would be improved relative to NAA. Flows in the Old River fish migration corridor would be isolated from the San Joaquin River downstream of Old River and the Middle River water conveyance corridor eliminating SWP/CVP entrainment risk for San Joaquin River basin outmigrating juvenile salmon. The greater flows through the Old River compared to the NAA would increase outmigration speed, thus improving through-Delta migration survival.

Juvenile salmon outmigrating via the Old River fish migration corridor would have a simplified pathway for outmigration. Alternative migration routes into the interior Delta are minimized with Alternative 9 since fish can't move down the San Joaquin River, or into Middle River from Old River into the central Delta. Alternative 9 delivers outmigrating fall-run Chinook salmon to the western Delta near Frank's Tract where the fish would then use Rock, Sandmound, Taylor or Dutch slough, Franks Tract of False River to reach the San Joaquin River. The mouth of Old River would be gated off under Alternative 9.

Although the Delta Passage Model is used to estimate through-Delta survival for most Chinook salmon runs, it can be problematic applying the DPM to San Joaquin River salmon for certain Alternatives and operations scenarios with highly reduced south Delta exports (such as Alternatives 6A, 7, 8 and 9). These issues are discussed further in Impact AQUA-78 under Alternative 6A. A qualitative assessment is more appropriate given this modeling limitation. Under Alternative 9, survival of juvenile fall-run Chinook salmon would be expected to be similar or greater compared to NAA, given the elimination of south Delta exports that could entrain juveniles and the improved migration corridor from the San Joaquin River.

Overall there would be a low risk of entrainment at the south Delta under Alternative 9 which would substantially improve migration conditions for San Joaquin River basin Chinook salmon juveniles. The effect would not be adverse.

Adults

The San Joaquin River basin fall-run Chinook salmon adult migration would be affected by the change in operations under Alternative 9. Chinook salmon would generally be attracted to migrate upstream through False River into the Old River fish migration corridor, because most of San Joaquin River basin flows would be diverted into the Old River corridor under Alternative 9 increasing olfactory cues. The proportion of San Joaquin River basin water at Collinsville would be increased relative to NAA, mainly due to the reduction in Sacramento River water. Thus the olfactory cues for the San Joaquin basin would be strengthened under Alternative 9. For adult Chinook salmon that do not migrate upstream along False River, they would migrate further upstream into the San Joaquin River, where they could become stranded in the channel between Stockton and Old River. They could potentially migrate into the Middle River water conveyance pathway. Chinook salmon adults that migrate into the Middle River would be subject to entrainment at the SWP/CVP south Delta facilities and would be returned to Old River. Overall there would be a beneficial impact on the species because the majority of Chinook salmon would likely migrate upstream along the Old River migration corridor which would be isolated from entrainment effects at the south Delta export facilities.

NEPA Effects: The results of the Impact AQUA-78 NEPA analysis indicate no differences between NAA and Alternative 9 effects related to location. Through-Delta conditions on the Sacramento River would not substantially affect migration conditions relative to NAA. Similarly, through-Delta conditions on the San Joaquin River and upstream of the Delta conditions relative to NAA would not substantially affect migration. Collectively, these results indicate that the effect is not adverse in these locations because it does not have the potential to substantially reduce migration habitat or substantially interfere with the movement of fish. Flows and water temperatures during juvenile and adult fall-/late fall-run Chinook salmon migration periods would be similar between Alternative 9 and the NEPA point of comparison in all evaluated upstream rivers, through Delta on the Sacramento River and through Delta on the San Joaquin River.

CEQA Conclusion:

Upstream of the Delta

In general, Alternative 9 would not reduce migration conditions for fall-/late fall–run Chinook salmon relative to Existing Conditions.

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February through May under A9_LLT would nearly always be similar to or greater than those under Existing Conditions, except in below normal water years during March (11% lower) and wet water years during May (20% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon upstream migration period (September through October) under A9_LLT would generally be similar to or greater than those under Existing Conditions except in dry and critical years during September (25% and 18% lower, respectively) and above normal and critical years during October (10% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the September through October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be unchanged (<5%) and 5% greater than those under Existing Conditions during September and October, respectively.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January through March) under A9_LLT would nearly always be similar to or greater than flows under Existing Conditions, except in below normal water years during March (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon upstream migration period (December through February) under A9_LLT would generally be similar to or greater than those under Existing Conditions, except in wet years during December (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run Chinook salmon upstream migration period (February through May). Flows under A9_LLT would be similar to or greater than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run Chinook salmon upstream migration period (September through October). Flows under A9_LLT would nearly always be similar to or greater than those under Existing Conditions, except in critical years during September (38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile migration period (February through May) under A9_LLT would generally be lower than flows under Existing Conditions during March (up to 15% lower) but similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period. Flows in the Feather River at the confluence with the Sacramento River during the September through October fall-run Chinook salmon adult migration period under A9_LLT would generally be similar to or greater than flows under Existing Conditions during September, except in dry and critical years (33% and 8% lower, respectively), and generally lower during October (up to 23% lower).

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were examined during the September through October fall-run Chinook salmon adult upstream migration 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 Existing Conditions and Alternative 9 in September and a 5% increase in October.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT during February through April would generally be similar to or greater than flows under Existing Conditions, except in critical years during February (16% lower) and above normal years during April (9% lower). Flows under A9_LLT during May would be generally lower by up to 36% than flows under Existing Conditions.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% to 7% higher than under Existing Conditions in all months except April, in which there would be no difference. Flows in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower than those under Existing Conditions throughout the period by up to 52%.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis). Mean monthly water temperatures under Alternative 9 would be 5% and 11% higher than those under Existing Conditions during September and October, respectively.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT throughout this period would generally be lower than Existing Conditions (up to 36% lower), except for March in wet water years (7% greater).

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions in every month of the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under Existing Conditions during September, except in wet and above normal years (17% and 6% lower, respectively). During October, flows would be 6% to 11% lower depending on water year type.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions during September but there would be no difference in mean monthly water temperatures between Alternative 9 and Existing Conditions during October.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be similar to Existing Conditions but drier water years would be up to 16% lower than those under Existing Conditions.

Flows in the San Joaquin River at Vernalis were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be lower than Existing Conditions by up to 11% during both months.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under Existing Conditions during February and March, but up to 18% lower than flows under Existing Conditions during April and May.

Flows in the Mokelumne River at the Delta were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be up to 29% lower than those under NAA depending on water year type.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River flows at Rio Vista under Alternative 9 would generally be similar to Existing Conditions. The only exception is in May and June when flows would be reduced by 23% and 13%, respectively, relative to Existing Conditions. The reduction in flows in May would affect the tail end of the juvenile fall-run and late fall–run outmigration periods. Furthermore, screening of the DCC and Georgiana Slough would prevent Sacramento River basin juvenile salmon from entering the interior Delta, thus improving migration survival. Based on DPM modeling, through-Delta survival of Sacramento River fall-run smolts would increase 2.3% (9% relative increase) compared to Existing Conditions. Survival of Mokelumne River fall-run Chinook salmon juveniles would decrease 1.3% (8% relative increase) under Alternative 9. Predation losses associated with the Georgiana Slough and DCC fish screens or with the fourteen operable barriers around the Delta are expected to be minimal, as discussed above for Impact-AQUA-42. For fall-run Chinook salmon from the San Joaquin River basin, outmigration success would be improved as flows would be increased in the Old River fish migration corridor thus reducing transit times for juvenile salmon. Survival rates for San Joaquin River basin salmon would also be improved because the Old River fish migration corridor would be isolated from the south Delta export facilities.

Overall the impact on Chinook salmon would not be negative because flow conditions for juveniles outmigrating from the Sacramento River and San Joaquin River basins based on the overall flows at Rio Vista and the lack of entrainment for San Joaquin basin fall-run Chinook salmon. Increased flows in the Old River fish migration corridor would reduce transit times for juvenile San Joaquin River basin Chinook salmon thus improving outmigration success. The impact on adults is unknown for San Joaquin River basin fish because of modification under Alternative 9.

Attraction flows from the Sacramento River would be similar (less than 4%) during fall-run adult migration (September to November) and reduced 8% to 12% during late fall-run migration (December to February) compared to Existing Conditions. The proportion of San Joaquin River flows at Collinsville would be increased relative to Existing Conditions, thus strengthening olfactory cues under Alternative 9. Overall the impact would be less than significant, no mitigation would be required.

Summary of CEQA Conclusion

The results of the Impact AQUA-78 CEQA analysis indicate differences between the CEQA baseline and Alternative 9 depending on location. Through Delta conditions on the Sacramento River and on the San Joaquin River would not substantially impact migration conditions relative to Existing Conditions. Upstream of the Delta conditions relative to Existing Conditions would be reduced although the impacts are related to climate change.

In the Delta on the Sacramento River, under Alternative 9 flows and olfactory cues would be similar to Existing Conditions for Sacramento River Chinook salmon migration periods. Additionally, screening of the DCC and Georgiana Slough would prevent Sacrament River basin juvenile salmon from entering the interior Delta, thereby improving migration survival. Therefore, it is concluded that the through-delta impact on the Sacramento River is less than significant and no mitigation is required.

In the Delta on the San Joaquin River there would be increased proportions of San Joaquin River flows at Collinsville which would strengthen olfactory cues relative to Existing Conditions. Also, increased flows in the Old River migration corridor would reduce transit times and improve outmigration success. Alternative 9 would be less than significant for fall-run Chinook salmon and no mitigation is required.

For upstream of the Delta, collectively, the results of the Impact AQUA-78 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce migration habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Flows under Alternative 9 in the Stanislaus and Mokelumne Rivers would generally be lower than flows under Existing Conditions. These flow reductions would reduce the ability of fall-run Chinook salmon adult migrants to sense olfactory cues from their natal spawning grounds, potentially delaying or preventing them from reaching these spawning grounds. Further, increases in temperatures in the Feather and Stanislaus River for one of the two month adult upstream migration period under Alternative 9 would have negative impacts. Flows and temperatures in other rivers would be variably similar to, negative or slightly positive depending on river, month and water year type.

These negative results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing

Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for fall- and late fall–run Chinook salmon under Alternative 1A (Impact AQUA-79 through Impact AQUA-81) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to fall-/late fall–run Chinook salmon, and most would be at least slightly beneficial. Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for fall- and late fall–run Chinook salmon under

Alternative 1A (Impact AQUA-82 through Impact AQUA-90) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM12)

Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM13)

Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM14)

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM15)

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM16)

Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM17)

Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM18)

Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM19)

Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon (Fall-/Late Fall–Run ESU) (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on fall- and late fall-run Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on fall- and late fall-run Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

Steelhead

Construction and Maintenance of CM1

Potential impacts from Alternative 9 construction are expected to be as described for Chinook salmon, under Alternative 9 above (see Impact AQUA-37). Steelhead could be present in the vicinity of the Alternative 9 facilities and barge landings during in-water construction. The potential for exposure of steelhead to construction-related activities is expected to be low due to the limited time required for installation of each individual cofferdam and barge landing. Adult and juvenile steelhead could be present at the Alternative 9 in-water construction areas in July to October (see

Table 11-6). Appendix A of the BDCP details the temporal and spatial distribution of various life history stages for steelhead.

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

The potential effects of construction of water conveyance facilities on steelhead would be similar to but greater than those described under Impact AQUA-91 under Alternative 1A, except the number of construction sites would have a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). 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.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-91, the effect would not be adverse for steelhead.

CEQA Conclusion: Although Alternative 9 affects a larger in-water area than Alternative 1A, as described in Impact AQUA-91, the impact of construction of the water conveyance facilities on steelhead would be less than significant except for construction noise associated with pile driving. The number of sites where noise impacts would potentially occur are greater under Alternative 9 because it has more construction sites than Alternative 1A. However, 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.

Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-92).

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-92, the impact would not be adverse for steelhead.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described under Alternative 1A, Impact AQUA-92 for steelhead, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

The potential effects would the same as those discussed for entrainment of winter-run Chinook under Alternative 9 (see Impact AQUA-39).

NEPA Effects: As concluded for Alternative 9, Impact AQUA-39, the effects would be beneficial for steelhead.

CEQA Conclusion: As described in Impact AQUA-39 for winter-run Chinook under Alternative 9, the impact of Alternative 9 operations of water conveyance facilities on steelhead would be less than significant. Overall the impact of water operations on steelhead would be beneficial to the species. No mitigation would be required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, Alternative 9 would have negligible effects on spawning and egg incubation habitat for steelhead relative to the NAA.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A9_LLT throughout the period would generally be similar to those under NAA except during January in dry and critical water years (7% and 11% lower, respectively) and during February during below normal water years (6% higher).

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 9 in any month or water year type throughout the period at either location

SacEFT predicts that there would be negligible effects (<5% difference) under Alternative 9 relative to NAA in the percentage of years with good spawning availability (measured as weighted usable area), percentage of years with good (lower) redd scour risk and redd dewatering risk, and percentage of years with good (lower) egg incubation conditions (Table 11-9-43). These results indicate that there would be negligible effects of Alternative 9 on these parameters relative to NAA.

Table 11-9-43. Difference and Percent Difference in Percentage of Years with "Good" Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	1 (2%)	-2 (-4%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	2 (4%)
Juvenile Rearing WUA	2 (5%)	-2 (-4%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg incubation habitat in the Sacramento River would be negligible.

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A9_LLT would generally be similar to flows under NAA throughout the period, except in critical years during January (6% higher) and below normal years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between NAA and A9_LLT for all water year types except for a reduction in above normal years which would be a relatively isolated, small event (Table 11-9-44).

No water temperature modeling was conducted for Clear Creek.

Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg incubation habitat in Clear Creek would be negligible.

Table 11-9-44. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	-31 (NA)	-31 (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.

[a] 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.

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 A9_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 A9_LLT at Thermalito Afterbay would generally be similar to flows under NAA, except lower in critical years during January (22% lower), below normal years during February (6% lower), and dry years during March (7% lower) and higher in below normal and dry years during April (14% and 19% higher, respectively).

Oroville Reservoir storage volume at the end of May and end of September influences flows downstream of the dam during the steelhead spawning and egg incubation period. May Oroville storage under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-45). Storage volume at the end of September under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-46).

Table 11-9-45. May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-57 (-2%)	-11 (0%)
Above Normal	-184 (-5%)	-28 (-1%)
Below Normal	-380 (-12%)	-27 (-1%)
Dry	-560 (-20%)	-40 (-2%)
Critical	-351 (-19%)	-35 (-2%)

Table 11-9-46. September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-1,017 (-35%)	-3 (0%)
Above Normal	-816 (-34%)	-25 (-2%)
Below Normal	-605 (-30%)	4 (0%)
Dry	-337 (-25%)	16 (2%)
Critical	-202 (-21%)	-14 (-2%)

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 9 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 11-9-47). The percent of months exceeding the threshold under Alternative 9 would generally be similar to or lower (up to 11% lower on an absolute scale) than the percent under NAA depending on month and degrees above the threshold.

Table 11-9-47. Differences between Baseline and Alternative 9 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

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	7 (600%)	1 (NA)	1 (NA)	1 (NA)	0 (NA)
April	33 (386%)	16 (325%)	11 (NA)	2 (NA)	1 (NA)
NAA vs. A9_LLT					
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%)	-1 (-50%)	0 (0%)	0 (0%)	-1 (-100%)
April	-11 (-21%)	-11 (-35%)	-6 (-36%)	-4 (-60%)	0 (0%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-9-48). Total degree-months would be similar between NAA and Alternative 9 in all months.

Table 11-9-48. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River above Thermalito Afterbay, January through April

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_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	2 (NA)	0 (0%)
	Critical	8 (800%)	0 (0%)
	All	12 (1,200%)	0 (0%)
April	Wet	4 (NA)	1 (33%)
	Above Normal	11 (550%)	0 (0%)
	Below Normal	15 (375%)	-1 (-5%)
	Dry	24 (480%)	-2 (-6%)
	Critical	21 (NA)	-2 (-9%)
	All	74 (673%)	-5 (-6%)

NA = could not be calculated because the denominator was 0.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under NAA during the period except in dry and critical years during March and April (5% lower for each) and during dry water years during February and April (8% and 12% higher, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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 9 in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-9-37). Steelhead spawn and eggs incubate in the American River between January and April. During this period, the percent of months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute scale) than the percent under NAA.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-9-38). During the January through April steelhead spawning and egg incubation period, total degree-months would be similar between NAA and Alternative 9.

Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg incubation habitat in the American River would be negligible.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT throughout this period would generally be identical to flows under NAA.

Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 9 throughout 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*).

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT throughout this period would generally be identical to flows under NAA.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. Reservoir storage, instream flows, and water temperatures would not be substantially changed by Alternative 9 in any waterway evaluated.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of steelhead spawning habitat relative to Existing Conditions.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows under A9_LLT would be mixed in January and February with individual water years similar to, lower than, or higher than Existing Conditions (up to 20% lower in below normal years during March or up to 13% higher in wet years during January). Flows would be similar to or lower than Existing Conditions during March and April (up 20% lower). Upstream of Red Bluff Diversion Dam, flows would generally be similar to those at Keswick except there would be fewer water years with lower flows.

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period at either location.

SacEFT predicts negligible change (0% difference) in spawning habitat, egg incubation, redd dewatering and redd scour risk for Alternative 9 compared to Existing Conditions (Table 11-9-43).

Clear Creek

Flows in Clear Creek were examined during the steelhead spawning and egg incubation period (January through April). Flows under A9_LLT would be similar to or greater than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest monthly flow reduction would be identical between Existing Conditions and A9_LLT for all water year types except wet, in which the greatest reduction would be 38% lower (worse) under A9_LLT than under Existing Conditions (Table 11-9-44).

No water temperature modeling was conducted in Clear Creek.

Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg 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 A9_LLT would not differ from Existing Conditions 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 A9_LLT at Thermalito Afterbay would are variable depending on the specific month and water year type. There would be primarily decreases in mean monthly flows in January and February (-11% to -39% and -6% to -55%, respectively) for all but wet water years, which would increase by 7% and 18%, respectively. March would experience substantial decreases (-18% to -39%) in drier water year types that could significantly affect spawning conditions, and increases in wetter water year types (12% to 13%). April would experience primarily higher flows (5% to 14%) in the drier water years.

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. Oroville Reservoir storage volume at the end of September would be 21% to 35% lower under A9_LLT relative to Existing Conditions depending on water year (Table 11-9-46). May Oroville storage volume under A9_LLT would be lower than Existing Conditions by 2% to 19% depending on water year type (Table 11-9-45).

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*). In the low-flow channel, mean monthly water temperatures under Alternative 9 would be 5% to 7% greater than those under Existing Conditions during January through March and similar to temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water temperatures under Alternative 9 would be 6% greater than those under Existing Conditions during January and February and similar to temperatures under Existing Conditions during March and April.

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 11-9-47). The percent of months exceeding the threshold under Alternative 9 would be similar to the percent under Existing Conditions during January and February and similar to or up to 33% greater (absolute scale) than the percent under Existing Conditions depending on month and degrees above the threshold.

Total degree-months exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during January through April (Table 11-9-48). Total degree-months would be similar between Existing Conditions and Alternative 9 during January and February and 673% to 1,200% higher under Alternative 9 compared to Existing Conditions during March and April.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower than flows under Existing Conditions during January (up to 28% lower), generally greater than flows under Existing Conditions during February and March (up to 27% higher), and similar to Existing Conditions during April except for lower flows in above normal years (9% lower) and higher flows in dry years (12% higher).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated 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*). Mean monthly water temperature under Alternative 9 would be 5% to 7% higher than those under Existing Conditions during January through March, and temperatures would not differ between Alternative 9 and Existing Conditions during April.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-9-37). Steelhead spawn and eggs incubate in the American River between January and April. During January and February, the percent of month exceeding the threshold under Existing Conditions and Alternative 9 would be similar. During March and April, the percent of months exceeding the threshold under Alternative 9 would be up to 30% greater (absolute scale) than the percent under Existing Conditions.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-9-38). During the January and February, there would be no difference in total degree-months above the threshold between Existing Conditions and Alternative 9. During March and April, total degree-months under Alternative 9 would be 384% and 94% greater, respectively than those under Existing Conditions.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT throughout this period would be up to 36% lower flows under Existing Conditions in all months with few exceptions.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was evaluated 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*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions in all months.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under Existing Conditions during January through March and up to 14% lower during April.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Alternative 9 would reduce instream flows in the Stanislaus and Mokelumne Rivers and would increase water temperatures in the Feather, American, and Stanislaus Rivers.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water

demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, Alternative 9 would not affect steelhead rearing habitat relative to the NAA.

Sacramento River

Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows would generally be similar to or greater (up to 18%) than flows under NAA during February through September, November, and December, and lower than flows under NAA (up to 13% lower) during January and October.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing 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 9 in any month or water year type throughout the period at either location.

SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions under A9_LLT would be 4% less than under NAA (Table 11-9-43). The percentage of years with good (lower) juvenile stranding risk conditions under A9_LLT would be the same as under NAA. These results indicate that Alternative 9 would cause a minimal decrease in rearing habitat conditions and no increase in juvenile mortality risk resulting from stranding in the Sacramento River.

Overall in the Sacramento River, Alternative 9 would have negligible effects on juvenile steelhead rearing conditions in the Sacramento River.

Clear Creek

Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under A9_LLT would generally be similar to or sometimes greater than flows under NAA, except for below normal years in March and critical years in September in which flows would be 6% 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 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 9 relative to NAA in all water years except in critical years when they would be 10% higher (Table 11-9-49).

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.

Overall, these results indicate that Alternative 9 would not affect juvenile rearing conditions in Clear Creek.

Table 11-9-49. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_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 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 A9_LLT would not differ from those under NAA. In the high flow channel, flows under A9_LLT would be mostly lower (up to 14%) during July and October, mostly greater (up to 42%) than flows under NAA during April and May, similar to or slightly lower than flows under NAA in January, February, March, and September, and mixed in November and December.

May Oroville storage under A9_LLT would be similar to that under NAA (Table 11-9-45). September Oroville storage volume would be similar to that under NAA (Table 11-9-46).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing 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 9 in any month or water year type throughout the period at either location.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 9 would generally be similar to or lower (up to 16% lower on an absolute scale) than the percent under NAA (Table 11-9-26). At Gridley, the percent of months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute scale) than the percent under NAA (Table 11-9-34).

Total degree-months exceeding 63°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) during May through August and total degree-months exceeding 56°F at Gridley during October through April. In the low-flow channel, total degree-months under Alternative 9 would be similar to or lower than those under NAA depending on the month (Table 11-9-27). At Gridley, total degree-months would be similar between NAA and Alternative 9 for all months of the rearing period (Table 11-9-35).

Overall in the Feather River, project-related effects of Alternative 9 would generally result in negligible effects on steelhead rearing habitat.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under NAA during March and June, similar to or greater than flows under NAA during February, May, September, November, and December, lower than flows under NAA during July, and October, and mixed in January, April, and August with higher flows in dry years and lower flows in critical years.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing 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 9 in any month or water year type throughout the period.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-9-50). During May, June, September, and October, the percent of months exceeding the threshold under Alternative 9 would similar to or up to 17% lower (absolute scale) than the percent under NAA. During July and August, the percent of months exceeding the threshold would be similar between NAA and Alternative 9.

Table 11-9-50. Differences between Baseline and Alternative 9 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
May	33 (169%)	28 (192%)	19 (167%)	12 (200%)	5 (100%)
June	33 (52%)	38 (72%)	30 (73%)	23 (76%)	20 (94%)
July	0 (0%)	1 (1%)	32 (51%)	40 (110%)	40 (229%)
August	0 (0%)	2 (3%)	19 (23%)	49 (103%)	56 (180%)
September	14 (16%)	37 (70%)	43 (135%)	46 (285%)	40 (533%)
October	68 (1,375%)	46 (1,850%)	35 (NA)	21 (NA)	9 (NA)
NAA vs. A9_LLT					
May	-11 (-17%)	-6 (-13%)	-10 (-25%)	-14 (-42%)	-7 (-43%)
June	-1 (-1%)	0 (0%)	-11 (-14%)	-11 (-17%)	-7 (-15%)
July	0 (0%)	0 (0%)	-2 (-3%)	4 (5%)	1 (2%)
August	0 (0%)	0 (0%)	0 (0%)	1 (1%)	-4 (-4%)
September	-1 (-1%)	-7 (-8%)	-10 (-12%)	-12 (-17%)	-14 (-22%)
October	-7 (-9%)	-17 (-26%)	-11 (-24%)	-9 (-29%)	-2 (-22%)

NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-9-51). During May, June, and August through October, total degree-months would be similar between NAA and Alternative 9 or up to 14% lower under Alternative 9. During July, there would be a 9% increase in total degree-months exceeding the threshold.

Table 11-9-51. Differences between Baseline and Alternative 9 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 CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	19 (317%)	-2 (-7%)
	Above Normal	25 (NA)	-2 (-7%)
	Below Normal	16 (533%)	-7 (-27%)
	Dry	21 (95%)	-13 (-23%)
	Critical	30 (158%)	-2 (-4%)
	All	111 (222%)	-26 (-14%)
June	Wet	61 (359%)	-7 (-8%)
	Above Normal	28 (117%)	-4 (-7%)
	Below Normal	40 (138%)	2 (3%)
	Dry	42 (62%)	2 (2%)
	Critical	48 (96%)	-2 (-2%)
	All	219 (116%)	-9 (-2%)
July	Wet	57 (73%)	8 (6%)
	Above Normal	13 (48%)	7 (21%)
	Below Normal	34 (100%)	13 (24%)
	Dry	64 (103%)	13 (12%)
	Critical	46 (57%)	0 (0%)
	All	213 (76%)	40 (9%)
August	Wet	107 (135%)	-1 (-1%)
	Above Normal	29 (71%)	-4 (-5%)
	Below Normal	34 (61%)	-3 (-3%)
	Dry	84 (124%)	3 (2%)
	Critical	66 (84%)	2 (1%)
	All	320 (99%)	-3 (0%)
September	Wet	67 (279%)	-7 (-7%)
	Above Normal	34 (213%)	-2 (-4%)
	Below Normal	40 (143%)	-7 (-9%)
	Dry	81 (193%)	-5 (-4%)
	Critical	53 (108%)	0 (0%)
	All	275 (173%)	-21 (-5%)
October	Wet	54 (5,400%)	0 (0%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	35 (NA)	-4 (-10%)
	Dry	35 (NA)	-2 (-5%)
	Critical	25 (500%)	-5 (-14%)
	All	176 (2,933%)	-10 (-5%)

NA = could not be calculated because the denominator was 0.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to flows under NAA throughout the period.

Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 9 throughout the year-round period (Appendix 11D, Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to flows under NAA throughout the period.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to flows under NAA throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish. Effects of Alternative 9 on flow would result primarily in negligible effects on mean monthly flow in all rivers analyzed, with relatively infrequent increases in flow (to 42%) that would have beneficial effects on rearing conditions, and isolated decreases in flow (to -26%) that would not be of the persistence and magnitude to have biologically meaningful negative effects on rearing conditions. Alternative 9 would have negligible effects (<5%), small negative effects (to -10%), or positive/beneficial effects on rearing conditions evaluated with SacEFT and minimum instream flows. Alternative 9 would have negligible effects on critical water temperatures in all location evaluated.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of rearing habitat for steelhead relative to the CEQA baseline.

Sacramento River

Year-round Sacramento River flows within the reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during January, February, April, May, June, and November under A9_LLT would generally be similar to or greater than those under Existing Conditions. Flows during March, July, August, September, October and December would generally be similar to or lower under A9_LLT than under Existing Conditions.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, mean monthly water temperatures under Alternative 9 would generally be similar to those under Existing Conditions, except during August through September, in each of which there would be a 6% higher temperatures under Alternative 9.

SacEFT predicts that there would be a small improvement (5%) in the percentage of years with good rearing habitat availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table 11-9-43). SacEFT predicts that there would be a substantial reduction (-41%) in the number of years with good (lower) juvenile stranding risk under A9_LLT relative to Existing Conditions.

Collectively, these impacts would have biologically meaningful effects on juvenile rearing success in the Sacramento River.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Flows in Clear Creek during the year-round rearing period under A9_LLT would generally be similar to or greater than flows under Existing Conditions, except for critical years in August, September and November in which flows would be 6% to 38% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 11-9-49. Results indicate that Alternative 9 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to Existing Conditions in all water years except for that they would be 8% lower in critical water years.

Overall, Alternative 9 would have primarily negligible effects on mean monthly flow in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 9 relative to Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at Thermalito Afterbay), flows under A9_LLT would be mostly lower (up to 55% lower) during January, February, October, November and December, mostly similar to or higher (up to 205% higher) in April, May, June, and August, and mixed with some water years higher and some lower in March and September.

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water temperatures under Alternative 9 would be similar to those under Existing Conditions between April and September, but would be 5% to 10% higher between October and March. In the high-flow channel, mean monthly water temperatures under Alternative 9 would be similar to those under Existing Conditions between March through September, but would be 6% to 8% in the remaining five months.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 9 would generally be similar to the percent under Existing Conditions during May, and similar or up to 44% (absolute scale) higher than the percent under Existing Conditions during June through August (Table 11-9-26). At Gridley, the percent of months exceeding the threshold under Alternative 9 would similar to the percent under Existing Conditions during December through February, but similar to or up to 58% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months (Table 11-9-34).

Total degree-months exceeding 63°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) during May through August and total degree-months exceeding 56°F at Gridley during October through April. In the low-flow channel, total degree-months under Alternative 9 would be similar to those under Existing Conditions during May and 45% to 175% higher during June through August (Table 11-9-27). At Gridley, total degree-months under Alternative 9 would be similar to those under Existing Conditions during December through and February and 99% to 3,275% greater than those under Existing Conditions in the remaining months of the period (Table 11-9-35).

Overall in the Feather River, Alternative 9 would affect juvenile rearing habitat in the Feather River low-flow channel and high-flow channel due to increased exposures to critical water temperatures, as well as due to persistent reductions in mean monthly flow (to -55%) below Thermalito Afterbay for much of the year, particularly in drier water years.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be generally lower than flows under Existing Conditions (up to 52% lower) during January and May through December, generally higher flows in February and March (up to 27% higher).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be 5% to 12% higher during January through March, May, and August through December and similar in the remaining 3 months.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-9-50). The percent of months under Alternative 9 would be up to 68 (absolute scale) higher than those under Existing Conditions except in July and August for the >1 degree category.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-9-51). Total degree-months under Alternative 9 would be 76% to 2,933% higher than those under Existing Conditions.

Overall in the American River, Alternative 9 would substantially reduce flows and increased water temperatures for most of the year depending on water year type.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to flows under Existing Conditions during June and July and up to 36% lower than flows under Existing Conditions during the remaining 9 months.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternatives 9 would be 6% greater than those under Existing Conditions during January through May, August, September, November, and December and would be similar to those under Existing Conditions in the remaining 3 months.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be up to 6% higher than Existing Conditions during January, generally similar to Existing Conditions during February except for being lower in two water years, lower in most water years than Existing Conditions during March through October (up to 38% lower), and similar to Existing Conditions during November and December.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 9 are generally lower than Existing Conditions in all months except that they are similar in March (although lower in dry water years), and generally higher in January, February and December (up to 18% higher depending on water year).

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-95 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of juvenile mortality, contrary to the NEPA conclusion set forth above. Alternative 9 would cause reduced juvenile steelhead rearing habitat conditions in the Sacramento, Feather, American, Stanislaus, and Mokelumne rivers based on persistent, small to substantial reductions in mean monthly flows and increased water temperatures throughout much of the year. Effects of Alternative 9 would not have biologically meaningful negative effects on juvenile rearing conditions in Clear Creek.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

Upstream of the Delta

In general, Alternative 9 would not negatively affect the quantity and quality of migration habitat for steelhead relative to the NEPA point of comparison.

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period. Flows under A9_LLT would be higher than NAA in some water years during February, April, May, August, November and December (up to 18% higher), similar to NAA during March, June, July, and September, and lower than NAA (up to 13% lower) during January and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 9 in any month or water year type throughout the period.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be higher than NAA in some water years during February, November and December (up to 8% higher), similar to NAA during March and September, and lower than NAA (up to 13% lower) during January and October.

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 9 in any month or water year type throughout the period.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during March would be similar to NAA and flows during April would be up to 7% higher than NAA. Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 9 in any month or water year type throughout the period.

Overall in the Sacramento River, project-related effects of Alternative 9 on mean monthly flow would not affect juvenile, adult, or kelt steelhead migration based on a prevalence of negligible effects with a few, isolated, small increases in flow (to 18%) that would have beneficial effects and decreases (to -13%) that would not have biologically meaningful effects on migration conditions.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Juveniles

Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period under A9_LLT would generally be similar to or greater than flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A9_LLT would generally be similar to or greater than flows under NAA except in critical years in September (13% lower) and below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A9_LLT would generally be similar to flows under NAA except in below normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall, in Clear Creek these results indicate that Alternative 9 on flows would not affect juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows under NAA during December, February, March, April and May, and lower than flows under NAA during October, November and January.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 9 in any month or water year type throughout the period.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows under NAA during September, December, February and March, and lower than flows under NAA during October, November and January.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 9 in any month or water year type throughout the period.

Kelts

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to those under NAA in March and April.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 9 in any month or water year type throughout the period. Overall in the Feather River, the effects of Alternative 9 on flow would not have biologically meaningful effects on juvenile, adult or kelt steelhead migration.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period. Flows under A9_LLT would be lower than under NAA during October (15% lower in below normal years although 12% higher in dry years), similar to or lower during January (5% lower in dry years), similar to or higher than flows under NAA during November, December, February, March, and May, and mixed in April (12% higher in dry years and 5% lower in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 9 in any month or water year type throughout the period.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be lower than under NAA during October (15% lower in below normal years although 12% higher in dry years), similar to or lower during January (5% lower in dry years), similar to or higher than flows under NAA during September, November, December, February, and March (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 9 in any month or water year type throughout the period.

Kelts

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows under A9_LLT would be similar to NAA during March (up to 17% lower in critical years), and mixed in April (12% higher in dry years and 5% lower in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in the American River, the effects of Alternative 9 on flow would not have biologically meaningful effects on juvenile, adult or kelt steelhead migration.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 9 in any month or water year type throughout the period.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 9 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt migration in the Stanislaus River.

Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River for Alternative 9 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt migration in the Stanislaus River.

San Joaquin River

Flows in the San Joaquin River at Vernalis for Alternative 9 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt migration in the San Joaquin River.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River at the Delta for Alternative 9 are not different from flows under NAA for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt migration in the Mokelumne River.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Juveniles

Under Alternative 9, Sacramento River flows at Rio Vista during the juvenile steelhead migration period (October–May) would be similar to NAA (<7% difference) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Little difference in flows would occur under Alternative 9 in May and June, compared to NAA. Based on DPM modeling for Chinook salmon, through-Delta survival of steelhead is expected to increase as a result of fish screens at the mouth of the DCC and Georgiana Slough which would prevent juveniles from entering the interior Delta where survival rates are lower than for the Sacramento River mainstem. The effect on Sacramento River basin juvenile steelhead outmigration success would be similar to NAA, and thus there is not a substantial effect.

Adults

The proportion of January-March Sacramento River flows in the Delta under Alternative 9 would be reduced 9% to 10% compared to NAA (Table 11-9-15). The proportion of Sacramento River flows would represent 57–66% of Delta outflows over the course of the entire adult steelhead migration. Therefore olfactory cues would be strong during the entire migration period. The impact on adult steelhead would not be substantial.

San Joaquin River

Juveniles

Migration conditions for San Joaquin River basin steelhead juveniles would overall be improved under Alternative 9 compared to NAA conditions. The Old River fish migration corridor would be isolated from the Middle River water conveyance corridor, thereby reducing entrainment losses of juvenile steelhead. There would be increased flows in the fish migration corridor as more San Joaquin River flows are diverted into the Old River; the increase in flows world reduce steelhead transit times through the Delta and thus increase survival rates. There would be a predation risk for juvenile steelhead as they travel through Frank's Tract to the False River, however there are several other routes to the San Joaquin River that would not require passing through Frank's Tract. Overall, the amount of predator-dense habitat to transit would be reduced for San Joaquin River fish.

Adults

Little information apparently currently exists as to the importance of Plan Area flows on the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult San Joaquin River region steelhead adults as well.

Upstream migration of San Joaquin River basin steelhead adults would be slightly affected by the change in operations under Alternative 9. The proportion of San Joaquin River-origin water in the flows at Collinsville would be 0.1% to 8.9% during the migration period, compared to 0.3% to 2.6% under NAA (Table 11-9-15). This change would increase olfactory cues from San Joaquin River basin relative to NAA. Steelhead would generally be attracted to migrate upstream of False River into the Old River fish migration corridor, because most of San Joaquin River basin flows would be routed into the Old River corridor under Alternative 9 increasing olfactory cues. For adult steelhead that do not migrate upstream of False River, they would migrate further upstream in the San Joaquin River and potentially into the Middle River water conveyance pathway or into the San Joaquin River past Stockton up to the barrier at Old River where passage would be available. Steelhead that migrate into the Middle River would be subject to entrainment at the SWP/CVP south Delta facilities. Overall there would be a beneficial impact on the species because the majority of steelhead adults would likely migrate upstream the Old River migration corridor which would be isolated from confounding flow cues and entrainment effects at the south Delta export facilities.

NEPA Effects: Collectively, these results indicate that there would be no substantial negative effects through Delta on the Sacramento River, through Delta on the San Joaquin River or upstream of the Delta.

There would be no negative effects on through-Delta survival or migration. The effect of Alternative 9 on Sacramento River basin juvenile steelhead outmigration success would be similar to NAA conditions. The effects would not be adverse.

Through Delta San Joaquin River basin conditions for juveniles would be improved because of the Old River fish migration corridor reducing entrainment losses and increased flows reducing transit times and increasing survival. Through Delta San Joaquin River adult fish would also experience increased olfactory cues, generally improved migration routes, and reduced entrainment at the south Delta facilities resulting in an overall beneficial effect on the species.

Upstream of the Delta these results indicate that the effect would not be adverse because it would not substantially affect migration habitat or substantially interfere with the movement of fish. Flows under Alternative 9 in each waterway examined would not be reduced enough or in high enough frequency relative to the NAA to affect steelhead migration. Effects on flow in all rivers analyzed consist primarily of negligible effects (≤5%), with relatively infrequent small to moderate increases in flow (to 30%) that would have beneficial effects on migration conditions, and small and/or infrequent moderate decreases in flow (to -28%) that would not affect migration conditions. Effects of Alternative 9 on water temperature would also be negligible in all locations analyzed.

CEQA Conclusion: In general, the quantity and quality of steelhead migration habitat would not be negatively affected by Alternative 9 water operations relative to the CEQA baseline, upstream of the Delta, through Delta on the Sacramento River and through Delta on the San Joaquin River.

Upstream of the Delta

Sacramento River

Juveniles

Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be generally similar to or greater than Existing Conditions during November through February, April and May, and lower flows in March and October.

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 9 in all months but October, in which the temperature under Alternative 9 would be 5% greater than that under Existing Conditions.

Adults

Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be generally similar to or greater than Existing Conditions during November through February, April and May, and lower flows than Existing Conditions in March and October, and mixed flows in September (higher in wet and above normal years and lower in dry and critical years).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 9 in all months except October, in which the temperature under Alternative 9 would be 5% greater than that under Existing Conditions.

Kelts

Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to those under Existing Conditions during March and April except in below normal water years during March (11% lower) and critical water years during April (20% lower).

Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Overall in the Sacramento River, project-related effects of Alternative 9 on mean monthly flow would not affect juvenile, adult, or kelt steelhead migration based on a prevalence of negligible effects with a few, isolated, small increases in flow that would have beneficial effects and decreases that would not have biologically meaningful effects on migration conditions.

Clear Creek

Water temperatures were not modeled in Clear Creek.

Flows in Clear Creek during the October through May juvenile steelhead migration period under A9_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54% greater) except in critical years during November (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows in Clear Creek during the September through March adult steelhead migration period under A9_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in critical years during September and November (38% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelt

Flows in Clear Creek during the March through April steelhead kelt downstream migration period under A9_LLT would generally be similar to or greater than flows under Existing Conditions with 10% higher flows in critical years during both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, the impacts of Alternative 9 on flows would not affect juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Flows in the Feather River at the confluence with the Sacramento River were examined during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower than flows under Existing Conditions during October, November, January and March (except for some wet and above normal water years with higher flows), similar to Existing Conditions in April, and mixed higher and lower flows during December, February, March and May depending on water year type.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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 Existing Conditions and Alternative 9 in all months except October, November and December, in which temperatures under Alternative 9 would be 5% greater than temperatures under Existing Conditions.

Adults

Flows in the Feather River at the confluence with the Sacramento River were examined during the September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). Flows under A9_LLT would generally be lower than flows under Existing Conditions during October, November, and January (except for some wet and above normal water years with higher flows), and mixed higher and lower flows during September, December, February, and March depending on water year type.

Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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 Existing Conditions and Alternative 9 in all months except October, November and December, in which temperatures under Alternative 9 would be 5% greater than temperatures under Existing Conditions.

Kelt

Flows in the Feather River at the confluence with the Sacramento River were examined during the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT compared to Existing Conditions would be mixed during March (higher flows in wet and above normal years and lower flows in below normal, dry, and critical years) and similar to or slightly greater than Existing Conditions during April (7% higher during dry water years).Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

Overall in the Feather River, the impact of Alternative 9 on flows would affect juvenile, adult, and kelt migration conditions due to a prevalence of lower flows and higher temperatures.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower during October, November, December, January, and May (up to 36% lower). Flows during February and March would generally be higher (up to 27%) except that February flows would be 16% lower in critical water years. Flows in January and April would be mixed with both higher and lower flows than under Existing Conditions depending on individual water year types.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% to 11% higher than those under Existing Conditions in all months during the period except December and April, in which there would be no difference in water temperatures between Existing Conditions and Alternative 9.

Adults

Flows in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower during September, October, November, December, January, and May (up to 40% lower). Flows during February and March would generally be higher (up to 27%) except that February flows would be 16% lower in critical water years. Flows in January would be mixed with both higher and lower flows than under Existing Conditions depending on individual water year types.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% to 11% higher than those under Existing Conditions in all months during the period except December, in which there would be no difference in water temperatures between Existing Conditions and Alternative 9.

Kelt

Flows in the American River at the confluence with the Sacramento River were evaluated for the March and April kelt migration period. Flows during March would generally be higher (up to 14%) than under Existing Conditions. Flows during April would be mixed with both higher and lower flows depending on water year type than under Existing Conditions. Mean monthly water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% higher than those under Existing Conditions in March but temperatures would be similar between Existing Conditions and Alternative 9 during April.

Overall in the American River, the impacts of Alternative 9 on flows would affect juvenile, adult and kelt steelhead migration in drier water years.

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be 7% to 18% lower than flows under Existing Conditions depending on month.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May steelhead juvenile downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 9.

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be 7% to 18% lower than flows under Existing Conditions depending on month.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions in all months during the period except October, in which temperature would be similar between Existing Conditions and Alternative 9.

Kelt

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be 8% to 11% lower than flows under Existing Conditions during March and April, respectively.

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the March and April steelhead kelt downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6% higher than those under Existing Conditions during March and April.

San Joaquin River

Flows in the San Joaquin River for Alternative 9 are generally below those under Existing Conditions for juveniles, adults or kelts (e.g., 13% lower in dry years during March and 10% lower in critical years during April) except during January and November. Flows during January are similar to or greater than Existing Conditions and flows during November are generally similar to Existing Conditions.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Flows in the Mokelumne River for Alternative 9 are generally substantially below those under Existing Conditions for juveniles, adults or kelts (e.g., 17% lower in below normal years during May) except for higher flow conditions in some water years for January, February and December (up to 18% higher).

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

The migration success for juvenile steelhead migrating down the Sacramento River would be similar to Existing Conditions based on DPM results for winter-run Chinook salmon under Alternative 9. Olfactory cues for steelhead migrating upstream the Sacramento River would also be similar to Existing Conditions during the initial period of upstream migration, but would be reduced during the later portion of the migration. The proportion of Sacramento River flows in the Delta would be reduced 11–12% from January–March. Flows during the overall adult steelhead migration would still represent 57–66% of Delta outflows. Based on the strength of olfactory cues and the similar in Rio Vista flows, the impact would not be substantial.

Juvenile steelhead would benefit from increased flows transferred into the Old River corridor from the San Joaquin River. The Old River fish migration corridor would be isolated from the Middle River water conveyance corridor, reducing entrainment loss. The Old River fish migration corridor would also reduce fish lost to false migration pathways into the south-central Delta. They still would be exposed to potential predation loss as they migrate through or around Frank's Tract into the San Joaquin River, but this a greatly reduced amount of predator occupied habitat compared to the other alternatives. Increased flows in the Old River corridor would reduce transit times and help mitigate the predation risk. Overall the impact on juvenile steelhead migration from the San Joaquin River basin would not be substantial.

For adult San Joaquin River basin steelhead, upstream migration success would depend on the migration pathway selected. The majority of steelhead would migrate through the Old River fish migration corridor because the San Joaquin River flow would be routed into the Old River thus improving attraction cues. For steelhead adults utilizing the Old River corridor, migration success would be improved relative to Existing Conditions because the corridor reduces false migration pathways and would be isolated from the south Delta export facilities. Steelhead that migrate upstream into the Middle River would be subject to entrainment at the south Delta facilities as there is no opportunity for steelhead to migrate from the Middle River water conveyance corridor into the Old River fish migration corridor. Salvaged steelhead could be returned to Old River. Steelhead that migrate up the San Joaquin River past Stockton could pass through the barrier located downstream of Old River. Overall the impact on adult steelhead would be unknown but is expected not to be substantial because the majority of steelhead would use the Old River corridor where passage would be improved.

Summary of CEQA Conclusion

The results of the Impact AQUA-96 analysis indicate different impacts between Alternative 9 and Existing Conditions on locations upstream of the Delta, through Delta conditions on the Sacramento River and through Delta conditions on the San Joaquin River.

Through-Delta migration success for juvenile Sacramento River steelhead under Alternative 9 would be similar to Existing Conditions. Olfactory cues for adult Sacramento River steelhead would also be similar to Existing Conditions for much of the upstream migration period. These impacts would not be significant and no mitigation is required.

Through Delta San Joaquin River basin conditions for juveniles would be improved because of the Old River fish migration corridor reducing entrainment losses and increased flows reducing transit times and increasing survival. Through Delta San Joaquin River adult fish would also experience increased olfactory cues, generally improved migration routes, and reduced entrainment at the south Delta facilities. The impacts are less than significant and no mitigation is required.

Upstream of the Delta, collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable migration habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. There would be flow reductions in the Feather, American, Stanislaus, San Joaquin, and Mokelumne rivers and temperature increases in the Feather, American, and Stanislaus rivers that would affect juvenile and adult steelhead migration. Impacts of Alternative 9 on flow would not have biologically meaningful effects on kelt migration in any of the locations analyzed, or on juvenile and adult migration in the Sacramento River and Clear Creek.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration habitat for steelhead. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through Impact AQUA-99) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to steelhead, and most would be at least slightly beneficial. Specifically for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-100 through Impact AQUA-108) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)

Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)

Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)

Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)

Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)

Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)

Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no mitigation is required.

Sacramento Splittail

Construction and Maintenance of CM1

Sacramento splittail eggs, larvae, juvenile young-of-the-year, and adult spawners could occur in the north Delta, south Delta and east Delta in June or July (see Table 11-6). Adult non-spawners could occur in the north Delta in October and November.

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

The potential effects of construction of water conveyance facilities on Sacramento splittail would be similar to but greater than those described under Impact AQUA-109 under Alternative 1A. Alternative 9 would have more in-water construction locations than Alternative 1A, which would result in a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). The effects related to temporary increases in turbidity, accidental spills, and disturbance of contaminated sediments would be similar to Alternative 1A, Impact AQUA-109 and the same environmental commitments and mitigation measures (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential effects.

The potential for Sacramento splittail to be exposed to impact pile driving noise would be relatively small, given the relatively small areas affected by underwater noise, and the expected limited use of impact pile driving. Therefore, the potential for larval and juvenile Sacramento splittail to experience an adverse effect (e.g., injury or mortality) from impact pile driving would be low. Mitigation Measures AQUA-1a and AQUA-1b would serve to further minimize the potential for effects from underwater noise.

NEPA Effects: Overall, as concluded for Alternative 1A, Impact AQUA-109, the effect would not be adverse for Sacramento splittail.

CEQA Conclusion: Although Alternative 9 affects a larger in-water area than Alternative 1A, as described in Impact AQUA-109, the impact of construction of the water conveyance facilities on splittail would be less than significant except for construction noise associated with pile driving. However, 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.

Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento Splittail

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply.

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-110), and would not be adverse for Sacramento splittail.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-110 for Sacramento splittail, the impact of the maintenance of water conveyance facilities on Sacramento splittail would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail

Juvenile splittail are vulnerable to entrainment at the south Delta export facilities when they migrate from floodplain rearing habitat into Delta channels. Under Existing Conditions, large numbers of juveniles are entrained in wetter years, when inundation of floodplain habitat and the Yolo Bypass results in very high splittail production. Under Alternative 9, entrainment of splittail, particularly those juveniles produced in the Yolo Bypass, would be substantially reduced due to the isolation of the Old River fish corridor and associated channels from the pumping effects of the SWP/CVP south Delta facilities. In addition, screening of the north Delta intakes at DCC and Georgiana Slough would also reduce the number of splittail from the north Delta that enter Alternative 9’s main conveyance channel via Middle River. Juveniles produced from San Joaquin floodplains upstream of the Delta would also be isolated from entrainment at the south Delta facilities by the creation of the isolated fish migration corridor along Old River. Overall, this would benefit splittail.

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of splittail would be minimal because the north Delta intakes at Georgiana Slough and DCC would be screened to exclude juvenile and adult splittail. There would still be a risk of injury from impingement associated with these north Delta intakes, and there would be monitoring to assess these effects.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

The effect of implementing dual conveyance for the NBA with a screened alternative Sacramento River intake would be the same as described under Alternative 1A (Impact AQUA-111).

Predation Associated with Entrainment

Predation loss of juvenile splittail associated with the SWP/CVP south Delta facilities would be substantially decreased because entrainment to these facilities would be substantially reduced under Alternative 9.

Localized predation may increase if predatory fish aggregate at the new screened intake facilities to be constructed at DCC and Georgiana Slough. There would potentially be increased predation loss in the vicinity of the operable barriers designed to isolate the Old River fish migration corridor from the Middle River water conveyance corridor. Predators are already abundant in this area of the Delta, however, so the overall impact of the new operable barriers is expected to be minor.

Impacts of potential predation at Alternative 9's two north Delta intake facilities would be similar to those described for Alternative 3, which has similar total screen length for NDD intakes (see Alternative 3, Impact AQUA-111).

Potential predation at the north Delta would be offset by reduced predation loss at the SWP/CVP south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was not a factor currently limiting splittail abundance.

Predators may aggregate near the operable barriers placed in various channels to isolate the Old River fish passage corridor and the Middle River conveyance corridor, but the effect may not be substantially greater than the NAA, because predators are already abundant in the interior and south Delta. Monitoring can be implemented to determine whether predation at physical barriers reaches levels of concern

NEPA Effects: Overall, effects from entrainment and entrainment-related predation on Sacramento splittail would be beneficial to Sacramento splittail.

CEQA Conclusion: As described above in Impact AQUA-111, the potential impacts of operations on Sacramento splittail entrainment and predation losses are considered to be beneficial, because increased predation losses associated with screening structures would be offset by the substantial reduction in entrainment losses from the isolation of the water conveyance corridor and the increased production of juvenile splittail in the Yolo Bypass. No mitigation would be required.

Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for Sacramento Splittail

Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning overwhelmingly dominates production in wet years. During low-flow years when floodplains are not inundated, spawning in side channels and channel margins would be much more critical.

In general, Alternative 9 would have beneficial effects on splittail spawning habitat relative to the NAA due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo Bypass. There would also be beneficial effects on channel margin and side-channel spawning habitat due to small to moderate increases in mean monthly flow in the Sacramento River and the Feather River for a portion of the spawning period, and reduced exposures to critical water temperatures in the Feather River.

Floodplain Habitat

Effects of Alternative 9 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored because flow velocity was generally very low throughout the modeled area for most conditions, with generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo Bypass inundation events compared to NAA for above normal to critical water year types and slightly decrease the frequency and duration of Yolo Bypass inundation events for wet water years; the changes are attributable to the influence of the Fremont Weir notch at lower flows. There would be a small decrease in 30–49-day events, and a slightly larger decrease in 50–69-day inundation events, in wet years, that would be partly offset by an increase in ≥70-day events in wet years. For the drier type years (below normal, dry, and critical), Alternative 9 results in an increase in frequency of inundation events greater than 30 days compared to NAA. For below normal years, Alternative 9 would result in the occurrence of 1 inundation event ≥70 days, compared to 0 such events for NAA. For critical years, Alternative 9 would result in the occurrence of 1 inundation event 30–49 days, compared to 0 such events for NAA. The overall project-related effects consist of an increase in occurrence of longer-duration inundation events during drier years that would be beneficial for splittail spawning by creating better spawning habitat conditions. (Figure 11-9-2, Table 11-9-52).

Table 11-9-52. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February 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. A9_LLT	NAA vs. A9_LLT
30–49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	4	4
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	0	0
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 9 ranging from 5 to 944 acres relative to NAA (Table 11-9-53). Areas under A9_LLT would be 56%, 54%, and 185% greater than areas under NAA in wet, above normal, and below normal water years, respectively. There would be increases in area under A9_LLT for critical years relative to NAA, but they would be minimal (5 acres) and there would be no increases in area for dry years. These results indicate that increases in inundated acreage in most water year types would result in increased habitat and have a beneficial effect on splittail spawning.

Table 11-9-53. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass from Existing Biological Conditions to Alternative 9 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	1,083 (70%)	944 (56%)
Above Normal	627 (55%)	619 (54%)
Below Normal	230 (175%)	234 (185%)
Dry	0 (NA)	0 (NA)
Critical	5 (NA)	5 (NA)

NA = percent differences could not be computed because little or no splittail weighted habitat occurred in the bypass for NAA and Existing Conditions in those years (dividing by 0).

A potential adverse effect of Alternative 9 that is not included in the modeling is reduced inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the Yolo Bypass.

Channel Margin and Side-Channel Habitat

Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel habitat upstream of the Delta. These habitats are likely to be especially important during dry years, when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are affected by changes in flow because greater flows cause more flooding, thereby increasing availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are expected to be most important to the splittail population because in years of high-flows, when most production comes from floodplain habitats, the upstream side-channel habitats contribute relatively little production.

Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the Sacramento River for the time-frame February through June. These are the most important months for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from the side-channel habitats during May and June if conditions become unfavorable.

Differences between model scenarios for monthly average flows during February through June by water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) flows during February through June under A9_LLT would be similar to flows under NAA with the exception of occurrences of flow increases of 10% to 32% for drier water year types in April and June. These results indicate that there would be some increases of flow (up to 32%) that would have beneficial effects for splittail spawning conditions in the Sacramento River.

For the Feather River at the confluence flows during February through June would be similar to or with small increases in flow compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During April there would be a small increase in flow in dry years (7%), and moderate increases during May in drier water year types (to 25%) that would have beneficial effects on splittail spawning conditions in the Feather River.

Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather River at the confluence with the Sacramento River, respectively were used to investigate the potential effects of Alternative 9 on the suitability of water temperatures for splittail spawning and egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and egg incubation.

There would be no biologically meaningful difference (>5% absolute scale) between NAA and Alternative 9 in the frequency of water temperatures in the Sacramento and Feather Rivers being within the suitable 45°F to 75°F regardless of water year type (Table 11-9-54).

Table 11-9-54. Difference (Percent Difference) in Percent of Days or Months[a] during February to June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at Hamilton City and Feather River at the Confluence with the Sacramento River[b]

	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River at Hamilton City		
Temperatures below 45°F		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-9 (-32%)	0 (0%)
All	-7 (-19%)	0 (0%)
Temperatures above 75°F		
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 at Sacramento River Confluence		
Temperatures below 45°F		
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)
Temperatures above 75°F		
Wet	5 (NA)	0 (0%)
Above Normal	7 (NA)	-2 (-20%)
Below Normal	11 (NA)	0 (0%)
Dry	14 (325%)	1 (6%)
Critical	12 (700%)	-2 (-11%)
All	10 (780%)	-0.2 (-2%)

NA = could not be calculated because the denominator was 0.
[a] Days were used in the Sacramento River and months were used in the Feather River.
[b] Based on the modeling period of 1922 to 2003.

Overall effects of Alternative 9 on flow consist of negligible effects (<5%) attributable to the project or beneficial effects on spawning conditions through increases in mean monthly flow (to 57%) in the Sacramento and Feather rivers and reduced occurrence of critical high water temperatures in the Feather River that would have beneficial effects on splittail spawning conditions (Table 11-9-54).

Overall, Alternative 9 would have negligible or beneficial effects on upstream spawning and rearing conditions in the upper Sacramento and Feather rivers.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, the following provides a narrative summary of potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture, which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al. 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds. Actions under Alternative 9 to increase the frequency of Yolo Bypass inundation would increase the frequency of potential stranding events. For splittail, an increase in inundation frequency would also increase the production of Sacramento splittail in the bypass. While total stranding losses may be greater under Alternative 9 than under NAA, the total number of splittail would be expected to be greater under Alternative 9.

In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the potential improvements in habitat capacity outweighed the potential stranding problems that may exist in some years.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The effects of Alternative 9 on splittail spawning habitat are largely beneficial. There would be substantial benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that would increase suitable spawning conditions. Effects of Alternative 9 on mean monthly flows would consist primarily of negligible effects (<5%) with occasional increases in flow (to 32% in the Sacramento River and to 25% in the Feather River) that would have beneficial effects on spawning conditions, with no reductions in flow. Effects on flow then would be beneficial for spawning conditions. Effects of Alternative 9 on water temperatures would be negligible in the Sacramento River, and would consist of primarily beneficial effects (reduced occurrence of preferred temperature exceedances) in the Feather River. There would be negligible effects on water temperatures in the Sacramento and Feather Rivers, relative to NAA.

CEQA Conclusion: In general, Alternative 9 would have beneficial effects on splittail spawning habitat relative to the Existing Conditions by increasing the quantity of spawning habitat in the Yolo Bypass through increased acreage subjected to periodic inundation. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River, with some beneficial effect due to increases in mean monthly flow for some months and water year types during the spawning period. There would be negative effects on water temperatures in the Feather River relative to the Existing Conditions, but the benefits due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River, as evidenced by the large amount of spawning activity when inundated.

Floodplain Habitat

The proposed changes to the Fremont Weir under Alternative 9 would have moderate effects on the frequency and duration of Yolo Bypass inundation events compared to Existing Conditions, with the largest changes including both increases and decreases in longer-duration inundation events in wetter water years and primarily no effect (0% difference) in drier water years (Table 11-9-52). Comparisons of splittail weighted habitat area for Alternative 9 to Existing Conditions (Table 11-9-53) indicate that Alternative 9 would result in increased acreage of suitable spawning habitat in most water year types, of between 5 and 1,083 acres, depending on water year type. Increased areas for wet, above normal, and below normal water years are predicted to be 70%, 55%, and 175%, respectively, for Alternative 9. Comparisons for dry and critical water years indicate no project-related change in inundated acreage for dry years and a project-related increase of 5 acres of suitable spawning habitat in critical years, compared to 0 acres under Existing Conditions. These results indicate that Alternative 9 would have beneficial effects on splittail habitat through increasing spawning habitats by up to 175%.

Channel Margin and Side-Channel Habitat

Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate that Alternative 9 would have primarily negligible effects (<5%) and small-scale increases and decreases in mean monthly flow (to 15%) during February through April. Effects of Alternative 9 during May, and June consist primarily of small to moderate increases in flow (to 44%) that would have beneficial effects on spawning conditions, with the exception of one moderate reduction in flow during May in wet years (-19%), when effects of flow reductions on spawning conditions would be less critical. Therefore, the impact on spawning habitat for Sacramento splittail on the upper Sacramento River would be less than significant.

Flows in the Feather River at the confluence with the Sacramento River were evaluated during February through June. Flows during this period would generally be similar between Existing Conditions and A9_LLT during February, April and May with some exceptions, and with substantial decreases during June and drier water years during March. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results show that Alternative 9 on flow would not have biologically meaningful effects on splittail rearing conditions in the Feather River.

There would be no difference between Existing Conditions and A9_LLT in the number of years with water temperatures below 45°F (Table 11-7-54) because there are never any months with temperatures below 45°F under any scenario. Exceedances above 75°F under A9_LLT would occur more often than under Existing Conditions in dry and critical water years but not in other water years. These results indicate that Alternative 9 would have negative temperature effects on splittail spawning in the Feather River in dry and critical water years and would have no effect in below normal, above normal and wet water year types.

Stranding Potential

As described in the NEPA effects section above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 9 would be as described for Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

Collectively, these results indicate that the impact would be less than significant because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality, and no mitigation would be necessary. The effects of Alternative 9 on splittail spawning habitat are largely beneficial. There would be substantial benefits due to increased inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that would increase suitable spawning conditions. Benefits due to increased inundation in the Yolo Bypass would outweigh relatively small, project-related increases in exceedance of preferred water temperatures in the Feather River. This is because the Yolo Bypass is a more important splittail spawning habitat than the Feather River channel margin habitat, as evidenced by the large amount of spawning activity in the Yolo Bypass when inundated. Effects of Alternative 9 on mean monthly flows would consist primarily of negligible effects (<5%), increases in flow (to 44% in the Sacramento River and to 29% in the Feather River) that would have beneficial effects on spawning conditions, with small, infrequent reductions in flow (to -19%) in the Sacramento River and more persistent and substantial flow reductions (to -31%) in the Feather River that would occur at the end of the spawning period and therefore would not have biologically meaningful effects on spawning conditions.

Summary of CEQA Conclusion

Overall, these results indicate that the impact is less than significant because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. No mitigation is necessary. Benefits to spawning habitat availability in the Yolo Bypass would outweigh negative effects of increased exposures to water temperatures above the upper threshold of 75°F in the Feather River, especially in drier water year types. Increased occurrence of higher water temperatures would increase stress to splittail, but only a small percentage of spawning occurs in the Feather River relative to the Yolo Bypass. Therefore, this would have a less-than-significant impact on the splittail population. There would be negligible effects on water temperatures in the Sacramento and Feather Rivers, relative to Existing Conditions.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years whereas the CEQA Existing Conditions do not. Second, the NAA baseline is assumed to occur during the late long-term implementation period whereas the CEQA conclusion assume existing climate conditions. Therefore, differences in model outputs between Existing Conditions and the Alternative 1A are due primarily to both the alternative and future climate change.

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

In general, Alternative 9 would have beneficial effects on splittail rearing habitat relative to the NAA by increasing the quantity and quality of rearing habitat in the Yolo Bypass. There would be beneficial effects on rearing conditions in channel margin and side-channel habitats from moderate to substantial increases in mean monthly flow during most of the rearing period in the Sacramento River and the Feather River. There would be a beneficial effect from reduced exposure to critical water temperatures in the Feather River.

Floodplains are important rearing habitats for juvenile splittail during periods of high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion applies to rearing as well as spawning habitat for splittail.

NEPA Effects: Based on the analyses above, the effect of Alternative 9 on splittail rearing habitat would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality.

CEQA Conclusion: In general, Alternative 9 would have beneficial effects on splittail rearing habitat relative to Existing Conditions by increasing the quantity of rearing habitat in the Yolo Bypass through increased acreage subjected to periodic inundation. There would be negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River**,** with beneficial effect due to moderate to substantial increases in mean monthly flow for some months and water year types during the rearing period. There would be negative effects on water temperatures in the Feather River relative to Existing Conditions, but the benefits due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water temperatures in the Feather River because the Yolo Bypass is a more important rearing habitat to splittail than channel margin habitat in the Feather River as evidenced by the large amount of rearing activity when inundated.

As described above, floodplains are important rearing habitats for juvenile splittail during periods of high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion applies to rearing as well as spawning habitat for splittail. Based on the analyses above, the impact of Alternative 9 on splittail rearing habitat would be less than significant because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of mortality, and no mitigation would be necessary.

Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento Splittail

Upstream of the Delta

In general, effects of Alternative 9 would not affect splittail migration conditions in the Sacramento River or the Feather River relative to the NAA, based on negligible or beneficial effects on mean monthly flow during the migration period and exposure to critical water temperatures in the Feather River.

The effects of Alternative 9 on splittail migration conditions would be the same as described for channel margin and side-channel habitats in the Sacramento River and Feather River for Impact AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both locations from increases in mean monthly flow, and from decreased exposure to critical high water temperatures compared to NAA conditions.

Through-Delta

Movement patterns within the Delta are not well understood. Under Alternative 9, screened intakes from the Sacramento River at DCC and Georgiana sloughs would limit movement of splittail from the Sacramento River into the central Delta. Several operable barriers would be installed to provide safe fish migration corridors and to isolate water conveyance corridors (at head of Old River and San Joaquin River, sloughs and canals between Old River and Middle River, locations at the mouth of Old River, and near the lower Mokelumne River). The barriers would alter potential movement pathways between the eastern Delta and other regions, and from the Sacramento River to the San Joaquin River, but the degree of isolation would depend on timing and duration of closure. The operable nature of the barriers would reduce impacts to migration conditions. Most barriers would be operated to pass high flows, which would maintain periodic connectivity among Delta regions.

NEPA Effects: Alternative 9 would not substantially reduce or degrade upstream migration habitat conditions or substantially reduce associated splittail mortality. While operable barriers would provide safer migration and isolated water conveyance corridors through the Delta, they could also restrict movement pathways within the Delta. Therefore, Alternative 9 could have minor effects on through-Delta migration conditions. Overall, Alternative 9 would not be adverse to the splittail population or their migration conditions.

CEQA Conclusion:

Upstream of the Delta

In general, effects of Alternative 9 would have beneficial effects on splittail migration conditions relative to Existing Conditions, based on moderate to substantial increases in mean monthly flow in the Sacramento River and the Feather River. There would be a negative effect based on a small increase in exposure to critical water temperatures in the Feather River but this would be offset by the more substantial beneficial effects from increases in mean monthly flow for much of the migration period.

Effects of Alternative 9 on splittail migration conditions would be similar to those described for channel margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact would be less than significant because it would not substantially reduce suitable migration habitat or substantially reduce the number of fish as a result of mortality and no mitigation would be necessary. Effects of Alternative 9 on flow would not have negative effects on the availability of channel margin and main-channel habitat, and would have a beneficial effect through increases in mean monthly flow for some months and water year types during the migration period. Benefits to flow conditions would outweigh negative effects of increased exposures to critical water temperatures in the Feather River.

Through-Delta

As described above in Impact AQUA-112, the potential impact is considered less than significant, and no mitigation would be required.

Summary of CEQA Conclusion

Effects of Alternative 9 on upstream migration habitat would be beneficial, relative to Existing Conditions, because of moderate to substantial increases in mean monthly flow in the Sacramento River and the Feather River. The small increase in potential exposure to critical water temperatures in the Feather River, would be offset by improved flows during much of the migration period. Alternative 9 would also have only minor effects on through-Delta migration conditions. Overall, Alternative 9 would be less than significant to the splittail population or their migration conditions, and no mitigation would be required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115 through Impact AQUA-117) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail

Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on Sacramento Splittail

Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to Sacramento splittail, and most would be at least slightly beneficial. Specifically for AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for Sacramento splittail under Alternative 1A (Impact AQUA-118 through Impact AQUA-126) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)

Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento Splittail (CM13)

Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail (CM14)

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (CM15)

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)

Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)

Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)

Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)

Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento Splittail (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on Sacramento splittail for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on Sacramento splittail, for the reasons identified for Alternative 1A, and no mitigation is required.

Green Sturgeon

Construction and Maintenance of CM1

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

The potential effects of construction of water conveyance facilities on green sturgeon would be similar to but greater than those described under Impact AQUA-127, under Alternative 1A. Alternative 9 would have more construction impact locations, resulting in temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). The effects related to temporary increases in turbidity, accidental spills, in-water work activities, and disturbance of contaminated sediments would be similar to Alternative 1A and the same environmental commitments and mitigation measures would be available to avoid and minimize potential effects (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments*). The number of juveniles that could be present in the north Delta during construction of the cofferdams, would result in a moderate risk of exposure to potentially harmful underwater sound levels. Therefore, there is a moderate potential for juvenile green sturgeon to experience an adverse effect (e.g., injury or mortality). However, the relatively low incidence and intermittent use of impact pile driving expected, and implementation of the avoidance and minimization measures included in Mitigation Measures AQUA-1a and AQUA-1b would minimize potential effects.

NEPA Effects: Overall, the effects of Alternative 9 on green sturgeon would not be adverse.

CEQA Conclusion: Although Alternative 9 affects a larger in-water area than Alternative 1A, as described in Impact AQUA-127, the impact of construction of the water conveyance facilities on green sturgeon would be less than significant except for construction noise associated with pile driving. The number of sites where noise impacts would potentially occur are greater under Alternative 9 because it has more operable barrier construction sites than Alternative 1A. However, 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.

Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-128).

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-128, the impact would not be adverse for green sturgeon.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-128 for green sturgeon, the impact of the maintenance of water conveyance facilities on green sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Alternative 9 would substantially reduce entrainment of juvenile green sturgeon at the south Delta export facilities compared to the NAA, due to screening and operable barriers to isolate fish corridors from water conveyance corridors. Fish screens at north Delta intakes (DCC and Georgiana Slough) would prevent entrainment and would reduce exposure to entrainment at agricultural diversions in the east Delta. The effect would be beneficial.

Predation Associated with Entrainment

The impact would be the same as described for green sturgeon in Alternative 2A (see Impact AQUA-129). In general, sturgeon in the Delta have low risk of predation from other fish because juvenile sturgeon grow rapidly and develop protective bony scutes.

NEPA Effects: The overall effect of Alternative 9 operations on entrainment would benefit green sturgeon. The effect would be beneficial.

***CEQA Conclusion*:** As described in Alternative 2A, Impact AQUA-129 for green sturgeon, the impact of the water operations on green sturgeon would be beneficial and no mitigation would be required.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 9 would not affect spawning and egg incubation habitat for green sturgeon relative to the NAA.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows can reduce the instream area available for spawning and egg incubation (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would always be similar to or greater than flows under NAA at both locations although flows can be lower or higher in individual months of individual years. These results indicate that there would be very few reductions in flows in the Sacramento River under Alternative 9.

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 9 in any month or water year type throughout the period.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees above the 63°F threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-55. There would be substantial increases the number of days with "orange" and "yellow" "levels of concern" between NAA and Alternative 9.

Table 11-9-55. Differences between Baseline and Alternative 9 Scenarios in the Number of Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Red	10 (250%)	1 (7%)
Orange	3 (300%)	3 (75%)
Yellow	6 (300%)	3 (38%)
None	-19 (-25%)	-7 (-13%)

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-9-56). Total degree-days under Alternative 9 would be 17% higher than under NAA during June, and no different (<5%) in the other months of the period.

Table 11-9-56. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	55 (423%)	0 (0%)
	Above Normal	4 (NA)	-1 (-20%)
	Below Normal	3 (NA)	1 (50%)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	63 (485%)	0 (0%)
June	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	19 (NA)	1 (6%)
	All	21 (NA)	3 (17%)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	1 (NA)	1 (NA)
	Critical	612 (7,650%)	-18 (-2.8%)
	All	614 (7,675%)	-16 (-3%)
August	Wet	2 (NA)	-1 (-33%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	78 (NA)	12 (18%)
	Critical	1,507 (750%)	-54 (-3%)
	All	1,588 (790%)	-41 (-2%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	-2 (-100%)
	Below Normal	7 (NA)	-6 (-46%)
	Dry	511 (1,648%)	28 (5%)
	Critical	1,256 (470%)	-6 (0%)
	All	1,775 (596%)	16 (1%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the March through June green sturgeon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would almost always be similar to or greater than flows under NAA at both locations, except in dry years during March at Thermalito (7% lower). These results indicate that there would be very few reductions in flows in the Feather River under Alternative 9 independent of climate change.

Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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 9 in any month or water year type throughout the period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-9-57). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In both May and June, the percent of months exceeding the threshold under Alternative 9 would be similar to or lower (up to 17% lower on an absolute scale) than the percent under NAA.

Table 11-9-57. Differences between Baseline and Alternative 9 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 64°F Threshold, May through September

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LLT					
May	30 (92%)	21 (113%)	11 (113%)	11 (300%)	6 (250%)
June	6 (7%)	9 (10%)	14 (17%)	27 (42%)	36 (74%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	23 (34%)
August	0 (0%)	0 (0%)	9 (9%)	19 (23%)	25 (40%)
September	-6 (-9%)	0 (0%)	17 (61%)	27 (367%)	23 (950%)
NAA vs. A9_LLT					
May	-10 (-14%)	-17 (-30%)	-11 (-35%)	-4 (-20%)	-4 (-30%)
June	0 (0%)	0 (0%)	-2 (-3%)	-1 (-1%)	-4 (-4%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-5 (-5%)
August	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-10 (-10%)
September	-5 (-7%)	-5 (-8%)	-4 (-8%)	-9 (-20%)	-2 (-9%)

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-9-58). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 9 would be 10% lower than that under NAA during May and no different (<5%) in June.

Table 11-9-58. Differences between Baseline and Alternative 9 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 CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	26 (433%)	2 (7%)
	Above Normal	12 (109%)	-2 (-8%)
	Below Normal	21 (263%)	-3 (-9%)
	Dry	19 (136%)	-10 (-23%)
	Critical	18 (106%)	-2 (-5%)
	All	95 (170%)	-16 (-10%)
June	Wet	68 (91%)	1 (1%)
	Above Normal	27 (53%)	-2 (-3%)
	Below Normal	33 (51%)	1 (1%)
	Dry	49 (52%)	-4 (-3%)
	Critical	38 (68%)	-1 (-1%)
	All	214 (63%)	-6 (-1%)
July	Wet	23 (14%)	7 (4%)
	Above Normal	15 (28%)	-2 (-3%)
	Below Normal	32 (47%)	0 (0%)
	Dry	54 (63%)	10 (8%)
	Critical	62 (78%)	8 (6%)
	All	186 (41%)	23 (4%)
August	Wet	15 (8%)	-2 (-1%)
	Above Normal	19 (42%)	-3 (-4%)
	Below Normal	32 (46%)	0 (0%)
	Dry	82 (121%)	4 (3%)
	Critical	49 (58%)	-1 (-1%)
	All	197 (44%)	-2 (0%)
September	Wet	-25 (-64%)	2 (17%)
	Above Normal	-6 (-38%)	3 (43%)
	Below Normal	36 (129%)	-4 (-6%)
	Dry	53 (189%)	1 (1%)
	Critical	51 (255%)	-3 (-4%)
	All	109 (83%)	-1 (0%)

NA = could not be calculated because the denominator was 0.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 9 would be similar to flows under NAA during the March through June spawning and egg incubation period, (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be limited project-related effects to flows and water temperatures in the Sacramento and Feather Rivers that would not affect spawning and egg incubation conditions for green sturgeon.

CEQA Conclusion: In general, Alternative 9 would not affect spawning and egg incubation habitat for green sturgeon relative to Existing Conditions.

Sacramento River

Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under A9_LLT at both locations would generally be similar to or greater than under Existing Conditions, except in below normal years during March at both locations (11% to 20% lower), wet years during May at both locations (20% to 25% lower), above normal years during March and April at Keswick (7% lower for both), and below normal years during April (7% lower) at Keswick although flows can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period, except for a 5% increase in wet years during May.

The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period (Table 11-9-55). The combination of number of days and degrees above the 63°F threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-10. The number of “red” years would be 250% higher under Alternative 9 relative to Existing Conditions.

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-9-56). Water temperatures under Alternative 9 would exceed the threshold 63 degree-days (485%) and 21 degree-days (no relative change calculation possible due to division by 0) more than those under Existing Conditions during May and June, respectively.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the March through June green sturgeon spawning and egg incubation period. At Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal and dry years during March (39% and 18% lower, respectively) and wet years during May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence with the Sacramento River, flows under A9_LLT would generally be up to 31% lower during March and June, and generally similar to or greater than flows under Existing Conditions during the April and May, except in wet and above normal years during May (27% and 11% lower, respectively). These results indicate that there would be reductions in flows in the Feather River under Alternative 9 relative to Existing Conditions. Mean monthly water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would generally be no differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative 9 in any month or water year type throughout the period, except during February, in which mean monthly temperatures under Alternative 9 would be 6% higher than that under Existing Conditions.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-9-57). For this impact, only the months of May and June were examined because spawning and egg incubation does not generally extend beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. During the period, the percent of months exceeding the threshold under Alternative 9 would be similar to or higher (up to 23% higher on an absolute scale) than the percent under Existing Conditions.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-9-58). Only May and June were examined for spawning and egg incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-months exceeding the threshold under Alternative 9 would be 43% to 154% higher than those under Existing Conditions during May and June.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 9 would be up to 38% lower than flows under Existing Conditions during the March through June spawning and egg incubation period, particularly in drier water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat and substantially reduce the number of fish from egg mortality, contrary to the NEPA conclusion set forth above. There would be flow reductions during substantial portions of the green sturgeon spawning and egg incubation period under Alternative 9 in the Feather and San Joaquin rivers. Further, there would be low, but persistent, temperature increases of Alternative 9.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in

the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

Upstream of the Delta

In general, Alternative 9 would not reduce the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to the NAA.

Water temperature was used to determine the potential effects of H3 on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthically oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing 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 9 in any month or water year type throughout the period.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 9 in any month or water year type throughout the period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-9-57). The percent of months exceeding the threshold under Alternative 9 would be similar to or lower (up to 17% lower on an absolute scale) than the percent under NAA in all months of the juvenile rearing period.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-9-58). Total degree-months exceeding the threshold under Alternative 9 would be 10% lower than those under NAA during May and would be similar to (<5%) those under NAA during June through September.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Through-Delta

Operable barriers on the eastern ends of Woodward Canal, Santa Fe Canal, and Connection Slough would eliminate flows through these sloughs, potentially altering water quality conditions locally and reducing habitat connectivity for Delta resident green sturgeon. The structural components of these barriers would have small localized impacts on benthic habitat, but this loss of Delta benthic habitat would be small overall (less than 1% loss). Changes to existing benthic foraging habitat would be offset by creation of additional tidal habitat.

NEPA Effects: Collectively, the results indicate that the effect would not be adverse because it would not substantially reduce suitable rearing habitat. Upstream flows and water temperatures under Alternative 9 during the rearing period would not substantially differ in any river evaluated between Alternative 9 and the NEPA point of comparison. Further, in-Delta rearing habitat would not be affected by Alternative 9.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature under Alternative 9 would be similar to those under Existing Conditions during May through July, but 5% to 9% lower than those under Existing Conditions during August through October.

Feather River

Mean monthly water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon juvenile rearing 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 Existing Conditions and Alternative 9 in any month of the rearing period.

The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley was evaluated during May through September (Table 11-9-57). The percent of months exceeding the threshold under Alternative 9 would be similar to or greater (up to 36% higher on an absolute scale) than the percent under Existing Conditions in all months during the period.

Total degree-days exceeding 64°F were summed by month and water year type at Gridley during May through September (Table 11-9-58). Total degree-months exceeding the threshold under Alternative 9 would be 41% to 170% greater than those under Existing Conditions depending on month.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River.

Through-Delta

As described above in Impact AQUA-131 for the NEPA effect, the impact of the water operations on green sturgeon rearing habitat would be less than significant and no mitigation would be required.

Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set forth above. There would be temperature increases under Alternative 9 in the Sacramento and Feather Rivers during the rearing period that could substantially degrade rearing habitat suitability. There would be no effects of Alternative 9 on in-Delta rearing habitat.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

Upstream of the Delta

In general, the effects of Alternative 9 on green sturgeon migration conditions relative to the NAA are uncertain.

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows under A9_LLT would nearly always be similar to or greater than flows under NAA in all months, except during October at Keswick (up to 14% lower) and during August and October at Wilkins Slough (up to 15% lower).

Flows under A9_LLT would generally be lower by up to 14% than those under NAA in the Feather River during October depending on location and water year type. Flows during other months under A9_LLT would generally be similar to or greater than flows under NAA, with few exceptions (up to 22% lower) depending on month, location, and water year type.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved green sturgeon larval transport that results in improved year class strength. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be lower under Alternative 9.

Through-Delta

The impact of Alternative 9 on in-Delta conditions would be the same as described for splittail in Impact AQUA-114. The effect on green sturgeon would not be adverse.

NEPA Effects: Upstream flows (above north Delta intakes) are similar between Alternative 9 and NAA. However, due to the removal of water at the north Delta intakes, there are substantial differences in through-Delta flows between Alternative 9 and NAA (see Table 11-9-63 below). Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green sturgeon, found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 9 would be deemed Not Adverse due to the similarities in upstream flow conditions between Alternative 9 and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 9 would be deemed Adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 9 as compared to NAA.

CEQA Conclusion: In general, under Alternative 9 water operations, migration habitat for green sturgeon would not be affected relative to the CEQA baseline.

Upstream of the Delta

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows at Keswick under A9_LLT would generally be similar to or greater than flows under Existing Conditions in all months, except during October and December (up to 15% lower) and in some water year types throughout the rest of the period (up to 27% lower). Flows at Wilkins Slough under A9_LLT would generally be similar to or greater than flows under Existing Conditions in all months), except during October during which flows would be up to 13% lower than under Existing Conditions, depending on month and water year type and in some water year types throughout the rest of the period (up to 28% lower).

Flows in the Feather River at Thermalito under A9_LLT would generally be up to 55% lower than flows under Existing Conditions during October through February and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 56% lower). Flows in the Feather River at the confluence with the Sacramento River under A9_LLT would generally be up to 35% lower than flows under Existing Conditions during March, June, July and October, and generally similar to or greater than flows under Existing Conditions during the rest of the period, with some exceptions (up to 33% lower).

For Delta outflow, the percent of months exceeding outflow thresholds under A9_LLT would nearly always be lower than those under Existing Conditions for each flow threshold, water year type, and month (up to 50% lower) with few exceptions (see Table 11-9-63 below).

Through-Delta

As described above, the potential impact is considered less than significant, and no mitigation would be required.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-132 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. The frequent and often large reductions in flows in the Feather River would reduce the ability of green sturgeon to migrate successfully. Flows would generally be similar in the Sacramento River, except during 1 or 2 months depending on location. Exceedance of Delta outflow thresholds would be lower under Alternative 9 than under Existing Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows co-vary with another unknown factor. Through-Delta migration would not be affected by Alternative 9 relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration conditions for green sturgeon. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-135) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to green sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-136 through Impact AQUA-144) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)

Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon (CM13)

Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (CM15)

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)

Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)

Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)

Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)

Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green Sturgeon (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

White Sturgeon

Construction and Maintenance of CM1

Juvenile and adult spawning white sturgeon could be present in the vicinity of the intake and barge landings during in-water construction. Table 11-6 illustrates the species and life stages of white sturgeon present in the north, east, and south Delta during the in-water construction window (expected to be June 1–October 31). Juveniles may be present year-round in all the construction areas. The potential for exposure of white sturgeon to construction-related activities is expected to be low, and would be limited to two construction seasons (one for installation of cofferdams and barge landings, and one for removal of cofferdams and barge landings).

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of construction of water conveyance facilities on white sturgeon under Alternative 9 would be the same as those described for green sturgeon under Alternative 9 (see Impact AQUA-127), which concluded that environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and that the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Impact AQUA-127 for green sturgeon under Alternative 9, the impact of the construction of water conveyance facilities on white sturgeon under Alternative 9 would be less than 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.

Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

The potential effects of maintenance of water conveyance facilities on white sturgeon under Alternative 9 would be the same as those described for green sturgeon under Alternative 9 (see Impact AQUA-128).

NEPA Effects: As concluded for Impact AQUA-128 for green sturgeon, the effect would not be adverse for white sturgeon.

CEQA Conclusion: As described in Impact AQUA-128 for green sturgeon under Alternative 9, the impact of the construction of water conveyance facilities on white sturgeon under Alternative 9 would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

The potential effects of the water operations under Alternative 9 would be the same as those described for green sturgeon (see Alternative 9, Impact AQUA-129). As concluded in Impact AQUA-129, the impact would be beneficial for white sturgeon.

Predation Associated with Entrainment

The potential effects would be the same as described for green sturgeon in Alternative 2A, Impact AQUA-129. In general, sturgeon in the Delta have low risk of predation from other fish because juveniles grow rapidly and develop protective bony scutes.

NEPA Effects: The overall effect of Alternative 9 operations on entrainment would benefit white sturgeon. The effect would be beneficial.

CEQA Conclusion: As described under Alternative 9, Impact AQUA-129 for green sturgeon, the impact of the water operations on white sturgeon would be beneficial and no mitigation would be required.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 9 would not affect spawning and egg incubation habitat for white sturgeon relative to the 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 A9_LLT at Wilkins Slough from February to May would always be similar to or greater than those under NAA. Flows under A9_LLT at Verona from February to May would be lower by up to 7% during March and generally similar to or greater than flows under NAA during the rest of the period, except in below normal and dry years during February (7% and 5% lower, respectively) and wet and above normal years during April (7% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 9 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 11-9-8). The combination of number of days and degrees above each threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-59. For the 61°F threshold, there would be 4 fewer (43% fewer) “red” years under Alternative 9 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 9

Table 11-9-59. Differences between Baselines and Alternative 9 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. A9_LLT	NAA vs. A9_LLT
61°F threshold		
Red	45 (563%)	-4 (-8%)
Orange	-1 (-7%)	2 (14%)
Yellow	-21 (-68%)	0 (0%)
None	-23 (-82%)	2 (40%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	1 (NA)	1 (100%)
Yellow	2 (NA)	-1 (-50%)
None	-3 (-4%)	0 (0%)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-9-60, Table 11-9-61). Total degree-days exceeding the 61°F threshold under Alternative 9 would be the same as or similar to (<5% difference) total degree-days under NAA during March and June. During April, total degree days exceeding the threshold would be 5% higher than those under NAA and during May total degree days exceeding the threshold would be 9% lower. Total degree-days exceeding the 68°F threshold would not differ between NAA and Alternative 9 during March and April, but would be 5% lower under Alternative 9 than under NAA during May and 17% higher during June.

Table 11-9-60. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	4 (NA)	0 (0%)
	Dry	11 (NA)	0 (0%)
	Critical	1 (NA)	0 (0%)
	All	16 (NA)	0 (0%)
April	Wet	66 (550%)	0 (0%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	73 (1,217%)	11 (16%)
	Dry	159 (312%)	15 (8%)
	Critical	16 (1,600%)	2 (13%)
	All	374 (468%)	20 (5%)
May	Wet	1,097 (329%)	-18 (-1%)
	Above Normal	342 (157%)	-9 (-2%)
	Below Normal	429 (233%)	-20 (-3%)
	Dry	147 (73%)	-286 (-45%)
	Critical	355 (176%)	5 (1%)
	All	2,370 (208%)	-328 (-9%)
June	Wet	1,006 (174%)	48 (3%)
	Above Normal	315 (103%)	-51 (-8%)
	Below Normal	550 (261%)	48 (7%)
	Dry	725 (216%)	23 (2%)
	Critical	621 (166%)	75 (8%)
	All	3,217 (179%)	143 (3%)

NA = could not be calculated because the denominator was 0.

Table 11-9-61. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_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	36 (514%)	0 (0%)
	Above Normal	18 (NA)	-2 (-10%)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	-2 (-100%)
	Critical	1 (NA)	0 (0%)
	All	56 (800%)	-3 (-5%)
June	Wet	9 (NA)	1 (13%)
	Above Normal	5 (500%)	1 (20%)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	32 (NA)	5 (19%)
	All	48 (4,800%)	7 (17%)

NA = could not be calculated because the denominator was 0.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in below normal years during February (6% lower) and dry years during March (7% lower). Flows under A9_LLT at the confluence with the Sacramento River would always be similar to or greater than flows under NAA. These results indicate that there would be very few reductions in flows in the Feather River during the white sturgeon spawning and egg incubation period under Alternative 9.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ between NAA and Alternative 9 at either location throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis under Alternative 9 during February through May would not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperature modeling was not conducted for the San Joaquin River.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 9 would generally be similar to flows under the NAA. In addition, exceedances above key water temperature thresholds for spawning adults and egg incubation under Alternative 9 would generally be similar to or lower than exceedances under the NAA.

CEQA Conclusion: In general, under Alternative 9 water operations, the quantity and quality of spawning and egg incubation habitat for white sturgeon would not be reduced relative to the CEQA baseline.

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 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Wilkins Slough, flows under A9_LLT would be similar to or greater than those under Existing Conditions, except in below normal water years during March (7% lower) and wet water years during May (19% lower). At Verona, flows under A9_LLT would be generally up to 16% lower than under Existing Conditions during February through April, and generally similar during May, except in wet years during May (22% lower). These results indicate that there would be small, yet frequent, reductions in flows in the Sacramento River under Alternative 9 relative to Existing Conditions. 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 Existing Conditions and Alternative 9 in any month or water year type throughout the period, except for a 6% increase in wet years during May.

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 11-9-8). The combination of number of days and degrees above each threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled years are presented in Table 11-9-59. For the 61°F threshold, there would be 45 more (563% increase) “red” years under Alternative 9 than under Existing Conditions. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between Existing Conditions and Alternative 9.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-9-60, Table 11-9-61). Total degree-days exceeding the 61°F threshold under Alternative 9 would be 16 degree-days (percent change unable to be calculated due to division by 0) to 3,217 degree-days (179%) higher depending on month. Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and Alternative 9 during March and April. During May and June, total degree-days would be 56 (800%)

and 48 (4,800%) degree-days higher under Alternative 9, although these small absolute differences would not cause a biologically meaningful effect on white sturgeon.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito Afterbay under A9_LLT would be lower than flows under Existing Conditions by up to 55% during February and generally greater than or similar to flows under NAA during March through May with the Sacramento River in below normal and dry water years during March (39% and 18% lower, respectively) and in wet years during May (35% lower). Flows at the confluence with the Sacramento River under A9_LLT would generally be similar to or greater than flows under Existing Conditions during February, April, and May except in below normal years during February (15% lower) and in wet and above normal water years during May (27% and 11% lower, respectively). Flows under A9_LLT would generally be lower during March (up to 15% lower). These results indicate that there would be few reductions in flows in the Feather River under Alternative 9 relative to Existing Conditions.

Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would not differ between Existing Conditions and Alternative 9 at either location throughout the period, except below Thermalito Afterbay during February, in which temperatures under Alternative 9 would be 6% higher than temperatures under Existing Conditions.

San Joaquin River

Mean monthly flows in the San Joaquin River at Vernalis under Alternative 9 during February through May would generally be lower than those under Existing Conditions, particularly in drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis)*.

Water temperature modeling was not conducted for the San Joaquin River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above. Flows in the Sacramento River at Verona and in the San Joaquin River are consistently lower under Alternative 9 relative to Existing Conditions, which would consistently reduce the amount of suitable habitat during the white sturgeon spawning and egg incubation period. Water temperature exceedances would be substantially higher under Alternative 9 relative to Existing Conditions. Elevated water temperatures can lead to reduced white sturgeon spawning success and higher egg mortality. There would be no effects of Alternative 9 on white sturgeon spawning habitat in the Feather River.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on spawning and egg incubation habitat for white sturgeon. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

Upstream of the Delta

In general, Alternative 9 would not affect quantity and quality of white sturgeon larval and juvenile rearing habitat relative to the NAA.

Water temperature was used to determine the potential effects of Alternative 9 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthically oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing 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 9 in any month or water year type throughout the period.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing 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 9 in any month or water year type throughout the period.

Water temperatures were not modeled in the San Joaquin River.

Through-Delta

The potential effects of the water operations of Alternative 9 on Delta rearing habitat would be the same as those described for green sturgeon (see Impact AQUA-131). As concluded in Impact AQUA-131, the impact would not be adverse for white sturgeon.

NEPA Effects: These results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat.

CEQA Conclusion:

Water temperatures in the upper Sacramento and Feather Rivers would be similar between NAA and Alternative 9 during the juvenile white sturgeon rearing period. In-Delta juvenile white sturgeon rearing habitat would not be affected by Alternative 9 relative to NAA.

Upstream of the Delta

In general, Alternative 9 would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 9 on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthically oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be similar between Existing Conditions and Alternative 9 during November through July and September, but 6% higher under Alternative 9 relative to Existing Conditions during August and 5% higher during October.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be similar between Existing Conditions and Alternative 9 during March through September, but 6% to 8% higher under Alternative 9 during October through February.

Water temperatures were not modeled in the San Joaquin River.

Through-Delta

As described in Impact AQUA-131 for green sturgeon, the impact of the water operations on white sturgeon rearing habitat would be less than significant and no mitigation would be required.

Summary of CEQA Conclusion

Considering the mostly small increase in temperature exceedance under Alternative 9, it is concluded that this impacts would be less than significant because it does not have the potential to substantially reduce the amount of suitable habitat. No mitigation would be necessary.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, the effects of Alternative 9 on white sturgeon migration conditions relative to the NAA are uncertain.

Upstream of the Delta

Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-9-62). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A9_LLT were identical to those under NAA. The number of months per year above 31,000 cfs at Verona under A9_LLT would be up to 33% lower than under NAA. Overall, there is no consistent difference between Alternative 9 and NAA.

Table 11-9-62. Difference and Percent Difference in Number of Months in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona

	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wilkins Slough, 17,700 cfs[a]		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.2 (12%)	0 (0%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs[b]		
Wet	-0.1 (-1%)	0.1 (2%)
Above Normal	-0.3 (-4%)	0.1 (1%)
Below Normal	0.4 (7%)	0.6 (13%)
Dry	0.8 (17%)	0.6 (11%)
Critical	0.2 (5%)	0.1 (2%)
Verona, 31,000 cfs[a]		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.1 (-40%)	-0.1 (-25%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.
[a] Months analyzed: February through May.
[b] Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percentage of months exceeding flow thresholds under A9_LLT would generally be lower by up to 50% than those under NAA for each flow threshold, water year type, and month (Table 11-9-63). These results indicate that, using the positive correlation between Delta outflow and year class strength, year class strength would generally be lower under Alternative 9.

Table 11-9-63. Difference and Percent Difference in Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in April and May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
April			
15,000 cfs	Wet	-8 (-8%)	-8 (-8%)
	Above Normal	-17 (-18%)	-17 (-18%)
20,000 cfs	Wet	-4 (-5%)	-4 (-5%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-15 (-17%)	-8 (-10%)
	Above Normal	-42 (-50%)	-17 (-29%)
20,000 cfs	Wet	-27 (-32%)	-4 (-6%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-19 (-28%)	-8 (-13%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-33 (-33%)	-25 (-27%)
20,000 cfs	Wet	-15 (-17%)	-12 (-14%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	0 (0%)	0 (0%)

For juveniles, year-round migration flows at Verona would generally be up to 13% lower under A9_LLT relative to NAA during January, March, and October and similar to or greater than flows under NAA during the rest of the year, with some exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-9-62). The average number of months exceeding 5,300 cfs under A9_LLT would generally be similar to or greater than the number of months under NAA, except in below normal and dry years (11% to 13% lower).

Through-Delta

The impact of Alternative 9 on in-Delta movement conditions would be the same as described for splittail in Impact AQUA-114. The effect on white sturgeon would not be adverse.

NEPA Effects: Upstream flows (above north Delta intakes) are similar between Alternative 9 and NAA (Table 11-9-62). However, due to the removal of water at the north Delta intakes, there are substantial differences in through-Delta flows between Alternative 9 and NAA (Table 11-9-63). Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations. If these targeted investigations determine that the primary mechanisms behind the positive correlation between high flows and sturgeon year-class strength are related to upstream conditions, then Alternative 9 would be deemed Not Adverse due to the similarities in upstream flow conditions between Alternative 9 and NAA. However, if the targeted investigations lead to a conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and through-Delta flow conditions, then Alternative 9 would be deemed Adverse due to the magnitude of reductions in through-Delta flow conditions in Alternative 9 as compared to NAA.

CEQA Conclusion: In general, under Alternative 9 water operations, migration conditions for white sturgeon would not be reduced relative to the CEQA baseline.

Upstream of the Delta

The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough under A9_LLT would generally be similar to or greater than those under Existing Conditions, except in below normal years (25% lower) (Table 11-9-62). The number of months per year above 31,000 cfs at Verona under A9_LLT would be 10% to 43% lower than the number under Existing Conditions in all water year types except critical years.

For Delta outflow, the percent of months exceeding outflow thresholds under A9_LLT would nearly always be lower than those under Existing Conditions for each flow threshold, water year type, and month (up to 50% lower) with few exceptions (Table 11-9-63).

For juveniles, year-round migration flows at Verona would be up to 18% lower under A9_LLT relative to Existing Conditions in most water year types in five of 12 months, January through April and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT during other months are generally similar to or greater than flows under Existing Conditions with some exceptions (up to 29% lower).

For adult migration, the average number of months exceeding 5,300 cfs under A9_LLT would generally be similar to or greater than the number of months under Existing Conditions (Table 11-9-62).

Through-Delta

As described above in Impact AQUA-150, the potential impact is considered less than significant, and no mitigation would be required.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta outflow would be lower under Alternative 9 than under Existing Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows are caused by another unknown factor. Juvenile migration flows in the Sacramento River at Verona would be up to 18% lower in five of 12 months relative to Existing Conditions. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality. There would be no effect of through-Delta migration conditions for white sturgeon under Alternative 9 relative to the CEQA baseline.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as described above in the NEPA Effects statement, further investigation is needed to better understand the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management would be used to make adjustments to meet the biological goals and objectives. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-153) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to white sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for white sturgeon under Alternative 1A (Impact AQUA-154 through Impact AQUA-162) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)

Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon (CM13)

Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (CM15)

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)

Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)

Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)

Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)

Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White Sturgeon (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A, and no mitigation is required.

Pacific Lamprey

Construction and Maintenance of CM1

Pacific lamprey are present in the north, east, and south Delta. Table 11-6 illustrates the species and life stages of Pacific lamprey present in these areas during the in-water construction window (expected to be June 1–October 31). Ammocoetes (larvae) are present year-round in all of the regions. Adult spawners may be migrating by the construction sites in June and July.

Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey

The potential effects of construction of water conveyance facilities on Pacific lamprey would be the same as described under Impact AQUA-163 under Alternative 1A. Alternative 9 would have more construction impact locations, resulting in temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) while there would be 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to approximately 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water construction locations the potential for noise effects is greater proportional to the increased number of sites compared to Alternative 1A.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for Pacific lamprey.

CEQA Conclusion: Although Alternative 9 affects a larger in-water area than Alternative 1A, as described in Impact AQUA-163, the impact of construction of the water conveyance facilities on Pacific lamprey would be less than significant except for construction noise associated with pile driving. The number of sites where noise impacts would potentially occur are greater under Alternative 9 because it has more operable barrier construction sites than Alternative 1A. However, 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.

Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, the potential effects of the maintenance of water conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-164).

NEPA Effects: As concluded in Impact AQUA-164, the impact would not be adverse for Pacific lamprey.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Impact AQUA-164 for Pacific lamprey, the impact of the maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey

Entrainment of Pacific lamprey at the SWP/CVP south Delta facilities would be substantially reduced under Alternative 9 compared to the NAA. Screening at the north Delta diversion sites, on the DCC and at Georgiana Slough, would be designed and operated to exclude lamprey. The project adaptive management plan includes monitoring of the new north Delta screens to determine their effectiveness and if they are not meeting expectations additional measures (i.e., modifications to screens or other structural components or changes in water diversion operations) may be implemented to improve screen performance. The screened intakes on the DCC and at Georgiana Slough would prevent Sacramento River basin lamprey from entering the interior delta, thus reducing potential entrainment to agricultural diversions in the Delta compared to the NAA.

Predation Associated with Entrainment

Lamprey pre-screen predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Due to the substantial reduction in lamprey predation at the SWP/CVP south Delta facilities under Alternative 9, there would also be a reduction in predation loss.

NEPA Effects: The overall effect of entrainment and entrainment-related predation on lamprey is considered beneficial.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be substantially reduced under Alternative 9 relative to Existing Conditions. The impact of predation loss at the north Delta would be unknown, since there is little available knowledge on their distribution and abundance in the Delta. Overall the impact on Pacific lamprey from water operations would be considered beneficial. No mitigation would be required.

Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for Pacific Lamprey

In general, effects of Alternative 9 on Pacific lamprey spawning habitat would be negligible relative to the NAA.

Flow-related impacts to Pacific lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk and effects on water temperature for the Sacramento River at Keswick, Sacramento River at 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. Pacific lamprey spawn in these rivers between January and August. Rapid reductions in flow can dewater redds leading to mortality. 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%. Water temperature results from the SRWQM and the Reclamation Temperature Model were used to assess the exceedances of water temperatures under all model scenarios in the upper Sacramento, Trinity, Feather, and American Rivers.

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, substrate) of Pacific lamprey are not adequately described to employ a more formal analysis such as a weighted usable area analysis. Therefore, the change in month-over-month flows is used as a surrogate for a more formal analysis, and a month-over-month flow reduction of 50% was chosen as a best professional estimate of flow conditions in which redd dewatering is expected to occur, but does not estimate empirically derived redd dewatering events. As such, 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, January to August.

Comparisons for Alternative 9 relative to NAA indicate negligible (<5%) to small reductions (to -13%) for all locations analyzed, indicating that project-related effects of Alternative 9 on flow would be beneficial and would not have negative effects on the number of Pacific lamprey redd cohorts predicted to experience a month-over-month change in flow of greater than 50% in all locations analyzed. (Table 11-9-64).

Table 11-9-64. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River at Keswick	Difference	13	-9
	Percent Difference	24%	-12%
Sacramento River at Red Bluff	Difference	9	-9
	Percent Difference	17%	-13%
Trinity River downstream of Lewiston	Difference	-3	-3
	Percent Difference	-2%	-2%
Feather River at Thermalito Afterbay	Difference	-49	-7
	Percent Difference	-33%	-7%
American River at Nimbus Dam	Difference	31	-6
	Percent Difference	37%	-5%
American River at Sacramento River confluence	Difference	34	-6
	Percent Difference	36%	-4%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 9 than Existing Conditions or NAA.

Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from January 1 through August 31, and 648 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Exact spawning locations of Pacific lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

In most locations, egg cohort exposure would generally not differ between NAA and Alternative 9 (Table 11-9-65). However, the number of cohorts exposed to 22°C (71.6°F) under Alternative 9 would be 91% lower in the Trinity River at Lewiston.

Table 11-9-65. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg Cohort Temperature Exposure[a]

Location	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River at Keswick	50 (NA)	-1 (-2%)
Sacramento River at Hamilton City	1,034 (NA)	-34 (-3%)
Trinity River at Lewiston	6 (300%)	-81 (-91%)
Trinity River at North Fork	14 (NA)	-3 (-18%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	81 (338%)	13 (14%)
American River at Nimbus	72 (655%)	-2 (-2%)
American River at Sacramento River Confluence	156 (279%)	-4 (-2%)
Stanislaus River at Knights Ferry	4 (NA)	2 (100%)
Stanislaus River at Riverbank	88 (4,400%)	1 (1%)

NA = could not be calculated because the denominator was 0.

[a] 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 Alternative 9 than in EXISTING CONDITIONS or NAA.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. This is based on prevalence of negligible effects or beneficial effects on redd dewatering risk for all locations analyzed (reductions in cohort exposure to flow reductions ranging from negligible, <5%, to -13%), and a small effect on water temperatures in the Feather

River (14% increase in egg cohorts exposed to water temperatures above 71.6°F) that would not have biologically meaningful effects on spawning success.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of Pacific lamprey spawning habitat relative to Existing Conditions.

Rapid reductions in flow can dewater redds leading to mortality. Effects of Alternative 9 on month-over-month flow reduction compared to Existing Conditions consist of negligible effects (<5% difference) in the Trinity River, a substantial decrease (-33%) in the Feather River, and moderate (17%) to substantial increases in dewatering exposures in the Sacramento River (to 24%) and the American River (to 37%) (Table 11-9-64). The moderate to substantial increases in egg cohorts exposed to dewatering risk in the Sacramento River and the American River would affect spawning success for these locations. The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 9 would be greater than that under Existing Conditions in all the river locations (Table 11-9-65).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality contrary to the NEPA conclusion set forth above. Impacts of Alternative 9 on flow would result in moderate to substantial increases in Pacific lamprey redd dewatering risk in the Sacramento River (to 24%) and the American River (to 37%). Impacts of Alternative 9 on water temperatures in the Feather River would substantially increase exposure of egg cohorts (81 cohorts or 338%) to water temperatures above 71.6°F during the incubation period which could cause mortality and negatively affect spawning success.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on Pacific lamprey spawning habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, effects of Alternative 9 on Pacific lamprey rearing habitat would be negligible relative to the NAA.

Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk 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 9 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 11-9-66). Results for Alternative 9 compared to NAA indicate either no effect (0%) or negligible effects (<5%) on cohort exposures to all flow reductions, with the exception of a moderate increase (18%), to flow reduction events of 85%. These results indicate that project-related effects of Alternative 9 on flow would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding in the Sacramento River at Keswick.

Table 11-9-66. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	2	-1
-65%	1	1
-70%	0	0
-75%	1	4
-80%	7	0
-85%	73	18
-90%	NA	NA

NA = all values were 0.

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-9-67) for Alternative 9 compared to NAA indicate no change (0%) or negligible effects (≤5%) in all flow reduction categories. These results indicate that project-related effects of Alternative 9 on flow would not affect Pacific lamprey ammocoete cohort stranding in the Sacramento River at Red Bluff.

Table 11-9-67. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	4	0
-60%	4	3
-65%	3	1
-70%	13	0
-75%	6	-3
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons for the Trinity River indicate no effect (0%) or negligible effects (≤5%) attributable to the project for all flow reduction categories (Table 11-9-68). These results indicate that project-related effects of Alternative 9 on flow would not affect Pacific lamprey ammocoete stranding in the Trinity River.

Table 11-9-68. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	24	-3
-85%	14	-3
-90%	36	0

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons of Alternative 9 to NAA for the Feather River indicate no effect (0%), negligible effects (<5%), or reductions (-28%) in the percentage of cohorts exposed to all flow reduction categories which would have beneficial effects on spawning success (Table 11-9-69). These results indicate that project-related effects of Alternative 9 on flow would not have negative effects on Pacific lamprey ammocoete stranding in the Feather River.

Table 11-9-69. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	2
-85%	28	-3
-90%	-64	-28

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons for the American River at Nimbus Dam (Table 11-9-70) and at the confluence with the Sacramento River (Table 11-9-71) indicate negligible effects (≤5%) and small (-9%) to substantial (-67%) decreases in exposure attributable to the project, compared to NAA. The small to substantial decreases in all the larger flow reduction categories for both locations would have beneficial effects on spawning success.

Table 11-9-70. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	-1
-65%	1	-1
-70%	33	-5
-75%	75	-9
-80%	171	-29
-85%	196	-42
-90%	0	-67

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Table 11-9-71. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	0	-1
-70%	4	-4
-75%	20	-12
-80%	171	-8
-85%	142	-31
-90%	145	-42

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

To evaluate water temperature-related effects of Alternative 9 on Pacific lamprey ammocoetes, we examined the predicted number of ammocoete "cohorts" that experience water temperatures greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each individual day or month starts a new "cohort" such that there are 18,244 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

There would be differences in the number of ammocoete cohorts exposed to temperatures greater than 71.6°F in most of the rivers (Table 11-9-72). There would be 671 fewer cohorts (6% decrease) under Alternative 9 in the Sacramento River at Hamilton City, 79 more cohorts (70% increase) exposed under Alternative 9 in the Trinity River at Lewiston, but 56 fewer cohorts (18% decrease) exposed in the Trinity River at North Fork. In addition, there would be 31 more cohorts (6% increase) exposed under Alternative 9 in the Feather River below Thermalito Afterbay, and 57 more cohorts (102% increase) exposed in the Stanislaus River at Knights Ferry. Overall, the increases and decreases are expected to balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

Table 11-9-72. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F in at Least One Day or Month

Location	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River at Keswick[b]	1,704 (NA)	-1 (-0.1%)
Sacramento River at Hamilton City[b]	10,584 (NA)	-671 (-6%)
Trinity River at Lewiston	192 (NA)	79 (70%)
Trinity River at North Fork	249 (NA)	-56 (-18%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	170 (45%)	31 (6%)
American River at Nimbus	353 (182%)	-14 (-2%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	113 (NA)	57 (102%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.
[a] Positive values indicate a higher value in Alternative 9 than in EXISTING CONDITIONS or NAA.
[b] Based on daily data; all other locations use monthly data; 1922–2003.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. There would be no substantial increases in redd dewatering risk in all locations and reduced risk in the American River. There would be increases and decreases in ammocoete exposure to elevated temperatures that are expected to balance out within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of Pacific lamprey rearing habitat relative to the NAA. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of Alternative 9 to Existing Conditions for the Sacramento River at Keswick indicate negligible changes (≤5%) in ammocoete cohort exposure to flow reductions for all flow reduction categories with the exception of a small increase (7%) in cohorts exposed to 80% flow reduction events and a more substantial increase (73%) in cohorts exposed to 85% flow reductions (Table 11-9-66). Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%) for all flow reduction categories, with the exception of small increases in exposure (13%) for 70% and 80% flow reduction events, and a more substantial increase (56 to 112 cohorts or 100%) for 85% flow reduction events. The occurrence of fairly substantial increases in exposure to a relatively large flow reduction event could have negative effects on ammocoete survival at both locations, but not to the extent that would be considered a biologically meaningful negative effect on rearing success.

Comparisons of Alternative 9 to Existing Conditions for the Trinity River indicate no effect (0% difference) for flow reductions from 50% to 70%, and increases ranging from 14% to 36% for the larger flow reduction categories (Table 11-9-68). Despite the prevalence of increased exposure risk to the higher flow reduction events, the percentage of cohorts exposed to stranding risk is relatively small compared to the total number of cohorts exposed to dewatering risks under Existing Conditions (for example, an increase from 346 to 470 cohorts for 36%) and therefore effects of

Alternative 9 are not expected to have biologically meaningful effects on spawning success in the Trinity River.

In the Feather River, Alternative 9 would have no effect (0%), a moderate increase (28%) in ammocoete cohorts exposed to flow reductions of 85%, and a substantial decrease (-65%) in exposure to 90% flow reduction events (Table 11-9-69). Based on a single, moderate increase in exposure to flow reductions, these results indicate that the effects of Alternative 9 on flow would not have biologically meaningful negative effects on Pacific lamprey ammocoete cohort stranding in the Feather River.

Comparisons for the American River at Nimbus Dam Table 11-9-70) and at the confluence with the Sacramento River (Table 11-9-71) predict negligible effects (<5%) for the lower flow reduction categories, and increased occurrence of flow reductions between 65% or 70% and 90% for Alternative 9 compared to Existing Conditions; predicted increases range from 33% to 196% for Nimbus Dam and from 20 to 171% for the confluence. These percentage increases are based on increases on the order of 56 to 166 cohorts (196%) and 112 to 303 (171%) cohorts exposed to flow reductions at Nimbus Dam, and 56 to 137 (145%) and 145 to 393 (171%) cohorts exposed to flow reductions at the confluence. These persistent and substantial increases in exposures to larger flow reduction events would have biologically meaningful effects on Pacific lamprey ammocoete cohort stranding and therefore spawning success in the American River.

The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under Alternative 9 would be higher than those under Existing Conditions in all the river locations (Table 11-9-72).

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of Alternative 9 on flow relative to Existing Conditions would have biologically meaningful, negative effects in the American River through substantial increases in the number of ammocoete cohorts exposed to a broad range of flow reductions (to 196%). Effects of Alternative 9 would not have biologically meaningful effects on Pacific lamprey ammocoete stranding in the Sacramento River, Trinity River, and the Feather River. Effects of Alternative 9 on water temperatures in the Feather River would result in substantial increases in ammocoete cohorts exposed to elevated water temperatures in all rivers evaluated, which would cause increased ammocoete mortality and reduce spawning success.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in

the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey

In general, effects of Alternative 9 on Pacific lamprey migration conditions would be negligible relative to the NAA.

After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. Migration generally is associated with large flow pulses in winter months (December through March) (USFWS unpublished data) meaning alterations in flow have the potential to affect downstream migration conditions. The effects of Alternative 9 on seasonal migration flows for Pacific lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the migration pathways of Pacific lamprey during the likely migration period (December through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, and the American River at the confluence with the Sacramento River.

CALSIM flow data form the basis for the evaluation of adult lamprey migration flows for the January to June migration period.

Sacramento River

Juveniles

The difference in mean monthly flow rate for the Sacramento River at Rio Vista for Alternative 9 compared to NAA for December to May indicates negligible effects (<5%) or decreases (to -28%) in mean monthly flow for the entire migration period, with the exception of a single, small increase in flow (9%) during May in critical years. Reductions in flow in drier water year types, when effects on migration conditions would be most critical, would occur throughout the migration period (to -28%) and would have negative effects on macropthalmia migration conditions in the Sacramento River at Rio Vista, compared to NAA.

For the Sacramento River at Red Bluff, results for Alternative 9 compared to NAA for December through May indicate primarily negligible effects (<5%) on flow attributable to the project throughout the migration period, with several isolated occurrences of increases in flow (to 18%) that would have a small beneficial effect on migration conditions, and isolated, small decreases in flow during January in dry (-7%) and critical years (-11%). These decreases would be isolated and small in magnitude and would not have biologically meaningful effects on migration conditions. These results indicate that the project-related effects on flow in the Sacramento River at Red Bluff would not have biologically meaningful negative effects on migration conditions, compared to NAA.

Adults

For the Sacramento River at Red Bluff for January to June, effects of Alternative 9 on mean monthly flow, compared to NAA consist mainly of negligible effects (<5%), with infrequent, small to moderate increases in flow (to 18%) that would have beneficial effects on migration conditions, and infrequent, small reductions in flow, during January in dry (-7%) and critical years (-11%). These decreases in flow would be isolated occurrences and of small magnitude and would not have biologically meaningful negative effects. These results indicate that the effects of Alternative 9 on flow would not have negative effects on adult migration in the Sacramento River, compared to NAA.

Feather River

Juveniles

Comparisons for the Feather River at the confluence with the Sacramento River for December to May indicate primarily negligible effects (<5%) with infrequent occurrence of small to moderate increases in flow (to 25%) that would have beneficial effects on migration conditions, and two isolated, small decreases in flow (to -9%) that would not have biologically meaningful effects on migration conditions. These results indicate that Alternative 9 would not have biologically meaningful negative effects on migration conditions in the Feather River, compared to NAA.

Adults

For the Feather River at the confluence with the Sacramento River, effects of Alternative 9 for January to June indicate project-related effects consist primarily of negligible effects (<5%) with a single occurrence of a small flow reduction during January in critical year (-9%) and increases during April in dry years (7%) and during May in drier water years (to 25%) that would have beneficial effects on migration conditions. These results indicate that effects of Alternative 9 on flow would not have biologically meaningful negative effects on adult migration in the Feather River, compared to NAA.

American River

Juveniles

Comparisons for the American River at the confluence with the Sacramento River for Alternative 9 compared to NAA for all December through May indicate project-related effects consist primarily of negligible effects (<5%), with infrequent, small increases (to 12%) and decreases (-5%) in mean monthly flows that would not have biologically meaningful effects on migration, and more substantial increases in flow during May (to 30%), including in drier water years, which would have beneficial effects on migration conditions. These results indicate that the effects of Alternative 9 on flow would not have biologically meaningful negative effects on macropthalmia migration in the American River, compared to NAA.

Adults

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June indicate predominantly negligible effects (<5%), with infrequent, small-scale increases (to 12%) or decreases (to -5%) attributable to the project, and more substantial increases in flow during May in drier years (to 30%) that would have beneficial effects on migration conditions. These results indicate that project-related effects of Alternative 9 on flow would not have biologically meaningful negative effects on adult migration conditions in the American River, compared to NAA.

Overall, for macropthalmia migration conditions, these results indicate that project-related effects of Alternative 9 on flow consist primarily of negligible effects (<5%), small to moderate increases in flow (depending on location, to 18% in the Sacramento River at Red Bluff, 25% in the Feather River, and 30% in the American River) that would have beneficial effects on migration conditions, with infrequent and/or small decreases in flow (to -11% in the Sacramento River at Red Bluff, to -9% in the Feather River, and to -5% in the American River) that would not have biologically meaningful negative effects on migration conditions. The exception to this is that Alternative 9 would cause more persistent reductions in flow (to -28%) in the Sacramento River at Rio Vista throughout the migration period, including in drier water years when effects of flow reductions would be more critical for migration conditions, which would have negative effects on macropthalmia migration conditions at this location.

Overall, results for adult migration indicate that project-related effects of Alternative 9 on flow would consist primarily of negligible effects (<5%), with relatively infrequent occurrence of small to moderate increases in flow (to 18% in the Sacramento River, 25% in the Feather River, and 30% in the American River) that would have beneficial effects on migration conditions, and infrequent, small reductions in flow (to -11% in the Sacramento River, to -9% in the Feather River, and -5% in the American River) that would not have biologically meaningful negative effects on adult migration, compared to NAA.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Effects of Alternative 9 on mean monthly flow during the Pacific lamprey macropthalmia migration period in the Sacramento River at Rio Vista consists of persistent, moderate flow reductions (to -28%) throughout the migration period that would have negative effects on migration conditions at that location; however, consideration of the relatively small magnitude of the flow reductions, and the fact that similar negative effects would not occur in any of the other locations analyzed, the overall effect would not be adverse. The effects of Alternative 9 on flow would not have biologically meaningful negative effects on macropthalmia and adult migration conditions in the Sacramento River at Red Bluff, the Feather River, and the American River (based on a prevalence of negligible project-related effects and small-scale flow reductions, to -11%, that would not have biologically meaningful effects).

CEQA Conclusion: In general, under Alternative 9 water operations, the quantity and quality of Pacific lamprey migration habitat would not be affected relative to the CEQA baseline.

Sacramento River

Juveniles

Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista for December to May for Alternative 9 relative to Existing Conditions indicate predominantly moderate reductions in mean monthly flow (to -23%) throughout the migration period in drier water years, and small increases in flow in wetter years (to 13%) during January through March, and decreases in wetter years for the remaining months of the migration period. The persistent, moderate decreases in flow would affect migration conditions, but not to the extent that would be considered a biologically meaningful effect.

Comparisons for the Sacramento River at Red Bluff for December to May for Alternative 9 relative to Existing Conditions indicate primarily negligible effects (<5%), with infrequent, small increases in flow (to 11% overall, with a more substantial increase during May in dry years, 23%) that would have small beneficial effects on migration conditions, with limited occurrence of reductions in flow during December in wet years (-8%), during March in below normal years (-11%), and during May in wet years (-20%) when effects of flow reductions are less critical for migration conditions, which collectively would not have biologically meaningful negative effects on migration conditions. These results indicate that the effects of Alternative 9 on flow would not have biologically meaningful effects on outmigrating macropthalmia in the Sacramento River at Red Bluff.

Adults

Comparisons of mean monthly flow for the Sacramento River at Red Bluff during the Pacific lamprey adult migration period from January through June indicate variable effects of Alternative 9, relative to Existing Conditions, on mean monthly flow during January, with increases (to 26%) in wetter years and decreases in drier years (to -28%); effects during February would consist of increases in flow (to 27%) with the exception of a moderate decrease (-16%) in critical years; effects during March and April would consist of negligible effects (<5%), increases in flow (to 14%) that would have small beneficial effects, with a single small decrease (-9%) during April in above normal years; and primarily reductions in flow (to -49%) during May and June for all but dry years during May (increase of 18%) and below normal and dry years during June (negligible effects). Decreases in drier water years when the effects of flow reductions would be more critical for migration conditions include small (-12%) to moderate (-28%) reductions during January, followed by a moderate reduction during February in critical years (-16%), followed by negligible project effects during March and April, and small (-8%) to substantial (-48%) reductions during May and June which constitute the end of the migration period. Based on a prevalence of flow reductions in drier water years during 3 out of 6 months of the total migration period, these results indicate that the effects of Alternative 9 on flow would have negative effects on adult migration conditions in the Sacramento River.

Feather River

Juveniles

Comparisons for the Feather River at the confluence for December to May indicate variable effects relative to Existing Conditions, by month and water year type, with decreases in mean monthly flow during December for wet (-16%) and critical (-19%) water year types and small increases (to 9%) in above and below normal years; primarily negligible effects (<5%) with isolated small-scale increases (to 15%) and decreases (to -15%) in flow during January, February, and April; variable effects during March with small increases in flow in wetter years (to 10%) and decreases in drier years (to -15%); and variable effects during May with decreases in wetter years (to -27%) and increases during drier years (to 29%). Effects throughout the migration period in drier water years, when effects of flow changes would be most critical for migration conditions, consist primarily of negligible effects (<5%), with moderate reductions during December (-19%), and small reductions during March and June (to -7%). These would be partially offset by increases in flow in drier years (to 29%) during May. Overall effects of Alternative 9 on flow are not expected to have biologically meaningful negative effects on migration conditions in the Feather River.

Adults

Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento River for January to June indicate effects of Alternative 9 on flow, relative to Existing Conditions, consist entirely of small (6%) to substantial increases in flow (to 121%) for January through May that would have beneficial effects on migration conditions, and decreases in flow during June (to -47%) in all water years. The decreases in June would occur in the last month of the migration period and would occur after a prolonged period of persistent, substantial increases in flow under Alternative 9 in all water years. Therefore, the overall effects of Alternative 9 would be beneficial, and the flow reductions in June would not have biologically meaningful negative effects on migration conditions.

American River

Juveniles

Comparisons for the American River at the confluence with the Sacramento River for December to May indicate variable effects of Alternative 9 relative to Existing Conditions, with decreases in mean monthly flow during December (to -18%); variable effects during January, February and March with primarily increases in wetter years (to 27%) and decreases in drier years (January and February, to -28%); negligible effects or increases in flow during April (to 14%); and negligible effects with a small decrease (-9%) and a small increase (12%) during May. Effects that would be most critical for migration conditions consist of reductions in flow in drier water years; these would occur in December (to -18%) and January (to -28%) at the start of the migration period, and would persist in critical years during February (-16%). Negative effects of these reductions would be somewhat offset by small increases in flow in dry years during April (12%) and May (18%), the last two months of the migration period. The persistent, moderate decreases in drier water years during January and February would have negative effects on migration conditions that would only be partially offset by later increases. However, based on the limited duration compared to the entire migration period in most water year types, and the magnitude of the flow reductions, effects are not expected to have biologically meaningful negative effects on migration conditions in the American River.

Adults

Comparisons of mean monthly flow for the American River at the confluence with the Sacramento River for January to June indicate variable effects of Alternative 9, relative to Existing Conditions, depending on the month and water year type, with effects during January through March consisting primarily of negligible effects (<5%) and small-scale increases (to 15%) and decreases (to -15%) in mean monthly flow. During May there would be decreases in wetter years (to -27%) when effects of flow reductions would be less critical for migration conditions, and increases in drier years (to 29%) that would have beneficial effects. During June there would be decreases for most water years (to -31%) with relatively small effects (-8%) in drier water years that would not have biologically meaningful negative effects on migration conditions. Despite the variability of these results, these results indicate that overall effects of Alternative 9 on flow would not have biologically meaningful negative effects on adult migration in the Feather River, compared to Existing Conditions.

Relative to Existing Conditions, the overall effects of Alternative 9 on flow during the adult migration period, vary depending on location, month, and water year type. Effects in drier water years when effects of flow reductions would be more critical for migration conditions would affect migration conditions in the Sacramento River (based on a prevalence of small to moderate flow reductions during one half of the migration period) and would not have biologically meaningful effects in the Feather River and the American River, relative to Existing Conditions.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Impacts of Alternative 9 on flow would have negative effects on adult migration conditions in the Sacramento River, based on small to substantial reductions in flow, to -48%, in drier water years during three out of six months of the migration period. Despite some variability in results, impacts of Alternative 9 on flow would not have biologically meaningful negative effects on juvenile migration conditions in the Sacramento, Feather, or American Rivers, or on adult migration in the Feather River and the American River relative to Existing Conditions.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on migration conditions for Pacific lamprey. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-171) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey

Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific Lamprey

Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to Pacific lamprey, and most would be at least slightly beneficial.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact AQUA-172 through Impact AQUA-180) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)

Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey (CM13)

Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)

Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey (CM15)

Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)

Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)

Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)

Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)

Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific Lamprey (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified for Alternative 1A.

River Lamprey

Construction and Maintenance of CM1

River lamprey are present in the north, east, and south Delta. Table 11-6 illustrates the species and life stages of river lamprey present in these areas during the in-water construction window (expected to be June 1–October 31). Ammocoetes are present year-round in all of these areas. Adult spawners may be migrating by construction sites for the intakes and barge landings from September to October. Macropthalmia (migrating juveniles) may be in the north and south Delta in June and July.

Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey

The potential effects of construction of water conveyance facilities on river lamprey under Alternative 9 would be the same as those described for Pacific lamprey under Alternative 9 (see Impact AQUA-163).

NEPA Effects: As concluded for Impact AQUA-163 for Pacific lamprey, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Impact AQUA-163 for Pacific lamprey under Alternative 9, the impact of the construction of water conveyance facilities on river lamprey under Alternative 9 would be less than 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.

Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects would apply.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-182, the impact would not be adverse for river lamprey.

CEQA Conclusion: Although the facilities involved in maintenance activities under Alternative 9 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from maintenance activities would apply. Consequently, as described in Alternative 1A, Impact AQUA-182 for river lamprey, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Water Exports

Entrainment of river lamprey at the SWP/CVP south Delta facilities would be substantially reduced under Alternative 9 compared to the NAA. Screening at the north Delta intakes, at the DCC and at Georgiana Slough, would exclude lamprey. The project adaptive management plan includes monitoring of the new north Delta screens to determine their effectiveness and if they are not meeting expectations additional measures (i.e., modifications to screens or other structural components or changes in water diversion operations) may be implemented to improve screen performance. This would be a beneficial impact on river lamprey. The screened intakes on the DCC and Georgiana Slough would prevent Sacramento River basin lamprey from entering the interior delta, thus reducing potential entrainment to agricultural diversions in the Delta compared to the NAA.

Predation Associated with Entrainment

Lamprey pre-screen predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. Due to the substantial reduction in lamprey predation at the SWP/CVP south Delta facilities under Alternative 9, there would also be a reduction in predation loss.

NEPA Effects: The overall effect of entrainment and entrainment-related predation on lamprey is considered beneficial.

CEQA Conclusion**:** As described above, annual entrainment losses of lamprey would be substantially reduced under Alternative 9 relative to Existing Conditions. The impact of predation loss at the north Delta would be unknown, since there is little available knowledge on their distribution and abundance in the Delta. Overall the impact on River lamprey from water operations would be considered beneficial. No mitigation would be required.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, effects of Alternative 9 on river lamprey spawning habitat would be negligible relative to the NAA based on primarily negligible effects on dewatering risk and only a small effect on critical water temperatures in the Feather River.

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 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%. There would be negligible effects (<5%) in all locations (Table 11-9-73). These results indicate that project-related effects of Alternative 9 on flow would not affect redd dewatering risk in the Sacramento River, Trinity River, Feather River, and the American River, relative to the NAA.

Table 11-9-73. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts[a]

Location	Comparison[b]	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Sacramento River at Keswick	Difference	2	-1
	Percent Difference	6%	-3%
Sacramento River at Red Bluff	Difference	0	-2
	Percent Difference	0%	-5%
Trinity River downstream of Lewiston	Difference	-5	-3
	Percent Difference	-7%	-4%
Feather River Below Thermalito Afterbay	Difference	-10	0
	Percent Difference	-15%	0%
American River at Nimbus	Difference	12	3
	Percent Difference	22%	5%
American River at Sacramento River confluence	Difference	19	2
	Percent Difference	32%	3%

[a] 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%.

[b] Positive values indicate a higher value in Alternative 9 than under 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 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey "adults need… temperatures [that] do not exceed 25°C," although there is no mention of thermal requirements for eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs, significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs. The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data from the Bureau's temperature model. Each individual day or month starts a new "egg cohort" such that there are 12.320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid every day each year from February 1 through June 30, and 405 cohorts for the other rivers using monthly data over the same period. The incubation periods used in this analysis are conservative and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited because the extreme temperatures are masked; however, no better analytical tools are currently available for this analysis. Spawning locations of river lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

For both thresholds, there would be few differences in egg cohort exposure between NAA and Alternative 9 among all sites (Table 11-9-74). The reduction of 14 cohorts (39% decrease) in the Sacramento River at Hamilton City for the 77°F threshold is negligible to the population considering the total number of cohorts is 12,320. In the Feather River below Thermalito Afterbay, there would be 9 more cohorts (24% increase) exposed to the 71.6°F threshold under Alternative 9 relative to NAA and no differences in cohorts at the 77°F threshold. Overall, these results indicate that there would be no differences in egg exposure to elevated temperatures under Alternative 9.

Table 11-9-74. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg Cohort Temperature Exposure

Location	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	326 (NA)	3 (1%)
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	38 (422%)	9 (24%)
American River at Nimbus	26 (520%)	1 (3%)
American River at Sacramento River Confluence	53 (189%)	-1 (-1%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	34 (3,400%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	22 (NA)	-14 (-39%)
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)	0 (0%)
American River at Nimbus	4 (NA)	0 (0%)
American River at Sacramento River Confluence	11 (NA)	5 (83%)
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.

[a] 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.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce spawning habitat or substantially reduce the number of fish as a result of egg mortality. Alternative 9 would not affect river lamprey egg survival based on negligible project-related changes to risk of dewatering (≤5%) and only a small project-related effect (24%) on increases in exposure to water temperatures above preferred thresholds in the Feather River below Thermalito Afterbay that would not have biologically meaningful effects on egg mortality and spawning success.

CEQA Conclusion: In general, under Alternative 9 water operations, the quantity and quality of river lamprey spawning habitat would not be affected relative to the CEQA baseline.

Effects of Alternative 9 on flow reductions during the river lamprey spawning period from February to June consist of no effect (0% difference) in the Sacramento River at Red Bluff and the Feather River, decreases in redd cohort dewatering risk in the Trinity River (-7%) and the Feather River (-15%) that would have beneficial effects on spawning success, a small increase (6%) in the Sacramento River at Keswick that would not have biologically meaningful effects, and moderate increases in the American River at Nimbus Dam (22%) and at the confluence with the Sacramento River (32%) (Table 11-9-73) that would have moderate, negative effects on spawning conditions at those locations.

In the Sacramento River at Hamilton City, there would be 326 more cohorts (could not calculate relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 9 relative to Existing Conditions, although this represents a very small proportion of the total number of cohorts evaluated (12,320 cohorts)(Table 11-9-74) and, therefore, would not be biologically meaningful. There would be no differences between Existing Conditions and Alternative 9 at either location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 38 more cohorts (422% higher) exposed to the 71.6°F threshold under Alternative 9 relative to Existing Conditions, although there would be no difference at the Fish Barrier Dam. At the two locations in the American River, there would be 26 to 53 more cohorts (189% to 520% higher) exposed to the 71.6°F threshold under Alternative 9 relative to Existing Conditions. In the Stanislaus River at Riverbank, there would be 34 more cohorts (3,400% higher) exposed to the 71.6°F threshold under Alternative 9 relative to Existing Conditions, although there would be no difference at the Knights Ferry. There would be no differences between Existing Conditions and Alternative 9 at any location examined in exposure of egg cohorts to the 77°F threshold, except for increases of 22 cohorts in the Sacramento River at Hamilton City and 11 cohorts in the American River at the confluence with the Sacramento River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce spawning habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Alternative 9 would increase risk of redd dewatering in the American River (through increased egg cohort dewatering exposure up to 32%) and would affect egg survival due to increases in water temperature in the Feather River below Thermalito Afterbay, based on a substantial increase in egg cohorts exposed to 71.6°F (38 cohorts or 422%), and a small increase in the number of cohorts exposed to 77°F (from 0 to 2). Increased water temperatures would increase stress and reduce survival of lamprey eggs.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the

alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on river lamprey spawning habitat. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey

In general, effects of Alternative 9 on river lamprey rearing habitat would be negligible relative to the NAA, based on primarily negligible effects on stranding risk in the locations analyzed, and on water temperatures in the Feather River. There would be a beneficial effect from substantial reductions in dewatering risk in the Feather River and the American River.

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 9 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 for the Sacramento River at Red Keswick of Alternative 9 to NAA indicate no effect (0%) or negligible effects (≤5%) attributable to the project in all flow reduction categories, with the exception of small increases in exposure to 75% and 80% flow reduction events (9% and 5% respectively), and a moderate increase in exposure to 85% flow reduction events (23%) (Table 11-9-75). These are relatively small increases in exposure that are not expected to have biologically meaningful negative effects on spawning success at this location.

Table 11-9-75. 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 Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	2	0
-60%	3	-1
-65%	-1	-2
-70%	0	0
-75%	2	9
-80%	17	5
-85%	77	23
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%) for all flow reductions categories attributable to the project. These results indicate that project-related effects of Alternative 9 on flow would not affect risk of ammocoete exposure and mortality in the Sacramento River at Red Bluff (Table 11-9-76).

Table 11-9-76. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red Bluff

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	6	3
-60%	8	1
-65%	3	2
-70%	13	4
-75%	18	-3
-80%	10	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons for the Trinity River indicate no effect (0%) or negligible effects (<5%) for all flow reduction events attributable to the project. These results indicate that project-related effects of Alternative 9 on flow would not affect risk of ammocoete exposure and mortality in the Trinity River. (Table 11-9-77).

Table 11-9-77. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	32	0
-80%	34	-4
-85%	26	-4
-90%	56	2

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons in the Feather River (Table 11-9-78 indicate no effect (0%), a single small increase (6%) that would not have biologically meaningful negative effects, and two decreases (-5% and -32%) in exposure to flow reduction events that would have beneficial effects. These results indicate that project-related effects of Alternative 9 on flow would have beneficial effects on spawning conditions in the Feather River.

Table 11-9-78. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito Afterbay

	Percent Difference[a]	
Percent Flow Reduction	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-1	6
-85%	25	-5
-90%	-62	-32

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Comparisons for the American River at Nimbus Dam (Table 11-9-79) and at the confluence with the Sacramento River (Table 11-9-80) indicate negligible effects (<5%) or decreases in exposure (to -67% at Nimbus Dam, to -43% at the confluence) attributable to the project for all flow reduction categories. Decreased risk of dewatering would have beneficial effects on spawning conditions for both locations. These results indicate that project-related effects of Alternative 9 on flow would have beneficial effects on spawning conditions in the American River.

Table 11-9-79. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus Dam

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	-1	-1
-60%	0	-4
-65%	3	-4
-70%	47	-7
-75%	102	-11
-80%	220	-33
-85%	200	-46
-90%	0	-67

NA = could not be calculated because the denominator was 0.
[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Table 11-9-80. Relative Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the Confluence with the Sacramento River

Percent Flow Reduction	Percent Difference[a]	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	1	-3
-70%	13	-8
-75%	32	-14
-80%	197	-12
-85%	178	-35
-90%	164	-43

[a] Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day or month starts a new "cohort" such that there are 18,730 cohorts for the Sacramento River, corresponding to 82 years of ammocoetes being "born" every day each year from January 1 through August 31, and 380 cohorts for the other rivers using monthly data over the same period.

In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 9 would be similar to or lower than those under NAA (Table 11-9-81). Biologically meaningful exceptions includes the Trinity River at Lewiston, Feather River below Thermalito Afterbay, and Stanislaus River at Knights Ferry for the 71.6°F threshold, and the Sacramento River at Hamilton City and Feather River below Thermalito Afterbay for the 77°F threshold. In all cases, there would be another location within the river that would have similar or lower exceedances under Alternative 9.

Table 11-9-81. 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. A9_LLT	NAA vs. A9_LLT
71.6°F Threshold		
Sacramento River at Keswick[b]	1,217 (NA)	-1 (-0.1%)
Sacramento River at Hamilton City[b]	8,787 (NA)	-708 (-7%)
Trinity River at Lewiston	90 (NA)	40 (80%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	150 (79%)	20 (6%)
American River at Nimbus	235 (261%)	-10 (-3%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	50 (NA)	25 (100%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick[b]	0 (NA)	0 (NA)
Sacramento River at Hamilton City[b]	1,502 (NA)	451 (30%)
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	75 (NA)	35 (88%)
American River at Nimbus	200 (NA)	-20 (-9%)
American River at Sacramento River Confluence	240 (NA)	10 (4%)
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.
[a] Positive values indicate a higher value in Alternative 9 than in EXISTING CONDITIONS or NAA.
[b] Based on daily data; all other locations use monthly data; 1922–2003.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of ammocoete mortality. Project-related effects of Alternative 9 on flow reductions that would be harmful for ammocoete survival consist entirely of negligible effects (<5%), a single, small-scale increase in dewatering exposure (6%) in one location that would not have biologically meaningful negative effects, and reductions in exposure (to -32% in the Feather River and to -67% in the American River) that would have beneficial effects by reducing dewatering risk. Exposure to elevated water temperature would generally not differ between NAA and Alternative 9.

CEQA Conclusion: In general, under Alternative 9 water operations, the quantity and quality of river lamprey rearing habitat would not be affected relative to the CEQA baseline.

Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparison of potential for ammocoete stranding under Alternative 9 relative to Existing Conditions for the Sacramento River at Keswick indicates negligible effects (<5%) for ammocoete cohort exposures to flow reductions from 50% to 75%, a moderate increase in exposure (17%) to 89% flow reduction events, and a more substantial increase in exposure (77%) to 85% flow reduction events (Table 11-9-75). There would be no change for 90% flow reduction events because all values are zero. Comparisons for the Sacramento River at Red Bluff indicate similar results with negligible effects (<5%) and small to moderate increases (to 18%) in exposure for 50% to 80% flow reduction categories, and a more substantial increases in exposure (from 25 to 50 cohorts or 100%) in the 85% flow reduction category (Table 11-9-76). Based on the prevalence of small-scale effects with only a single flow reduction category with more substantial increases in dewatering risk at each location, effects of Alternative 9 on flow are not expected to have biologically meaningful negative effects on spawning success in the Sacramento River.

Comparisons for the Trinity River indicate no effect (0%) for flow reduction categories from 50% to 70%, and increases ranging from 26% to 56% for the higher flow reduction categories (Table 11-9-77). The substantial and persistent increases in dewatering exposure would affect spawning success in the Trinity River.

Comparisons for the Feather River indicate no effect (0%) or negligible effects (<5%) in frequency of exposure to all flow reduction categories from 50% to 80%, a moderate increase in exposure (25%) to 85% flow reduction events, and a substantial decrease (-62%) in exposure to 90% flow reduction events (Table 11-9-78). The substantial reduced ammocoete cohort exposure to the largest flow reduction category would have beneficial effects on spawning success and overall Alternative 9 would not have any negative effects in the Feather River.

Comparisons for the American River indicate no effect (0%) or negligible effects (<5%) in ammocoete exposure to 50% through 65% flow reduction events, and substantial increases in frequency of occurrence to the larger flow reduction categories, with increases of 47% to 220% (from 50 to 160 cohorts) in ammocoete cohorts exposed flow reduction events at Nimbus Dam (Table 11-9-79) and increases of 13% to 197% (from 71 to 211 cohorts) for the confluence (Table 11-9-80). These persistent and substantial increases in ammocoete cohort exposure to flow reductions would have negative effects on spawning success in the American River.

The number of ammocoete cohorts exposed to 71.6°F under Alternative 9 would be higher than those under Existing Conditions in all locations examined (Table 11-9-81). The number of ammocoete cohorts exposed to 77°F under Alternative 9 would be similar at all locations except the Sacramento River at Hamilton City, Trinity River at North Fork, Feather River below Thermalito Afterbay and at both locations in the American River.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Impacts of Alternative 9 would affect ammocoete cohort stranding through increases in flow reductions in the

Trinity River (to 56%) and the American River (to 220%). Effects in the Sacramento River would include moderate increases in exposure to some flow reduction events but not to the extent that would cause biologically meaningful negative effects; effects in the Feather River would be beneficial by reducing dewatering events and therefore stranding potential. Exposure to elevated water temperatures would increase in all rivers evaluated under Alternative 9 relative to NAA.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey

In general, effects of Alternative 9 on river lamprey migration conditions would be negligible relative to the NAA based on primarily negligible effects on mean monthly flow in the locations analyzed. There would be beneficial effects from small to moderate increases in flow in some locations; this effect would generally be somewhat offset by small flow reductions in other months leading to a net conclusion of negligible effects.

Macropthalmia

After 3 to 5 years river lamprey ammocoetes migrate downstream and become macropthalmia once they reach the Delta. River lamprey migration generally occurs September through November (USFWS unpublished data). The effects of water operations on seasonal migration flows for river lamprey macropthalmia were assessed using CALSIM II flow output. Flow rates along the likely migration pathways of river lamprey during the likely migration period (September through November) were examined to predict how Alternative 9 may affect migration flows for outmigrating macropthalmia.

Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with the Sacramento River, and the American River at the confluence with the Sacramento River.

Sacramento River

Comparisons for the Sacramento River at Red Bluff for September through November for Alternative 9 relative to NAA indicate primarily negligible effects (<5%) throughout the migration period, with occasional, small increases in flow (to 9%) during September and November in some water years, and decreases during October in above normal (-10%), below normal (-13%), and critical years (-10%) that would not be a magnitude or frequency in the migration period to result in biologically meaningful effects. These results indicate that effects of Alternative 9 on flow would not have biologically meaningful negative effects on macropthalmia migration conditions in the Sacramento River, relative to the NAA.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for September through November for Alternative 9 compared to NAA indicate negligible effects (<5%) during September in all water years, and negligible effects or small decreases in flow (to -12%) during October and November with the exception of a small increase (10%) during November in dry years. Reductions in flow in drier water years when they would have the greatest effect on migration conditions are limited to isolated and/or small decreases that are not expected to have biologically meaningful negative effects on migration conditions in the Feather River, relative to the NAA.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November for Alternative 9 compared to NAA indicate negligible effects (<5%) or small increases in flow (to 13%) during September, decreases in most water years during October (to -18%) with the exception of a small increase (12%) in dry years, and negligible effects (≤5%) or increases (to 20%) during November. Project-related effects in drier years when effects of flow reductions would be most critical for migration conditions consist of negligible or beneficial effects (increases to 20%), with the exception of small decreases during October (-15% in below normal years, -10% in critical years) that would be infrequent and of small magnitude and therefore not expected to cause biologically meaningful negative effects on migration conditions, compared to the NAA.

Adults

Effects of Alternative 9 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Project-related effects of Alternative 9 on mean monthly flow during September through November in drier water years consist primarily of negligible effects (<5%), small to moderate increases in flow (to 20%) that would have beneficial effects on migration conditions, and infrequent, small decreases in flow (to -15%) that would not have negative effects on migration conditions, compared to NAA.

CEQA Conclusion: In general, under Alternative 9 water operations, the quantity and quality of river lamprey migration habitat would be reduced relative to the CEQA baseline. Differences between the anticipated future conditions under this alternative and Existing Conditions (the CEQA “baseline” or point of comparison) are largely attributable to sea level rise and climate change, and not to the operational scenarios. As a result, the differences between Alternative 9 (which is under LLT conditions that include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either overstate the effects of Alternative 9 or indicate significant effects that are largely attributable to sea level rise and climate change, and not to Alternative 9.

Macropthalmia

Sacramento River

Comparisons for the Sacramento River at Red Bluff for September through November for Alternative 9 relative to Existing Conditions indicate variable effects during September, with increases in mean monthly flow for wetter water year types (43 to 64%) and decreases for drier water year types (to -25%). Alternative 9 would have negligible effects (<5%) or small reductions in flow (to -11%) during October, and would result in primarily increases in mean monthly flow during November (to 22%). The occurrence of moderate reductions in flow during September in drier water years, followed by a further small reduction during October in critical years, would affect migration conditions for a substantial portion of the migration period in drier water years in the Sacramento River.

Feather River

Comparisons for the Feather River at the confluence with the Sacramento River for September through November for Alternative 9 relative to Existing Conditions indicate variable effects, with substantial increases in mean monthly flow during September in wetter water years (to 146%), and reductions (to -33%) in drier years; primarily reductions in flow (to -23%) during October, and negligible effects (<5%) or reductions in flow (to -21%) during November. Effects in drier water years when effects of flow reductions would be most critical for migration conditions consist of small to moderate reductions during September and October with the exception of a small increase (13%) during September in below normal years, and negligible effects or a small decrease (-6%) during November. The occurrence of small to moderate reductions in flow during September in drier water years, followed by a further moderate reduction during October in critical years, would affect migration conditions for a substantial portion of the migration period in drier water years in the Feather River.

American River

Comparisons for the American River at the confluence with the Sacramento River for September through November indicate primarily reductions in mean monthly flow throughout the migration period in all water year types, ranging from -6% to -52%, including in drier water year types when effects on migration conditions would be more critical (to -52%). These results indicate Alternative 9 would have negative effects on migration conditions in the American River.

Adults

Effects of Alternative 9 on flow during the adult migration period, September through November, would be the same as described for the macropthalmia migration period, September through November, above.

Summary of CEQA Conclusion

Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the alternative could substantially reduce the amount of suitable habitat and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth above. This is based on a predominance of small to substantial (to -33%) reductions in mean monthly flow during September and October in drier water year types in the Sacramento River and the Feather River, and small to substantial reductions in flow for all months and all water year types, including drier water years (to -52%), in the American River.

These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT implementation period, which does include future sea level rise, climate change, and water demands. Therefore, the comparison of results between the alternative and Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water demands, isolates the effect of the alternative from those of sea level rise, climate change, and water demands.

The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term implementation period and Alternative 9 indicates that flows in the locations and during the months analyzed above would generally be similar between Existing Conditions during the LLT and Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9 found above would generally be due to climate change, sea level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on rearing habitat for river lamprey. This impact is found to be less than significant and no mitigation is required.

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

Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial differences in restoration-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through AQUA-189) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey

Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River Lamprey

Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey

NEPA Effects: As described in Alternative 1A, none of these impact mechanisms would be adverse to river lamprey, and most would be at least slightly beneficial.

CEQA Conclusion: All of the impact mechanisms listed above would be at least slightly beneficial, or less than significant, and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial differences in other conservation-related fish effects are anticipated anywhere in the affected environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of other conservation measures described for river lamprey under Alternative 1A (Impact AQUA-190 through Impact AQUA-198) also appropriately characterize effects under Alternative 9.

The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)

Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey (CM13)

Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)

Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)

Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)

Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)

Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)

Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)

Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey (CM21)

NEPA Effects: The nine impact mechanisms have been determined to range from no effect, to no adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified for Alternative 1A.

CEQA Conclusion: The nine impact mechanisms would be considered to range from no impact, to less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and no mitigation is required.

Non-Covered Aquatic Species of Primary Management Concern

Construction and Maintenance of CM1

The effects of construction and maintenance of CM1 under Alternative 9 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to the description of Alternative 9 at the beginning of Section 11.3.4.16 and Alternative 9, Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance facilities. That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic environment and aquatic species. The discussion there is also relevant to non-covered species of primary management concern.

NEPA Effects: As concluded for Alternative 9, Impact AQUA-1, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effects would not be adverse for non-covered aquatic species of primary management concern.

CEQA Conclusion: As described in Impact AQUA-1 under Alternative 9 for delta smelt, the impact of the construction of water conveyance facilities on non-covered species of primary management concern would not be significant except potentially 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.

Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered Aquatic Species of Primary Management Concern

Refer to Alternative 9, Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water conveyance facilities. The discussion there is also relevant to non-covered species of primary management concern.

NEPA Effects: As concluded in Alternative 9, Impact AQUA-2, the effects would not be adverse.

CEQA Conclusion: As described above, these impacts would be less than significant.

Water Operations of CM1

The effects of water operations of CM1 under Alternative 9 includes a detailed analysis of the following species:

- Striped Bass
- American Shad
- Threadfin Shad
- Largemouth Bass
- Sacramento tule perch

- Sacramento-San Joaquin roach – California species of special concern
- Hardhead – California species of special concern

Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic Species of Primary Management Concern

Striped Bass

Under Existing Conditions, striped bass are observed in salvage operations of the south Delta facilities throughout the year, with the majority of juvenile striped bass entrainment occurring during the summer (May through July). Under Alternative 9, juvenile entrainment at the proposed north Delta SWP/CVP diversions at Georgiana Slough and the DCC and the alternate NBA intake on the Sacramento River would be reduced due to fish screens designed to exclude fish larger than 15 mm, which would greatly reduce entrainment at the south Delta facilities. Larvae could be vulnerable to entrainment at the north Delta diversions as they are transported past from spawning areas upstream.

Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile striped bass. Reduction or consolidation of up to 12% of these diversions from the ROAs would not increase entrainment and may provide a minor benefit. Furthermore, decommissioning of agricultural diversions may also reduce entrainment of striped bass. Also, restoration activities as part of the conservation measures should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that these habitat changes would result in at least a minor improvement in production of juvenile striped bass.

NEPA Effects: Overall, the effect of Alternative 9 operations on striped bass entrainment would not be adverse and may benefit the species due to reductions in south Delta entrainment.

CEQA Conclusion: The impact of water operations on entrainment of striped bass would be the same as described immediately above. The changes in facilities and operations under Alternative 9 would reduce entrainment losses at the south Delta facilities. The impact would be less than significant and no mitigation would be required.

American Shad

American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP Delta diversions at Georgiana Slough and DCC and the alternate NBA intake on the Sacramento River as these life stages are passively transported downstream to the north Delta. The majority of spawning takes place upstream of the Delta, so only limited numbers of American shad eggs and larvae would be exposed to entrainment risk at the north Delta intakes.

American shad entrainment losses to the south Delta facilities would be substantially reduced because fish screens on these north Delta intakes would exclude juvenile and adult American shad from the water conveyance channel. Reduction or consolidation of agricultural diversions in ROAs would not increase entrainment and may provide a modest benefit.

NEPA Effects: Overall, the effect on American shad would not be adverse, and would provide some benefit.

CEQA Conclusion: The impact of water operations on entrainment of American shad would be the same as described immediately above. The changes in facilities and operations under Alternative 9 would reduce entrainment losses at the south Delta facilities. The impact would be less than significant and no mitigation would be required.

Threadfin Shad

Threadfin shad have a limited distribution in the Delta and are most abundant in the southern Delta. Threadfin shad are also the most common species collected at the export facilities, although there are no significant results for an effect of summer exports on the population (Baxter et al. 2010). Under Alternative 9, entrainment would be reduced for threadfin shad in the Old River fish corridor and San Joaquin River, but would likely increase for those fish in Middle River and associated sloughs. Entrainment of juvenile and adult threadfin shad from the north Delta would be reduced under Alternative 9 by screening the north Delta diversion intakes at DCC and Georgiana Slough, but this is not a region of high abundance. Decommissioning or consolidation of agricultural diversions in Delta ROAs, particularly the south Delta, may reduce entrainment of threadfin shad.

NEPA Effects: The overall effect would not be adverse because overall entrainment would be expected to be reduced.

CEQA Conclusion: The impact of water operations on entrainment of threadfin shad would be the same as described immediately above. The changes in operations under Alternative 9 would reduce entrainment risk and may benefit the threadfin shad population. The impact would be less than significant and no mitigation would be required.

Largemouth Bass

Since largemouth bass are predominantly found in the south and central portions of the Delta, largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to the south Delta facilities would be reduced under Alternative 9 because water conveyance channel leading to the south Delta intakes would be screened. As discussed for Alternative 1A (Impact AQUA-201) few larval largemouth bass would be vulnerable to entrainment to north Delta and alternative NBA intake since they are not expected to readily occur there. Decommissioning agricultural diversions could reduce entrainment of largemouth bass since they hold in shallow water habitats where most agricultural diversions are sited.

NEPA Effects: Overall entrainment would be reduced under Alternative 9 and there would be a benefit for the species.

CEQA Conclusion: The impact of water operations on largemouth bass would be as described immediately above. Entrainment under Alternative 9 would be reduced and would be beneficial to the largemouth bass. The impact would be less than significant and no mitigation would be required.

Sacramento Tule Perch

Sacramento tule perch entrainment is documented in small numbers to the SWP/CVP south Delta facilities under the NAA. Entrainment would be reduced under Alternative 9 because of the separation of the fish passage channel from San Joaquin River through Old River to Franks Tract) from the screened water conveyance channels leading into the south Delta facilities. Because Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to be effectively screened at the proposed north Delta facilities. Reduction or consolidation of agricultural diversions under the Plan would decrease potential entrainment into these agricultural intakes.

NEPA Effects: Overall the effect of Alternative 9 would not be adverse because of the potential reduction of entrainment.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. Entrainment under Alternative 9 would potentially be reduced and would be beneficial to Sacramento tule perch. The impact would be less than significant and no mitigation would be required.

Sacramento-San Joaquin Roach

The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento-San Joaquin roach would be the same as described immediately above. The impacts would be less than significant.

Hardhead

The effect of water operations on entrainment of hardhead under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of hardhead would be the same as described immediately above. The impacts would be less than significant.

California Bay Shrimp

The effect of water operations on entrainment of California bay shrimp under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201.

NEPA Effects: California bay shrimp do not occur in the vicinity of the DCC gates and the Georgiana Slough screened diversion so there would be an effect.

CEQA Conclusion: The impact of water operations on entrainment of California bay shrimp would be the same as described immediately above. There would be no impact.

Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Aquatic Species of Primary Management Concern

Striped Bass

In general, Alternative 9 would slightly improve the quality and quantity of upstream habitat conditions for striped bass relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA, regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the range would be similar to or lower than the percentage under NAA in all water years except above normal years (17% increase) and dry years (17% increase) (Table 11-9-82). These are relatively infrequent and small magnitude increases in unsuitable temperature exposures and are not expected to have biologically meaningful negative effects.

Table 11-9-82. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-12 (-29%)	0 (0%)
Above Normal	-15 (-45%)	3 (17%)
Below Normal	-10 (-36%)	0 (0%)
Dry	-19 (-63%)	2 (17%)
Critical	-17 (-67%)	-6 (-67%)
All	-14 (-44%)	0 (0%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat. Flows in all rivers examined during the April through June spawning, incubation, and initial rearing period under Alternative 9 would generally be similar to or greater than flows under the NAA. The percentage of months outside the 59°F to 68°F water temperature range would generally be lower under Alternative 9 than under the NAA with the exception of moderate increases for two water year types that would not have biologically meaningful negative effects.

CEQA Conclusion: In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for striped bass relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June striped bass spawning, embryo incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream habitat available for spawning, egg incubation, and rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful negative effects on habitat conditions, compared to Existing Conditions.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April except in above normal years (7% lower), and generally similar to or lower than flows under Existing Conditions during May and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, are limited to below normal years during May (19% lower) and critical years during June (42% lower). Despite the moderate to substantial magnitude, these are isolated flow reductions that would not be expected to have biologically meaningful negative effects on spawning.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation, and initial rearing during April through June would be substantially lower than the percentage under Existing Conditions in all water years (Table 11-9-82).

Collectively, these results indicate that the impact would not be significant because Alternative 9 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under Alternative 9 would generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 9, although this effect would not be biologically meaningful to striped bass. The percentage of months outside the 59°F to 68°F water temperature range would be lower under Alternative 9 than under Existing Conditions.

American Shad

In general, Alternative 9 would slightly improve the quality and quantity of upstream habitat conditions for American shad relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the 60°F to 70°F water temperature range would be similar to the percentage under NAA for all water year types (Table 11-9-83).

Table 11-9-83. Difference and Percent Difference in the Percentage of Months during April–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F to 70°F Water Temperature Range for American Shad Adult Migration and Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-4 (-8%)	1 (3%)
Above Normal	9 (25%)	0 (0%)
Below Normal	7 (23%)	0 (0%)
Dry	4 (10%)	-2 (-4%)
Critical	6 (15%)	0 (0%)
All	3 (7%)	0 (0%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in American shad spawning or adult migration. Flows in all rivers examined during the April through June adult migration and spawning period under Alternative 9 would generally be similar to or greater than flows under the NAA. The percentage of months outside the 60°F to 70°F water temperature range would be similar under Alternative 9 to the NAA.

CEQA Conclusion: In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for American shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through June American shad adult migration and spawning period. Lower flows could reduce migration ability and instream habitat quantity and quality for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in wet years during May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful negative effects on habitat conditions.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April except in above normal years (7% lower), and generally similar to or lower than flows under Existing Conditions during May and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, are limited to below normal years during May (19% lower) and critical years during June (42% lower). Despite the moderate to substantial magnitude, these are isolated flow reductions that would not be expected to have biologically meaningful negative effects on spawning.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 60°F to 70°F water temperature range for American shad adult migration and spawning during April through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased adult migrant stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related effects in these rivers during the April through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of the 60°F to 70°F water temperature range would be greater than the percentage under Existing Conditions (from 10% to 25% greater) in all water years except critical years (8% higher) (Table 11-9-83).

Collectively, these results indicate that the impact would not be significant because Alternative 9 would not cause a substantial reduction in American shad adult migration and spawning habitat, and no mitigation is necessary. Flows in all rivers examined, except the San Joaquin and Stanislaus rivers, during the April through June adult migration and spawning period under Alternative 9 would generally be similar to or greater than flows under Existing Conditions. Flows in the San Joaquin and Stanislaus rivers would be lower under Alternative 9, although this effect would be biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water temperature range would be greater under Alternative 9 than under Existing Conditions for all but wet water years, but the magnitude of the increases (to 25%) would not be expected to result in biologically meaningful negative effects.

Threadfin Shad

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August threadfin shad spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through August, and except in above normal years during August (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through August spawning period in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during April through August in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type, except in dry (10% lower) and critical (13% lower) years during July. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type, except in wet and critical years during July (to 23% lower) and in dry and critical years during August (8% and 9% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated, small-magnitude flow reductions that would not be expected to have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT below 68°F would be similar to or lower than those under NAA in all water years (to 8% lower) (Table 11-9-84).

Table 11-9-84. Difference and Percent Difference in the Percentage of Months during April–August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F Water Temperature Threshold for Threadfin Shad Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-13 (-21%)	0 (0%)
Above Normal	-27 (-36%)	2 (4%)
Below Normal	-24 (-35%)	0 (0%)
Dry	-33 (-45%)	-3 (-8%)
Critical	-30 (-46%)	-2 (-5%)
All	-24 (-35%)	-1 (-2%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in spawning habitat. Flows in all rivers examined during the April through August spawning period under Alternative 9 would generally be similar to or greater than flows under the NAA. There would relatively infrequent, small-magnitude flow reductions for some months and water year types that would not have a biologically meaningful effect on threadfin shad. The percentage of months below the spawning temperature threshold would be lower under Alternative 9 relative to the NAA in the Feather River and there are no temperature-related effects in any other rivers.

CEQA Conclusion: In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for threadfin shad relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during April through August spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through August, except in wet years during May (19% lower), in critical years during July (9% lower), and in wet (7% lower) and critical years (13% lower) during August Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through August, except in critical years during May (6% lower), in wet (14% lower) and critical years (6% lower) during July, and in critical years during August (33% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are isolated and/or relatively small-magnitude flow reductions and would not have biologically meaningful negative effects.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during April through August regardless of water year type except in critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through August, except in wet years during May and June (35% and 21% lower, respectively), in dry (12% lower) and critical years (32% lower) during July, and in dry years (34% lower) during August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful negative effects on habitat conditions, and reductions in drier water years would be relatively isolated and not expected to have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April except in above normal years (7% lower), and generally similar to or lower than flows under Existing Conditions during May through August (to 43% lower) except in dry years during May (19% greater) and in critical years during July (11% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would be fairly persistent during May through August, including in drier water year types when effects would be more critical for habitat conditions, and would have a localized effect on spawning conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below 68°F water temperature threshold for the April through August adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water temperature threshold for threadfin shad spawning under A9_LLT would be 21% to 46% lower than the percentage under Existing Conditions, depending on water year type (Table 11-9-84).

Collectively, these results indicate that the impact would not be significant because Alternative 9 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers examined during the April through August spawning period under Alternative 9 would generally be similar to or greater than flows under Existing Conditions, with the exception of relatively infrequent and small-magnitude flow reductions in some months and water year types for most locations. There would be more persistent flow reductions for a greater portion of the spawning period in the American River (May through August, to 43% lower, including in drier water year types) but based on the fact that this would occur at a single location it is not expected to have biologically meaningful negative effects on the threadfin shad population. The percentage of months outside all temperature thresholds are lower under Alternative 9 than under Existing Conditions, indicating that there would be a net temperature-related benefit of Alternative 9 to threadfin shad.

Largemouth Bass

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for largemouth bass relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June, in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during March through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type except in dry years during March (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the range would be similar, only slightly greater (to 6%), or lower (14% lower), than the percentage under NAA (Table 11-9-85). These inconsistent and small-magnitude changes would not be expected to have biologically meaningful negative effects.

Table 11-9-85. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-11 (-23%)	2 (6%)
Below Normal	-11 (-24%)	0 (0%)
Dry	-17 (-35%)	1 (5%)
Critical	-15 (-33%)	-4 (-14%)
All	-12 (-25%)	0 (0%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: This effect is not adverse.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions. This would be a significant impact. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June largemouth bass spawning period. Lower flows could reduce the quantity and quality of instream spawning habitat.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March (11% lower) and in wet years during May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during March through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal and dry years during March (39% and 18% lower, respectively), and in wet years during May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions are relatively isolated and/or occur in wetter water years and would not be expected to have biologically meaningful negative effects on habitat conditions.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March and April except in above normal years during April (7% lower), and generally similar to or lower than flows under Existing Conditions during May and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, are limited to below normal years during May (19% lower) and critical years during June (42% lower). Despite the moderate to substantial magnitude, these are isolated flow reductions that would not be expected to have biologically meaningful negative effects on spawning.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 75°F suitable water temperature range for largemouth bass spawning during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of the 59°F to 75°F water temperature range for largemouth bass spawning would be substantially lower than the percentage under Existing Conditions in all water years (Table 11-9-85).

Sacramento Tule Perch

The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-202, the effects would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of Sacramento tule perch would be the same as described immediately above. The impacts would be less than significant.

Sacramento-San Joaquin Roach – California Species of Special Concern

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin Roach relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during March through June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type except in dry years during March (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type during March through June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A9_LLT would be similar to or lower than the percentage under NAA in all water years (Table 11-9-86).

Table 11-9-86. Difference and Percent Difference in the Percentage of Months during March–June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-5 (-11%)	0 (0%)
Dry	-14 (-26%)	-3 (-7%)
Critical	-15 (-26%)	0 (0%)
All	-11 (-19%)	-1 (-1%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: This effect would not be adverse.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in below normal years during March (11% lower) and in wet years during May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March through June, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during March through June regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June, except in below normal and dry years during March (39% and 18% lower, respectively), and in wet years during May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions are relatively isolated and/or occur in wetter water years and would not be expected to have biologically meaningful negative effects on habitat conditions.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during March and April except in above normal years during April (7% lower), and generally similar to or lower than flows under Existing Conditions during May and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, are limited to below normal years during May (19% lower) and critical years during June (42% lower). Despite the moderate to substantial magnitude, these are isolated flow reductions that would not be expected to have biologically meaningful negative effects on spawning.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months below the 60.8°F water temperature threshold for Sacramento-San Joaquin roach spawning initiation during March through June was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the March through June period.

In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures would be below the 60.8°F water temperature threshold for roach spawning initiation under A9_LLT would be lower than the percentage under Existing Conditions in all water years (Table 11-9-86).

Hardhead – California Species of Special Concern

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under NAA during April and May, in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA during April and May in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows under NAA during April and May in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the range would generally be similar to or lower than the percentage under NAA in all water year types (Table 11-9-87).

Table 11-9-87. Difference and Percent Difference in the Percentage of Months during April–May in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F to 64°F Water Temperature Range for Hardhead Spawning[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	4 (6%)	2 (3%)
Above Normal	-9 (-14%)	0 (0%)
Below Normal	18 (42%)	-4 (-6%)
Dry	-8 (-15%)	-3 (-6%)
Critical	-8 (-15%)	-8 (-18%)
All	0 (0%)	-2 (-3%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: This effect would not be adverse.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream spawning habitat conditions for hardhead relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through May hardhead spawning period. Lower flows could reduce the quantity and quality of instream habitat available for spawning.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April and May, except in wet years during May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April and May, except in critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under Existing Conditions during April and May regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April and May, except in wet years during May (35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful negative effects on habitat conditions.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April except in above normal years (7% lower), and generally similar to or lower than flows under Existing Conditions during May (to 33% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat conditions, are limited to below normal years during May (19% lower) and would not be expected to have biologically meaningful negative effects on spawning.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months outside of the 59°F to 64°F suitable water temperature range for hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced spawning success and increased egg and larval stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower than the percentage under Existing Conditions in all water years except wet (6% higher) and below normal years (42% higher) (Table 11-9-87).

California Bay Shrimp

NEPA Effects: The effect of water operations on spawning habitat of California bay shrimp under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

CEQA Conclusion: The impact of water operations on spawning habitat of California bay shrimp would be the same as described immediately above. The impacts would be less than significant.

Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic Species of Primary Management Concern

Striped Bass

The discussion under Alternative 9, Impact AQUA-202 for striped bass also addresses the embryo incubation and initial rearing period. That analysis indicates that there is no adverse effect on striped bass rearing during that period.

NEPA Effects: Other effects of water operations on rearing habitat for striped bass under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). The effects would not be adverse.

CEQA Conclusion: As described above the impacts on striped bass rearing habitat would be less than significant.

American Shad

The effects of water operations on rearing habitat for American shad under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on American shad rearing habitat would be less than significant.

Threadfin Shad

The effects of water operations on rearing habitat for threadfin shad under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

CEQA Conclusion: As described above the impacts on threadfin shad rearing habitat would be less than significant.

Largemouth Bass

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater than flows under NAA for the entire period regardless of water year type, except in above normal years during August (7% lower), and in above normal, below normal, and critical years during October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated, small flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would be similar to or greater than flows under NAA during the April through November period except in critical years during August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA for April through November for all water year types, except in critical years during September (13% lower)(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under NAA for April through June and August, and similar to or lower (up to 15%) than flows under NAA during July and September through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions during these months in drier water years, when effects would be more critical for habitat conditions, would be inconsistent from month to month and/or of small magnitude and would not be expected to have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June, September, and November, and would be similar to or lower than flows under NAA during July, August, and October (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively infrequent and low-magnitude flow reductions and would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under NAA or A9_LLT (Table 11-9-88). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 9 and NAA.

Table 11-9-88. Difference and Percent Difference in the Percentage of Months during April–November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater than flows under NAA except in dry and critical years during January (to 11% lower), in above normal years during August (7% lower), and above normal, below normal, and critical years during October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated and small-magnitude flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA throughout the year except for isolated, small flow reductions in below normal years during February (28% lower), and in critical years during August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and in critical years during August (13% lower).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June and August, and similar to or lower than flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-magnitude reductions that would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during January through June, September, November, and December, and similar to or lower than flows under NAA during July, August, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of relatively small magnitude and would not be consistent by water year type from month to month and therefore, would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A9_LLT (Table 11-9-89). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 9 and NAA.

Table 11-9-89. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_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.
[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 9 are generally similar to or greater than flows under the NAA in most months. Flows are generally lower in the Feather River high-flow channel during July through December, and in the American River below Nimbus Dam during the summer months, although the flow reductions would be of relatively small magnitude and would not be consistent month to month within each water year type, and therefore would not have biologically meaningful negative effects on the largemouth bass population. The percentage of months outside all temperature thresholds examined in the Feather River under Alternative 9 are generally similar to or lower than under the NAA, and there are no temperature-related effects in any other rivers examined.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for largemouth bass relative to Existing Conditions.

Juveniles

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the April through November juvenile largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions in all months but August and October with some exceptions (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during August and October under A9_LLT would be up to 13% lower than flows under Existing Conditions. Flow reductions in drier water years throughout the rearing period would occur in dry years during September (25% lower) and in critical years during August, September, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively infrequent, isolated and small-magnitude flow reductions that would not have biologically meaningful negative effects on juvenile rearing success.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT during April through July would generally be similar to or greater than flows under Existing Conditions with the exception of a few isolated, small flow reductions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT during August through November would be similar to or up to 41% lower than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Reductions in drier water year types would occur consistently in critical years for August through November (to 41%), which would have a localized effect on rearing conditions in that specific water year type.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the April through November period, except in critical years during August through November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during April through June and August through September, with a few exceptions in wetter water years, and generally lower (up to 32% lower) during July, October, and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate to substantial flow reductions (to 56% lower) would occur in some drier water year types during July through November, and would have a localized effect on rearing conditions in drier water years.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or lower than flows under Existing Conditions during April through November (to 42% lower) with very few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate to substantial flow reductions would occur in drier water year types, when effects on habitat conditions would be most critical, during June to September and November, and would affect habitat conditions for this time-frame in drier water years.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass rearing during April through November was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of instream habitat available for juvenile rearing and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F water temperature threshold for year-round juvenile largemouth bass occurrence under Existing Conditions or A9_LLT (Table 11-9-88). As a result, there would be no difference in the percentage of months in which the 88°F water temperature threshold is exceeded between Alternative 9 and Existing Conditions.

Adults

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower flows could reduce the quantity and quality of instream habitat available for adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during all months with a few isolated exceptions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with relatively small, isolated flow reductions, and more moderate reductions in critical years during August through December (up to 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August, September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or lower than flows under Existing Conditions during January, February, drier water year types during March and July through September (to 56% lower), and most water year types during October through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and would be fairly persistent for July through December, affecting rearing conditions during that time-frame.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during January in wetter water year types, and during February through April, and would be similar to or lower than flows under Existing Conditions during January in drier water years (to 17% lower) and during May through December in most water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would include moderate to substantial flow reductions in drier water year types for much of this time-frame that would affect rearing conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F water temperature range for year-round adult largemouth bass occurrence under Existing Conditions or A9_LLT (Table 11-9-89). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 9 and Existing Conditions.

Collectively, these results indicate that the impact would be significant because Alternative 9 would cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower during the majority of the juvenile and adult rearing periods in the American River and in the Feather River. There would be substantial reductions for a portion of the rearing periods in the Trinity River that would contribute to regional effects. The percentages of years outside all temperature thresholds are generally lower under Alternative 9 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA conclusion assumes existing climate conditions. Therefore, differences in model outputs between the Existing Conditions and Alternative 9 are due primarily to both the alternative and future climate change.

Sacramento Tule Perch

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater than flows under NAA except in dry and critical years during January (to 11% lower), in above normal years during August (7% lower), and above normal, below normal, and critical years during October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated and small-magnitude flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA throughout the year except for isolated, small flow reductions in below normal years during February (28% lower), and in critical years during August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA throughout the year, except in below normal years during March (6% lower) and in critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June and August, and similar to or lower than flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-magnitude reductions that would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during January through June, September, November, and December, and similar to or lower than flows under NAA during July, August, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of relatively small magnitude and would not be consistent by water year type from month to month and therefore, would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT exceeding the 72°F threshold would be similar to (below normal and critical years), lower than (dry years), or higher than the percentage under NAA by up to 50% depending on water year type (Table 11-9-90). Although relative differences in wet and above normal years are large due to small values, the absolute differences in percent exceedance are only 1%, and do not represent biologically meaningful effects to Sacramento tule perch.

The percentage of months under A9_LLT exceeding the 75°F threshold would be similar to the percentage under NAA in all water year except dry and critical years (50% and 17% higher, respectively) (Table 11-9-90). Although the relative differences in dry and critical years are large due to small values, the absolute differences in percent exceedance are only 1% and do not represent biologically meaningful effects to Sacramento tule perch.

Table 11-9-90. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F Water Temperature Thresholds for Sacramento Tule Perch Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
72°F Threshold		
Wet	0.3 (14%)	1 (25%)
Above Normal	2 (NA)	1 (50%)
Below Normal	3 (NA)	0 (0%)
Dry	5 (NA)	-0.5 (-10%)
Critical	11 (267%)	1 (5%)
All	3 (262%)	0 (6%)
75°F Threshold		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	2 (NA)	1 (50%)
Critical	8 (1,100%)	1 (17%)
All	2 (1,500%)	0 (25%)

NA = could not be calculated because the denominator was 0.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined during the year under Alternative 9 are generally similar to or greater than flows under the NAA in most months. Flows are generally lower in the Feather River high-flow channel during July through December, and in the American River below Nimbus Dam during the summer months, although the flow reductions would be of relatively small magnitude and would not be consistent month-to-month within each water year type, and therefore would not have biologically meaningful negative effects on hardhead. The percentages of years outside all temperature thresholds under Alternative 9 are generally similar to the percentages under the NAA.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for Sacramento tule perch relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during all months with a few isolated exceptions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with relatively small, isolated flow reductions, and more moderate reductions in critical years during August through December (up to 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August, September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or lower than flows under Existing Conditions during January, February, drier water year types during March and July through September (to 56% lower), and most water year types during October through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and would be fairly persistent for July through December, affecting rearing conditions during that time-frame.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during January in wetter water year types, and during February through April, and would be similar to or lower than flows under Existing Conditions during January in drier water years (to 17% lower) and during May through December in most water years (to 44% lower) Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*. This would include moderate to substantial flow reductions in drier water year types for much of this time-frame that would affect rearing conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in Clear Creek or the San Joaquin River.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT exceeding 72°F would be similar to the percentage under Existing Conditions in all water years except wet (14% higher) and critical years (267% higher) (Table 11-9-90). These values correspond to relatively low absolute increases of 0.3% and 11%, respectively, and would not have biologically meaningful negative effects on Sacramento tule perch.

The percentage of months under A9_LLT exceeding 75°F relative to the percentage under Existing Conditions would be similar to the percentage under Existing Conditions except in critical years when it would be 1,100% higher (Table 11-9-90). This large percentage increase corresponds to a relatively small absolute percent increase, 8%, and would not have biologically meaningful negative effects.

Collectively, these results indicate that the impact would be significant because Alternative 9 would cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially lower during the majority of the juvenile and adult rearing periods in the American River and in the Feather River, with substantial reductions for a portion of the rearing periods in the Trinity River contributing to regional effects. The percentages of years outside both temperature thresholds are generally lower or only slightly higher under Alternative 9 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA, and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA conclusion assumes existing climate conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 9 are due primarily to both the alternative and future climate change.

Sacramento-San Joaquin Roach

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater than flows under NAA except in dry and critical years during January (to 11% lower), in above normal years during August (7% lower), and above normal, below normal, and critical years during October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated and small-magnitude flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA throughout the year except for isolated, small flow reductions in below normal years during February (28% lower), and in critical years during August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and in critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June and August, and similar to or lower than flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-magnitude reductions that would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during January through June, September, November, and December, and similar to or lower than flows under NAA during July, August, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of relatively small magnitude and would not be consistent by water year type from month to month and therefore, would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A9_LLT (Table 11-9-91). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 9 and NAA.

Table 11-9-91. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay at Exceed the 86°F Water Temperature Range for Sacramento-San Joaquin Roach Survival[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_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.

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in spawning and juvenile and adult Sacramento-San Joaquin roach rearing habitat. Flows under Alternative 9 in all rivers examined throughout the year are generally similar to or greater than flows under the NAA, except for relatively infrequent/isolated, small to moderate flow reductions that would not be biologically meaningful to the roach population. The percentage of months outside temperature thresholds would be similar to or lower under Alternative 9 than under the NAA.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach rearing period. Lower flows could reduce the quantity and quality of instream habitat available for rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during all months with a few isolated exceptions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with relatively small, isolated flow reductions, and more moderate reductions in critical years during August through December (up to 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August, September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or lower than flows under Existing Conditions during January, February, drier water year types during

March and July through September (to 56% lower), and most water year types during October through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and would be fairly persistent for July through December, affecting rearing conditions during that time-frame.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during January in wetter water year types, and during February through April, and would be similar to or lower than flows under Existing Conditions during January in drier water years (to 17% lower) and during May through December in most water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would include moderate to substantial flow reductions in drier water year types for much of this time-frame that would affect rearing conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round juvenile and adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or A9_LLT (Table 11-9-91). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 9 and Existing Conditions.

Collectively, these results indicate that the impact would be significant because Alternative 9 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be substantially lower during the majority of the juvenile and adult rearing periods in the American River and in the Feather River, with substantial reductions for a portion of the rearing periods in the Trinity River contributing to regional effects. The percentages of years outside both temperature thresholds are generally lower under Alternative 9 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA conclusion assumes existing climate conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 9 are due primarily to both the alternative and future climate change.

Hardhead

In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for hardhead relative to the NAA.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater than flows under NAA except in dry and critical years during January (to 11% lower), in above normal years during August (7% lower), and above normal, below normal, and critical years during October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively isolated and small-magnitude flow reductions that would not have biologically meaningful negative effects.

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under NAA throughout the year except for isolated, small flow reductions in below normal years during February (28% lower), and in critical years during August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful effects.

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than NAA throughout the year, except in below normal years during March (6% lower) and in critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or greater than flows under NAA during April through June and August, and similar to or lower than flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-magnitude reductions that would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during January through June, September, November, and December, and similar to or lower than flows under NAA during July, August, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of relatively small magnitude and would not be consistent by water year type from month to month and therefore, would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers throughout the year.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the range would be similar to or lower than the percentage under NAA in all water years (Table 11-9-92).

Table 11-9-92. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence[a]

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-4 (-5%)	-1 (-1%)
Above Normal	-5 (-7%)	-1 (-1%)
Below Normal	-9 (-13%)	2 (3%)
Dry	-6 (-9%)	0.9 (1%)
Critical	-7 (-10%)	0 (0%)
All	-6 (-8%)	0.2 (0%)

[a] A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in spawning and juvenile and adult hardhead rearing. Flows in all rivers examined during the year under Alternative 9 are generally similar to or greater than flows under the NAA in most months. Flows are generally lower in the Feather River high-flow channel during July through December, and in the American River below Nimbus Dam during the summer months, although the flow reductions would be of relatively small magnitude and would not be consistent month to month within each water year type, and therefore would not have biologically meaningful negative effects on hardhead. The percentages of years outside all temperature thresholds are generally lower under Alternative 9 than under the NAA.

CEQA Conclusion: In general, Alternative 9 would reduce the quality and quantity of upstream habitat conditions for hardhead relative to Existing Conditions.

Flows

Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in Clear Creek were examined during the year-round juvenile and adult hardhead rearing period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile and adult rearing.

In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during all months with a few isolated exceptions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year with relatively small, isolated flow reductions, and more moderate reductions in critical years during August through December (up to 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the year, except in critical years during August, September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or lower than flows under Existing Conditions during January, February, drier water year types during March and July through September (to 56% lower), and most water year types during October through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and would be fairly persistent for July through December, affecting rearing conditions during that time-frame.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions during January in wetter water year types, and during February through April, and would be similar to or lower than flows under Existing Conditions during January in drier water years (to 17% lower) and during May through December in most water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would include moderate to substantial flow reductions in drier water year types for much of this time-frame that would affect rearing conditions.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate reductions in flows during the period relative to Existing Conditions.

Water Temperature

The percentage of months in which year-round in-stream temperatures would be outside of the 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the April through November period.

In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be similar to or lower than the percentage under Existing Conditions in all water years (Table 11-9-92).

Collectively, these results indicate that the impact would be significant because Alternative 9 would cause a substantial reduction in hardhead habitat. Flows would be substantially lower during the majority of the juvenile and adult rearing periods in the American River and in the Feather River, with substantial reductions for a portion of the rearing periods in the Trinity River contributing to regional effects. The percentages of years outside both temperature thresholds are generally lower under Alternative 9 than under Existing Conditions. This impact 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 impact to a less-than-significant level would fundamentally change the alternative, thereby making it a different alternative than that which has been modeled and analyzed. As a result, this impact is significant and unavoidable because there is no feasible mitigation available.

The NEPA and CEQA conclusions differ for this impact statement because they were determined using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-term implementation period, whereas the CEQA conclusion assume existing climate conditions. Therefore, differences in model outputs between the Existing Conditions and Alternative 9 are due primarily to both the alternative and future climate change.

California Bay Shrimp

The effect of water operations on rearing habitat of California bay shrimp under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203.

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-203, these effects would not be adverse.

CEQA Conclusion: As described above the impacts on rearing habitat of California bay shrimp would be less than significant.

Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered Aquatic Species of Primary Management Concern

Striped Bass

Striped bass adults migrate into the Delta and upstream starting in March and peaking in April and May. Conditions for adult striped bass migrating to spawning habitat would not be affected under Alternative 9 because average monthly flows in the lower Sacramento River downstream of the north Delta intakes would be similar to NAA (-3% to 7%). Several operable barriers would be installed to provide safe fish migration corridors and to isolate water conveyance corridors (at head of Old River and San Joaquin River, sloughs and canals between Old River and Middle River, locations at the mouth of Old River, and near the lower Mokelumne River). The physical isolation of the water conveyance corridor on the Middle River from the fish migration corridor on Old River may interfere with the movement patterns of highly mobile striped bass to and from the south and east Delta. The degree of isolation would depend on timing and duration of barrier closure. The operable nature of the barriers would reduce impacts to migration conditions. Most barriers would be operated to pass high flows, which would maintain periodic connectivity among Delta regions. Alternative 9 would affect some movement corridors within the Delta, but the effect would not be adverse to the striped bass population.

NEPA Effects: Overall, the effect on striped bass migration under Alternative 9 would not be adverse because the similarity in flow conditions in the north Delta and barrier operations to allow periodic connectivity.

CEQA Conclusion: Impacts would be as described immediately above. Flows in the north Delta would be similar on average to Existing Conditions during the striped bass migration to spawning habitat upstream in the Sacramento River. Also, the barriers isolating the Middle River from the Old River would alter movement corridors for striped bass in the central and south Delta. Overall, the impact would be less than significant. No mitigation would be required.

American Shad

Flows in the Sacramento River below the north Delta diversion facilities would be similar to NAA from March-May. Flows from the San Joaquin River at Vernalis would be unchanged. Sacramento River flows are highly variable inter-annually, and American shad are still able to migrate upstream the Sacramento River during lower flow years. The effect of isolating the Middle River water conveyance corridor would affect movement patterns of American shad in a manner similar to that described above for striped bass.

NEPA Effects: Overall, the effect of Alternative 9 on American shad migration would not be adverse under Alternative 9.

CEQA Conclusion: Impacts would be as described immediately above. Flows downstream of the north Delta intakes and the south Delta would be similar to Existing Conditions. The isolation of the Middle River from the Old River would alter some movement pathways within the Delta. Overall, Alternative 9 would not substantially interfere with the migration of American shad. Therefore, the impact would be less than significant. No mitigation would be required.

Threadfin Shad

NEPA Effects: Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn. The effect of isolating the Middle River water conveyance corridor would affect local movement patterns of threadfin shad in a manner similar to that described for striped bass under Alternative 9 (Impact AQUA-204), and would reduce potential entrainment loss. Overall the effect would not be adverse

CEQA Conclusion: Flows downstream of the north Delta intakes and the south Delta would be similar to Existing Conditions. The isolation of the Middle River from the Old River would alter threadfin shad movements in the same way as for striped bass (refer to Alternative 9, Impact AQUA-204 for striped bass), but would reduce the potential for incidental entrainment loss at the south Delta facilities. Overall, Alternative 9 would not substantially interfere with the migration of threadfin shad. Therefore the impact would be less than significant. No mitigation would be required

Largemouth Bass

NEPA Effects: Alternative 9 operations would not adversely affect migration conditions for largemouth bass because this a resident species remains close to vegetated nearshore habitat and does not use the Delta as migration corridor.

CEQA Conclusion: As described immediately above, the impact of Alternative 9 operations on migration would is considered less than significant because largemouth bass do not migrate within the Delta. No mitigation would be required.

Sacramento Tule Perch

NEPA Effects: Similar to largemouth bass, Sacramento tule perch are a non-migratory species and do not use the Delta as a migration corridor as they are a resident Delta species. There would be no effect.

CEQA Conclusion: As described immediately above, flow changes would not affect Sacramento tule perch movements within the Delta. No mitigation would be required.

Sacramento-San Joaquin Roach

NEPA Effects: For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 9, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to the NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

Hardhead

NEPA Effects: For hardhead the overall flows and temperature in upstream rivers during migration to their spawning grounds would be similar to those described under Alternative 9, Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream conditions relative to the NAA. These conditions would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of water operations on migration conditions for hardhead would not be significant and no mitigation is required.

California Bay Shrimp

NEPA Effects: The effect of water operations on migration conditions of California bay shrimp under Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects would not be adverse.

CEQA Conclusion: As described above the impacts on migration conditions of California bay shrimp would be less than significant.

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

The effects of restoration measures under Alternative 9 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

The potential effects of the construction of restoration measures on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for Alternative 1A (see Alternative 1A, Impact AQUA-7).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-7, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of the construction of restoration measures would be less than significant.

Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-Covered Aquatic Species of Primary Management Concern

The potential effects of contaminants associated with habitat restoration measures, on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail under Alternative 1A (see Alternative 1A, Impact AQUA-8).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-8, these effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of contaminants associated with restoration measures would be less than significant.

Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of Primary Management Concern

NEPA Effects: The potential effects of restored habitat conditions on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-8). In addition, see Alternative 1A, Impact AQUA-207 for a discussion of the minor differences in effects on non-covered species of primary management concern. The effects range from slightly beneficial to beneficial.

CEQA Conclusion: As described immediately above, the impacts of restored habitat conditions would range from slightly beneficial to beneficial.

Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of Primary Management Concern (CM12)

The potential effects of methylmercury management on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-10).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-10, these effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of methylmercury management would be less than significant.

Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered Aquatic Species of Primary Management Concern (CM13)

NEPA Effects: The potential effects of invasive aquatic vegetation management on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch also use the cover of aquatic vegetation in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. The effect on them will not be adverse.

CEQA Conclusion: Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic vegetation management on non-covered species of primary management concern. Although there are minor differences, the effects are similar, except for predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch use the cover of aquatic vegetation in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory species and Sacramento tule perch. However, this control will not substantially reduce the ability of the predatory species to hunt and there will still be many other habitats in which the predatory species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on them will not be significant and no mitigation is required.

Other Conservation Measures (CM12–CM19 and CM21)

The effects of other conservation measures under Alternative 9 would be similar for all non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic Species of Primary Management Concern (CM14)

The potential effects of dissolved oxygen management on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-12).

NEPA Effects: As concluded for Alternative 1A, these effects would be beneficial.

CEQA Conclusion: As described immediately above, the impacts of oxygen level management would be beneficial.

Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic Species of Primary Management Concern (CM15)

Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of predatory fish (striped bass and largemouth bass) and predator management on non-predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive.

NEPA Effects: The effects of this management will not be adverse.

CEQA Conclusion: Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of predatory fish and predator management on non-predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting success. This management will have negative effects on predatory fish. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of this management will not be significant. No mitigation is required.

Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of Primary Management Concern (CM16)

NEPA Effects: The potential effects of nonphysical fish barriers on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-14). The effects would be similar except for Sacramento-San Joaquin roach and hardhead which are unlikely to be present in their vicinity. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of nonphysical fish barriers would be less than significant.

Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of Primary Management Concern (CM17)

The potential effects of illegal harvest reduction on non-covered species of primary management concern under Alternative 9 would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-15).

NEPA Effects: As concluded for Alternative 1A, Impact AQUA-15, the effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of illegal harvest reduction would be less than significant.

Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of Primary Management Concern (CM18)

The potential effects of conservation hatcheries on non-covered species of primary management concern under Alternative 9 would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-16).

NEPA Effects: For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be no effect.

CEQA Conclusion: As described immediately above, conservation hatcheries would have not impact.

Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species of Primary Management Concern (CM19)

The potential effects of stormwater treatment on non-covered species of primary management concern under Alternative 9, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-17).

NEPA Effects: For a detailed discussion, please see Alternative 1A, Impact AQUA-17. These effects would be beneficial.

CEQA Conclusion: As described immediately above, the impacts of stormwater management would be beneficial.

Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered Aquatic Species of Primary Management Concern (CM21)

NEPA Effects: The potential effects of removal/relocation of nonproject diversions under Alternative 9, on non-covered species of primary management concern, would be similar to those described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-18). The effects would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which are unlikely to be present near these diversions. The effects would not be adverse.

CEQA Conclusion: As described immediately above, the impacts of removal/relocation of nonproject diversions would be less than significant.

Upstream Reservoirs

Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat

NEPA Effects: Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 9 would not be substantially reduced when compared to the No Action Alternative.

CEQA Conclusion: Similar to the description for Alternative 1A, Alternative 9 would reduce the quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant impact. These results are primarily caused by four factors: differences in sea level rise, differences in climate change, future water demands, and implementation of the alternative. The analysis described above comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the alternative from those of sea level rise, climate change and future water demands using the model simulation results presented in this chapter. However, the increment of change attributable to the alternative is well informed by the results from the NEPA analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.5 Cumulative Effects on Fish and Aquatic Resources

Under CEQA, cumulative impacts are defined as two or more related past, present, and reasonably foreseeable future projects and programs, that when considered together, are considerable or that compound or increase other environmental impacts. Cumulative impacts consist of impacts which are created as a result of the combination of the proposed project with other projects that would cause related impacts. The CEQA cumulative impacts focus is on whether the proposed project's incremental contribution to any other significant impact is cumulatively considerable and thus significant in and of itself.

The Council of Environmental Quality (CEQ) regulations defines cumulative impacts as the impact on environment, human, and community resources that results from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal on non-Federal) or persons undertakes such actions. Cumulative Impacts can result from individually minor but collectively significant actions taking place over time (40 Code of Federal Regulations [CFR] 1508.7, 1508.25.)

11.3.5.1 Assessment Methodology

The cumulative effects analysis for fish and aquatic resources addresses the potential for the action alternatives to act in combination with other past, present, and probable future projects or programs to create a cumulatively significant adverse impact. The geographic scope of the cumulative analysis for each of the covered and non-covered species varies, depending on the potential for other projects or programs to influence individuals that rely on the BDCP Plan Area for some stage of their life history. While these areas extend beyond the Plan Area, the primary focus for these resource effects is the Delta Region, where BDCP conservation and operational efforts are concentrated, and areas upstream of the Delta where operational effects would be the primary mechanism to affect aquatic habitat conditions. For some species, such as anadromous fish, the analysis area extends well beyond the Plan Area. Other fish species whose individuals do not range beyond the Plan Area, such as Delta smelt, the geographic range of the cumulative analysis has been limited to this smaller area.

When the effects of the changes in aquatic habitat or species resources under the alternatives are considered in connection with the potential effects of projects listed in Chapter 3, *Description of Alternatives,* the potential effects range from beneficial to potentially adverse cumulative effects on fish and aquatic resources.

The projects and programs that have been considered as part of the cumulative analysis have been drawn primarily from a list developed for this EIR/EIS and contained in Appendix 3D. This list was compiled in part by reviewing the projects addressed in the cumulative impacts analysis for the Delta Land Use and Resource Management Plan (Delta Protection Commission 2010). The list was augmented by reviewing the alternatives development information presented in Appendix 3A, *Identification of Water Conveyance Alternatives, Conservation Measure 1*, and other recent environmental documents for Delta-area projects, Central Valley diversion-related projects, and by coordinating with local, state, and federal agencies that are sponsoring activities in the Delta area or on other areas within the relevant range of individual fish species. The list of past, present and probable future projects has been evaluated to determine which may have effects on aquatic habitats and species that occur within the Plan Area. The list of projects relevant to fish and aquatic resources is contained in Table 11-13. This analysis is qualitative in nature.

A determination of the potential adverse effects of each individual alternative was used to assess whether implementation of the alternatives would contribute to an adverse cumulative effect on the fish and aquatic resources of the Plan Area. Based on the analyses presented in earlier parts of this chapter, the alternatives would often have a beneficial effect on many of the aquatic resources in the Plan Area. However, there are many instances where the alternatives would have adverse effects on fish and aquatic resources. While construction and restoration activities in the near-term period of the alternatives would temporarily or permanently alter the available habitat for the covered species, the near-, mid- and long-term conservation actions would replace, enhance and in most cases expand habitat for these species. The potential construction-related adverse effects of implementing the alternatives are limited to short-term losses. The potential operation-related adverse effects of implementing the alternatives can be either short-term or long-term, varying among the specific types of effects and alternatives.

While the modeling of operations included several projects in addition to the action alternatives, there are some known future projects that were not included. Those projects are addressed qualitatively in this cumulative analysis. Similarly, there are numerous projects that would entail construction and maintenance activities, extending through portions of the same time period as BDCP, which are also addressed in this cumulative analysis. The specific programs, projects and policies that are considered in combination with the BDCP are identified below for each relevant impact category based on the potential to contribute to a BDCP impact that could be considered cumulatively considerable.

Many of the projects and programs included in the cumulative effect analysis, would be similar to those included in the action alternatives, and would have similar potential effects. These effects would also be similar between the different covered species. Therefore, the following assessment addresses all the covered species as a group, for the most part, rather than individual species.

When the effects of the BDCP on fish and aquatic resources are considered in connection with the potential effects of projects listed in Table 11-14, the combined effects range from beneficial to potentially adverse. There are elements of the BDCP that will have negative effects (construction and, in some situations, operations) and others that will have positive effects (conservation and restoration). The cumulative analysis looks at the whole of these actions.

Table 11-13. Effects on Covered Fish Species from the Plans, Policies, and Programs Included in the Cumulative Effects Analysis

Agency	Programs, Projects, and Policies	Comments
Department of Fish and Game	California Aquatic Invasive Species Draft Rapid Response Plan	Program under development. Draft Plan issued in 2007.
Department of Fish and Game	Fremont Landing Conservation Bank	Project completed.
Department of Fish and Game	Fish Screen Project at Sherman and Twitchell Islands	Program included in Delta Initiatives List.
Department of Parks and Recreation	Central Valley Vision	Implementation Plan completed in 2009.
Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Completed in 2012.
Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Project implementation began in 2012. Estimated completion in 2016.
Department of Water Resources	State Water Project Contract Extension	
Contra Costa Water District, U.S. Bureau of Reclamation, and Department of Water Resources	Los Vaqueros Reservoir Expansion Project	Project completed in 2012.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Project under development. Final EIR in 2009. Specific design and operations criteria not identified.
Northeastern San Joaquin County Groundwater Banking Authority	Eastern San Joaquin Integrated Conjunctive Use Program	Final Programmatic EIR in 2011.
University of California, Davis, California Department of Water Resources, Department of Fish and Game, U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation	Delta Smelt Permanent Refuge	Program under development to develop a permanent facility, possibly at the proposed FWS Science Center at Rio Vista.
U.S. Bureau of Reclamation	Delta-Mendota Canal/ California Aqueduct Intertie	Project completed in 2012.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010–2019	Final EIS/EIR in 2009.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Agricultural Drainage Selenium Management Program	Program under development. Draft EIS/EIR in 2008.

Agency	Programs, Projects, and Policies	Comments
Water Forum and U.S. Bureau of Reclamation	Lower American River Flow Management Standard	Program under development. Draft EIR in 2010. Recommendations included in NMFS Biological Opinion.
West Sacramento Area Flood Control Agency and U.S. Army Corps of Engineers	West Sacramento Levee Improvements Program	Program under development. Construction initiated in several areas. Further environmental and engineering documentation required for future projects.
California Department of Fish and Game	Calhoun Cut/ Lindsey Slough Restoration	Increase intertidal marsh habitat and adjacent riparian habitat on 927 acres in Cache Slough ROA.
California Department of Fish and Game	Ecosystem Restoration Program Conservation Strategy	Created in 2000. Ongoing program to preserve, restore, and enhance terrestrial natural communities and ecosystems in the San Francisco Bay and Sacramento-San Joaquin Delta. Protected and restored more than 150,000 acres of habitat, including 3,900 acres and 59 miles of riparian and riverine aquatic habitat (as of 2010) after 7 of the planned 30 years of the project.
California Department of Fish and Game	Lower Sherman Island Wildlife Area Land Management Plan	Ongoing program. Directs habitat and species management on 3,100 acres of marsh and open water.
California Department of Fish and Game	Yolo Bypass Wildlife Area Land Management Plan	Ongoing program. Provides for multiple use management of 16,000 acres of mixed agricultural, grassland and managed wetland habitats.
California Department of Water Resources	Central Valley Flood Protection Plan	Proposes significant expansion of flood protection features in the study area, including expansion of the Yolo Bypass.
California Department of Water Resources	Delta Levees Flood Protection Program	Ongoing program. Includes modification to Delta levees within the Sacramento-San Joaquin Delta and portions of the Suisun Marsh. The project works with 60 reclamation districts and strives to complete levee rehabilitation projects with no net loss of habitat in the Delta.
California Department of Water Resources	FloodSAFE California	Promotes public safety through integrated flood management while protecting environmental resources; emphasizes action in the Delta.
California Department of Water Resources	Levee Repair-Levee Evaluation Program	Ongoing program. Upgrading levees along the Sacramento and San Joaquin Rivers and Delta; 1,600 miles of levees included in Central Valley.
California Department of Water Resources and MOA Partners	Lower Yolo Restoration Project	In Cache Slough ROA, reintroduce tidal action to half of 3,408-acre Yolo Ranch.

Agency	Programs, Projects, and Policies	Comments
Contra Costa Water District	Contra Costa Canal Fish Screen Project	Completed in 2011. Designed to restore Delta ecosystems. Minor terrestrial impact at fish screen sites.
Contra Costa Water District, U.S. Bureau of Reclamation, and California Department of Water Resources	Contra Costa Water District Middle River Intake and Pump Station (Alternative Intake Project)	Completed in 2010. Resulted in permanent conversion of 6–8 acres of rural agricultural land. Features about 12,000 feet of pipe across Victoria Island and under Old River.
National Marine Fisheries Service, U.S. Bureau of Reclamation, and Department of Water Resources	Biological Opinion (BiOp) on the Long-Term Operations of the Central Valley Project and State Water Project	Ongoing program. Action area consists of the Oroville Reservoir, Feather River downstream of Oroville, Sacramento River downstream of Feather River, Sacramento-San Joaquin Delta, and adjacent habitats that are dependent on or influenced by waterways. Designed to conserve freshwater, estuarine, nearshore, and offshore sites. Includes 8,000-acre tidal wetland restoration requirement.
Reclamation District 2093	Liberty Island Conservation Bank	Under implementation. Permits and approvals acquired in 2009. Project site is on northern tip of Liberty Island. Over 160 acres in the project site with about 50 proposed to be converted to open water channels, emergent marsh wetland, and riparian habitat. Focuses on Delta fish habitat but will restore 2.7 acres of riparian habitat.
Sacramento Area Flood Control Agency, Central Valley Flood Protection Board, and U.S. Army Corps of Engineers	Central Valley Flood Management Program	Ongoing program. Supports flood management planning in Sacramento and San Joaquin Valleys. To be updated every 5 years with first update to be completed in 2017. Combined total of about 2.2 million acres of land within the Central Valley.
Semi Tropic Water District	Delta Wetlands	Flood storage and habitat conservation project on three Delta islands.
U.S. Army Corps of Engineers	CALFED Levee Stability Program	Includes maintaining and improving levee stability in the Delta. Long-term strategy will include ecosystem restoration. Partially funds McCormack-Williamson Tract Restoration in Cosumnes-Mokelumne ROA; 1,500 acres of tidal and floodplain restoration.
U.S. Bureau of Reclamation	Delta Mendota Canal/California Aqueduct Intertie	Construction completed in April 2012. Includes construction of a pump and 500-foot pipeline between the two canals near the Jones Pumping Plant. No special-status plant community affected.

Agency	Programs, Projects, and Policies	Comments
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Department of Water Resources and Department of Fish and Game	San Joaquin River Restoration Program	Initiated in 2006. Ongoing program; 150 miles of the river is planned for restoration, including within the BDCP Plan Area.
U.S. Fish and Wildlife Service	Recovery Plan for Sacramento-San Joaquin Delta Native Fishes	Includes developing additional shallow water habitat, riparian vegetation zones and tidal marsh to restore wetland habitats throughout the Bay-Delta ecosystem.
U.S. Army Corps of Engineers	Sacramento River Bank Protection Project	Provides erosion control to levees of the federally authorized flood control project along the Sacramento River and its tributaries. Ongoing program with NOA/NOP for an additional 80,000 linear feet issued in 2009.

Cumulative Effects of No Action

Effects of Past, Present and Reasonably Foreseeable Projects and Programs

The current conditions of study area aquatic resources are the byproduct of past and ongoing human activity and natural processes. The present range and condition of natural communities, covered and noncovered species are described in Section 11.1, *Environmental Setting/Affected Environment*. A brief synopsis of general environmental conditions and their evolution in the study area is presented in Section 11.1.4, *Ecological Processes and Functions* and Section 11.1.5, *Stressors*. This discussion provides a context of current hydrodynamic conditions within the Delta.

The various projects and programs listed in Table 11-13 will have cumulative effects on the existing biological resources of the study area over the next 50 years. The most relevant elements of these projects and programs are their ability to modify hydrodynamics in the study area. Many of the projects and programs that would occur under the No Action Alternative in a cumulative scenario would be similar to those included in the BDCP alternatives and would have similar potential effects. These effects would also be similar between the different covered species. For any projects implemented under the NAA that include in-water construction and maintenance activities, there would be the potential to stress, injure, or kill covered fish species through direct or indirect effects, and the potential to alter spawning, rearing and/or migration habitat of covered fish species through direct loss or modification. However, these effects would be mitigated through the environmental permitting processes and project-specific AMMs, BMPs, environmental commitments and/or mitigation measures and there would be no expected adverse effect on covered or non-covered species.

Implementation of south Delta export pumping restrictions under the USFWS (2008) and NMFS (2009) BiOps would continue in the No Action Alternative in a cumulative scenario in addition to other improvements in SWP/CVP facilities and operations which would be expected to occur. As a result, effects on covered and non-covered species as a result of entrainment or on spawning and egg incubation, rearing or migration habitat would not be adverse.

11.3.5.2 Covered Fish Species

Construction and Maintenance of CM1

Impact AQUA-CUM1: Effects of Construction of Facilities on Covered Fish Species

The potential exposure of covered fish species to the cumulative effects of constructing the proposed project and the other projects listed in Table 11-13 include increased turbidity, accidental spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water work activities, loss of spawning, rearing or migration habitat, and predation. The construction and maintenance activities occurring under the cumulative effects analysis, would have similar effects on all the covered fish species; therefore, the analysis below is combined for all the covered species instead of analyzed by individual species.

Turbidity

As described in detail under Alternative 1A, in-water and nearshore construction and maintenance activities have the potential to generate and release suspended sediments to the water column, altering aquatic habitat conditions the covered species, as well as other fish species occurring in the area.

Construction and maintenance of projects or programs under the Cumulative Effects analysis (Table 11-13), such as the Battle Creek Salmon and Steelhead Restoration Project which would involve substantial in-channel and near-channel construction activities (e.g., dredging, dam removal, bank restructuring), would result in the temporary generation and release of suspended sediments to the water column, and other potential construction-related water quality effects. Similarly, routine construction activities that may occur from urbanization and infrastructure to accommodate population growth would generally be anticipated to involve relatively dispersed, temporary, and intermittent land disturbances across the affected environment. Further, certain maintenance activities, such as levee repair and maintenance, could result in temporary increases in water turbidity. Erosion of disturbed soils and associated sediment load would potentially enter surface water bodies. Increased suspended sediments would temporarily increase water column turbidity, altering habitat conditions in the Plan Area for fish and other aquatic species. However, adverse effects on fish from increases in turbidity during in- or near-water construction and maintenance activities would be minimized through adherence to applicable federal, state, and local regulations. In addition, project-specific designs, BMPs, and environmental commitments would be required to avoid, prevent, or minimize turbidity (e.g., implementation of site-specific erosion and sediment control plans). Each project would also require its own separate environmental compliance process.

As described in Chapter 8, *Water* Quality, water conveyance operations under the NAA would alter the magnitude and timing of water releases from reservoirs upstream of the Delta as well as alter downstream river flows relative to Existing Conditions. Delta turbidity levels are affected by turbidity in Delta inflows (and associated sediment load), and the influence of tidal actions in the Delta, as they relate to re-suspension of sediments. Overall however, the cumulative effects of turbidity would be similar to Existing Conditions, as many of the projects listed in Table 11-13 are on-going, completed, or very similar to activities that already periodically occur in the Plan Area. Therefore, because no significant cumulative changes in turbidity are expected to occur in the long-term upstream of the Delta, in the Plan Area or in the SWP/CVP Export Service Areas, covered fish species would not be adversely affected by turbidity changes.

Accidental Spills

As described in detail under Alternative 1A, in-water and nearshore construction and maintenance activities increase the potential for accidental spills entering the area waterways. Potential construction-related water quality effects associated with the proposed project and other construction projects associated with program actions occurring under the NAA, may include the inadvertent release of construction-related chemicals (e.g., fuels, solvents, and oils) and construction-related wastes (e.g., concrete, asphalt, cleaning agents, paint, and trash) to surface waters, which would result in localized water quality degradation. This could in turn result in adverse effects on covered fish species through direct injury and mortality or delayed effects on growth and survival, depending on the nature and extent of the spill and the contaminants involved. Generally, though, adverse effects on fish from inadvertent spills would be avoided through adherence to applicable federal, state, and local regulations, project-specific design, BMPs, and environmental commitments intended to avoid, prevent or minimize hazardous spills and construction-related hazards and/or mitigate for such occurrences (e.g., spill prevention and control plans and hazardous materials management plans). Each project implemented through the NAA would require its own separate environmental compliance process.

Disturbance of Contaminated Sediments

Sediment in many locations throughout the Plan Area has been affected by historical and current urban discharges (e.g., hydrocarbons, metals, and PCBs), agricultural runoff containing persistent pesticides (e.g., organochlorines), and mercury from historic mining. Projects and programs implemented through the NAA (see Table 11-13) that require in-water construction activities or sediment-disturbing maintenance activities (e.g., periodic channel dredging) have the potential to disturb and re-suspend contaminated sediments, which could result in direct and indirect effects on covered fish species. However, appropriate BMPs are expected to be implemented to minimize the disturbance and redistribution of these sediments, and because the duration of these activities would typically be limited, it is unlikely that exposure would be prolonged and therefore the potential for adverse effects on fish related to toxicants is minimal. Further, exposure of covered fish species to any disturbed contaminated sediments would be minimized by project permit restrictions on in-water work that would limit times to those when covered fish species are least abundant in the construction or maintenance area. Therefore the effect would not be adverse.

Underwater Noise

With the exception of the proposed project, very few projects identified in Table 11-13 would require the installation of extensive in-channel structures where the use of pile driving is necessary (e.g., cofferdams and diversion intakes). Therefore, the potential for adverse cumulative effects on covered fish species would be minimized. As described in detail for Alternative 1A, the effects of exposure to loud underwater noise can range from temporary hearing loss to physical injury sufficient to cause direct mortality or increased predation risks. The degree of effect is a function of the intensity of the sound, the distance from the source, the duration of exposure, the size of the fish exposed (smaller fish are more sensitive), and the species-specific sensitivity.

Implementation of Mitigation Measures AQUA-1a and AQUA-1b under the proposed project (see Impact AQUA-1, Alternative 1A) would effectively avoid and minimize adverse effects from impact pile driving. Similar measures are also expected to be required for other projects constructed in the Plan Area, when unmitigated construction noise levels could exceed the potential disturbance or injury thresholds. Therefore, the cumulative effects on covered fish species would be minimized or avoided through project-specific AMMs, BMPs, environmental commitments and/or mitigation measures, which could include seasonal timing restrictions on in-water activities; the use of vibratory pile drivers when possible; the use of noise attenuation devices; and limitations on the duration of impact pile driving activities. In addition, the chance of any individual fish being exposed to more than one project identified in Table 11-13 would be unlikely. Therefore the cumulative effect would not be adverse.

Fish Stranding and Direct Injury

As discussed above, for underwater noise, few projects are expected to require extensive cofferdam construction, and most projects can be implemented in a manner to eliminate or minimize fish stranding effects. In addition, fish would likely avoid the noise and activity of in-water construction and/or maintenance activities. However, direct injury and potential effects of fish stranding would be minimized by implementation of project-specific AMMs, BMPs, environmental commitments and/or mitigation measures, which could include seasonal timing restrictions on in-water activities, and implementation of species-specific fish rescue and salvage plans. As a result, effects would not be adverse.

Loss of Spawning, Rearing, or Migration Habitat

In-water construction and maintenance activities of programs and projects implemented through the late long-term period could temporarily or permanently alter habitat conditions for covered fish species in the vicinity of these activities and thereby adversely affect spawning, rearing and/or migration habitat. For example, any activities that occurs in a species' migration corridor has the potential to affect the behavior (i.e., through a change in migration route within the channel, delay from a noise deterrent, artificial light sources, etc.). Cofferdams used during in-water construction to isolate the work areas, temporarily reduce the width of riverine habitat available to fish for migration and rearing in the area. Further, in-water maintenance activities such as dredging and riprap placement can reduce habitat values. For example, dredging decreases the number of macroinvertebrates in the dredged area, which can cause a temporary loss of prey resources for benthic feeders such as splittail, green sturgeon, and juvenile Chinook salmon.

The fish species affected and the severity or magnitude of any adverse effects on spawning, rearing or migration habitat would depend on several factors including the seasonal timing of the activity, the suitability and/or quality of the habitat to begin with, and the quantity of habitat disturbed. As indicated above, for other in-water construction factors, effects are not expected to be adverse due to the implementation of project-specific AMMs, BMPs, environmental commitments and/or mitigation measures, which could include seasonal timing restrictions on in-water activities, and implementation of species-specific fish rescue and salvage plans.

Predation

Programs and projects contributing to the cumulative effects on the covered fish species, that involve the construction of in- and over-water structures (e.g., docks and associated pilings) could potentially result in increased predation relative to Existing Conditions. These types of structures can provide suitable predator habitat by providing shade and cover for predatory fishes, and perching areas for piscivorous birds.

Overall, predation risks to covered fish species is expected to increase due to a number of factors, including the continued spread of nonnative species and alteration of habitat conditions in the Plan

Area. This includes non-native predator fish species that directly prey on native species, as well as invasive aquatic plants, such as water hyacinth and *Egeria.* Increases in these non-native aquatic vegetation species is believed to provide excellent habitat for nonnative ambush predators, such as bass and sunfish, which prey on native fish species. *Egeria* is thought to reduce turbidity through a reduction in water velocity, which has been hypothesized to increase predation rates on some native fish (Brown and Michniuk 2007).

However, structural and operational improvements implemented at the SWP/CVP facilities and programs implemented elsewhere in the Plan Area, to reduce predator habitat, are expected to reduce site-specific predation levels. In addition, the expected amount of in-water and overwater structures likely to be permitted would be small compared to the overall habitat occurring in the Plan Area. Therefore, the effect would not be adverse.

NEPA Effects: Overall, the potential cumulative effects on covered fish species from construction and maintenance activities occurring in the Plan Area would include effects from increased turbidity, accidental spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water work activities, loss of spawning, rearing or migration habitat, and predation. These effects would be similar to those described for Alternative 1A (Impact AQUA-1 and Impact AQUA-2), also as described in those sections, these effects would not be adverse because of the limited extent, intensity, and duration of expected construction projects in the Plan Area. In addition, any such construction projects would be subject to a separate environmental compliance process, with permit stipulations which would include the implementation of project-specific AMMs, BMPs, environmental commitments and/or mitigation measures. This would include project-specific erosion and sediment control plans; hazardous materials management plans; SWPPPs; spill prevention and control plans; and limiting in-water activities to periods of low flow and/or to times when covered fish species are not likely to be present.

The construction activity with the most potential to affect covered fish species is the installation of cofferdams (pile driving), particularly under the proposed project. While other projects could also require some pile driving activities, the extent and duration of such activities would be substantially less than those of the proposed project. However, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, and other similar measures for other projects, would effectively avoid and minimize adverse effects from impact pile driving. Therefore, the effects of construction and maintenance projects on covered fish species would not be adverse, and no additional mitigation would be required.

CEQA Conclusion: The potential impact on covered fish species from construction and maintenance activities is considered less than significant due to implementation of the measures described in Appendix 3B, *Environmental Commitments.* Similar measures are expected to be required for other construction and maintenance project occurring in the Plan Area through the late long-term period. These measures would reduce the amount of turbidity from in-water construction and will guide rapid and effective response in the case of inadvertent spills of hazardous materials. Construction would not be expected to increase predation rates relative to Existing Conditions, but would likely result in both temporary and permanent alteration of rearing and migratory habitats used by some or all of the covered fish species. However, these effects are not expected to be significant because the loss of habitat would not be substantial compared to the amount of habitat currently available in combination with the amount of new habitat that would result from restoration actions. Thus, the cumulative effects of most construction or maintenance activities would be less than significant.

While most construction activities would result in less-than-significant effects, the direct effects of underwater construction noise from impact pile driving could be a significant impact because of the high likelihood that it would cause injury or death to fish in the immediate vicinity of the activity. However, implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the potential for effects from underwater noise and would reduce the severity of impacts to a less-than-significant level. Similar measures are expected to be required for other construction and maintenance project occurring in the Plan Area through the late long-term period.

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.

Impact AQUA-CUM2: Effects of Maintenance of Facilities on Covered Fish Species

NEPA Effects: The discussion of maintenance activity effects are provided above with the construction effects (Impact AQUA-CUM1), and the conclusions would also be the same.

CEQA Conclusion: The conclusion provide above for the construction activity effects (Impact AQUA-CUM1), would typically be very similar to those expected to occur during maintenance activities.

Water Operations of CM1

Operational impacts on fish may include changes in spawning, migration, and rearing habitat associated with changes in Sacramento River and tributary flows due to reservoir operations, water diversions, and the consequent changes in water quality and circulation through the Delta. As indicated in Chapter 5 *Water Supply*, the proposed project alternatives would have varying impacts on water supply, including changes in Delta exports and SWP and CVP deliveries. These impacts range from not adverse to adverse, depending on decreases or increases in exports and/or deliveries. Similarly, cumulative impacts on fish as a result of changes in water operations are likely to vary across alternatives. Considering the projects included in Table 11-13, there are three diversion projects that were not assumed to be operational in the analysis of the action alternatives (e.g., not included in the modeling) but would likely have some impact on water operations as they relate to fish and aquatic resources. Table 11-14 provides a summary of these three projects.

Table 11-14. Effects on Fish from the Programs, Projects, and Policies Considered for Cumulative Analysis

Agency	Program/Project	Status	Description of Program/Project	Effects on Fish
Contra Costa Water District and Bureau of Reclamation	Los Vaqueros Reservoir Expansion Project	Program under development. Draft EIS/EIR in 2009. Final EIS/EIR in 2010. Completed in 2012.	Project increases the storage capacity of Los Vaqueros Reservoir and diverts additional water from the Delta intake near Rock Slough to fill the additional storage volume (Bureau of Reclamation and Contra Costa Water District 2009).	The Los Vaqueros Expansion Project provides water to South Bay water agencies that otherwise would receive all of their Delta supplies through the existing SWP and CVP export pumps. The purpose of the project is to improve water quality to Bay Area water users and to adjust the pattern of diversions from the Delta to reduce impacts to aquatic resources. The project provides water supplies for previously identified water demands and not for additional non-identified growth. There are no new demands or increased water rights or contract amounts. An environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Program under development. Final EIR in 2009. Specific design and operations criteria not identified, but operation is expected to begin in 2016.	Project that will divert water on the Sacramento River upstream of the American River confluence to be conveyed to a new water treatment plant (City of Davis 2007).	Water diversions under the Davis-Woodland Water Supply Project would be made in compliance with Standard Water Right Permit Term 91, which prohibits surface water diversions when water is being released from CVP or SWP storage reservoirs to meet in-basin entitlements, including water quality and environmental standards for protection of the Sacramento- San Joaquin Delta. Water supply needs during periods applicable to Term 91 would be satisfied by entering into water supply transfer agreements with senior water rights holders within the Sacramento River watershed. The total diversion would be up to 45,000 acre-feet/year. An environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources.

Agency	Program/Project	Status	Description of Program/Project	Effects on Fish
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Department of Water Resources, and Department of Fish and Game	San Joaquin River Restoration Program	Final EIS/EIR and Record of Decision completed in 2011.	Program that aims at restoring flows to the San Joaquin River from Friant Dam to the confluence of Merced River (Bureau of Reclamation 2011).	The San Joaquin River Restoration Program would modify the release pattern of water from Friant Dam into the San Joaquin River, implement a combination of channel and structural modifications along the San Joaquin River below Friant Dam, and reintroduce Chinook salmon into portions of the San Joaquin River. Part or all of water released from Friant Dam could be recirculated to upstream water users. A final environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources. The project has the potential to result in beneficial impacts for salmonids.

All of these projects have completed final environmental documents that analyzed their potential impacts on fish and aquatic resources. According to these documents, the impacts on fish and aquatic resources would be less than significant or less than significant after mitigation measures are implemented.

Considering the results of the environmental analyses for these three projects, implementation of these projects in combination with the BDCP, are not anticipated to result in a significant change in flows in the locations considered in environmental documentation for these projects related to surface water resources beyond those changes presented above in the analysis of action alternatives. As a result, no significant changes to the entrainment of covered fish species, as well as the spawning, rearing, and migration habitat conditions for these species is expected beyond those changes presented above in the analysis of action alternatives. The following impact discussions present these conclusions.

Impact AQUA-CUM3: Effects of Water Operations on Entrainment of Covered Fish Species

Numerous methods were used to estimate entrainment losses under the NAA, and a complete analysis can be found in the *BDCP Effects Analysis – Appendix B*, *Entrainment, Section B.5 – Methods of Biological Analysis (hereby incorporated by reference).* Overall the primary mechanism for entrainment losses in the Plan Area is the operation of the existing south Delta export facilities, and the implementation of the proposed project would be the primary mechanism for altering the level of these entrainment losses. Therefore, the modeling results from Alternative 1A (see Impact AQUA-3) provide an approximation of the maximum cumulative effects on entrainment in the Plan Area. Simulations of entrainment conditions differ depending on the time period modeled, although the average annual proportion of covered fish populations, lost to entrainment at the south Delta facilities under Existing Conditions, increased under model simulations of the NAA. These results were most notably in wet, above-normal and below-normal water years. This proportional entrainment loss solely reflects variability attributable to simulated differences in south Delta export pumping (which influences OMR flows) and X2 flows. Despite these modeled increases in entrainment, the differences are not expected to reach the level of adverse effects on covered fish species populations (less than 5% of the population), primarily due to the implementation of restrictions implemented as part of the USFWS 2008 BiOp, and continued improvements in water export and fish salvage operations, as well as efforts to divert covered fish species from exposure to the south Delta facilities.

There is also no evidence of substantial entrainment at other intakes in the Plan Area, and any future intakes, including the three projects in Table 11-14, would be screened appropriately to minimize or eliminate entrainment, although some entrainment will continue to occur. Whatever entrainment is occurring would be reduced by continued efforts to screen the existing intakes in the Plan Area. While the effectiveness of the salvage operations at the south Delta facilities is relatively low, it has improved in recent years, and will continue to improve in the future (U.S. Fish and Wildlife Service 2008a). A substantial portion of this improvement would occur through the reduced use of the SWP/CVP south Delta facilities as part of the proposed project.

General improvements implemented during the NAA timeframe are expected to reduce entrainment losses of covered fish species through the implementation of the NMFS and USFWS BiOp requirements (National Marine Fisheries Service 2009; U.S. Fish and Wildlife Service 2008a), particularly the reverse OMR flow criteria, court-ordered restrictions on water operations, and actions taken by the water project operators in accordance with biological opinions (National Marine Fisheries Service 2009; U.S. Fish and Wildlife Service 2008). In addition, on-going and future operational improvements at the SWP/CVP south Delta facilities, and reduced use of these facilities under the proposed project, are expected to continue to reduce the rate of entrainment from water exports from the Delta, under the NAA.

NEPA Effects: The cumulative effects of water operations on entrainment would not be adverse to the covered fish species.

CEQA Conclusion: Implementation of south Delta export pumping restrictions under the NMFS and USFWS BiOp requirements (National Marine Fisheries Service 2009; U.S. Fish and Wildlife Service 2008a) has considerably limited entrainment loss of covered fish species. This would continue into the future, under the cumulative effects assumptions, along with enhancements to reduce overall entrainment at the SWP/CVP facilities and improve operation procedures. The reduced use of the SWP/CVP south Delta facilities is also expected to substantially reduce overall entrainment rates from water exports in the Delta. Therefore, the effect would be less than significant and no mitigation would be required.

Impact AQUA-CUM4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Covered Fish Species

NEPA Effects: Hydrology would change under implementation of the action alternatives, as previously described in this chapter. These changes are a result of implementing the various operational scenarios associated with each alternative. The three diversion-related projects in Table 11-14 also have the potential to change hydrology and/or spawning habitat. Cumulative effects to the extent and quality of spawning habitat would occur if physical habitat was modified or if changes in flow on the Sacramento and San Joaquin rivers and/or their tributaries result in substantially reduced spawning habitat, increased water temperatures, or increased occurrences of redd dewatering. However, the analyses for these projects indicates that there would not be any adverse effects on fish and aquatic resources, including spawning habitat. Therefore, the cumulative effects would be effectively approximated by the analyses conducted for the various action alternatives. As a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in cumulative adverse effects on spawning habitat. However, implementation of these projects in combination with the BDCP (Alternative 4) would not result in cumulative adverse effects on spawning habitat.

CEQA Conclusion: Implementation of the three diversion-related projects in Table 11-14 in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts on spawning habitat. However, implementation of these projects in combination with the BDCP (Alternative 4) would not result in significant cumulative impacts on spawning habitat.

Impact AQUA-CUM5: Effects of Water Operations on Rearing Habitat for Covered Fish Species

NEPA Effects: Hydrology would change under implementation of the action alternatives, as previously described in this chapter. These changes are a result of implementing the various operational scenarios associated with each alternative. The three diversion-related projects in Table 11-14 also have the potential to change hydrology and/or rearing habitat. Cumulative effects to the extent and quality of rearing habitat would occur if physical habitat was modified or if changes in flow on the Sacramento and San Joaquin rivers and/or their tributaries result in substantially reduced rearing habitat because of substantially reduced Delta outflow or increased water temperatures. However, the analyses for these projects indicates that there would not be any adverse effects on fish and aquatic resources, including rearing habitat. Therefore, the cumulative effects would be effectively approximated by the analyses conducted for the various action alternatives. As a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in cumulative adverse effects on rearing habitat. However, implementation of these projects in combination with Alternative 4 would not result in cumulative adverse effects on rearing habitat.

CEQA Conclusion: Implementation of the three diversion-related projects in Table 11-14 in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts on rearing habitat. However, implementation of these projects in combination with BDCP (Alternative 4) would not result in significant cumulative impacts on rearing habitat.

Impact AQUA-CUM6: Effects of Water Operations on Migration Habitat for Covered Fish Species

NEPA Effects: Hydrology would change under implementation of the action alternatives, as previously described in this chapter. These changes are a result of implementing the various operational scenarios associated with each alternative. The three diversion-related projects in Table 11-14 also have the potential to change hydrology and/or migration habitat. Cumulative impacts to migration habitat would occur if changes in flow on the Sacramento and San Joaquin Rivers and/or their tributaries result in substantially reduced migration habitat because of reduced flows or increased water temperatures, which provide environmental cues for some species to trigger the timing of migration. However, the analyses for these projects indicates that there would not be any adverse effects on fish and aquatic resources, including migration habitat. Therefore, the cumulative effects would be effectively approximated by the analyses conducted for the various action alternatives. As a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in cumulative adverse effects on migration habitat. However, implementation of these projects in combination with Alternative 4 would not result in cumulative adverse effects on migration habitat.

CEQA Conclusion: Implementation of the three diversion-related projects in Table 11-14 in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts on migration habitat. However, implementation of these projects in combination with the BDCP (Alternative 4) would not result in significant cumulative impacts on migration habitat.

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

The BDCP conservation measures include implementation of a suite of restoration activities intended to offset and mitigate for the short- and long-term effects on habitat conditions for the covered fish species. These effects are also expected to be similar to those resulting from the other programs and projects listed in Table 11-13. Therefore, the cumulative effects would incrementally alter the relative level of the effects, but not significantly change the nature of the effects.

NEPA Effects: Overall, the implementation of the conservation measures would result in short-term negative effects on habitat conditions, but the long-term effects would generally be beneficial to the covered fish species. These short-term effects could include the potential for increased turbidity and methylmercury exposure, accident spills, disturbance of contaminated sediments, disturbance from in-water activities, and increased predation.

Even with the large areas of proposed restoration provided by the BDCP, and the other projects and programs throughout the Plan Area, these activities would occur over a number of years. As a result, simultaneous restoration projects would likely be limited and dispersed, and would have minimal potential for cumulative adverse effects. Therefore, the cumulative effects from short-term restoration activities are not adverse to the covered species, and any effects would likely be localized, sporadic, and of low magnitude, and would be more than offset by the collective benefits of broad-scale habitat restoration programs throughout the Plan Area. Therefore the cumulative effect would be beneficial, and no additional mitigation would be required.

CEQA Conclusion: Habitat restoration activities could result in short-term effects on covered fish species, primarily as a result of the potential for increased turbidity and potential for contaminated sediments to enter the water column. Given the minimal extent of anticipated adverse impacts and the substantial net-benefits of habitat restoration, these impacts would be less than significant and no additional mitigation would be necessary.

Other Conservation Measures (CM12–CM19 and CM21)

In addition to the conservation measures related to habitat restoration actions, the BDCP includes conservation measures that improve existing habitat conditions or enhance fish populations. As with the restoration conservation measures, the cumulative effects of these other conservation measures would include similar corresponding activities occurring through other projects or programs in the Plan Area (see Table 11-13). Overall, the effects of most of these measures would be individually and cumulatively beneficial. The following assessment is based on the more detailed analysis included in BDCP *Effects Analysis – Appendix F, Biological Stressors (hereby incorporated by reference)*.

As indicated above, the BDCP would provide a long-term comprehensive program to address a wide range of stressors on the covered fish species, and some existing and future conservation measures would complement and cumulatively add to the overall effectiveness of these programs. For example, CM12 *Methylmercury Management* will be developed and implemented in coordination with efforts of the Central Valley Regional Water Quality Control Board to comply with Methylmercury TMDL standards. This conservation measure will minimize conditions that promote production of methylmercury in restored areas and its subsequent introduction to the foodweb and the covered species. Modeling of water operations effects of the BDCP show little changes in methylmercury concentrations in water or fish tissue, although methylmercury concentrations in both media would be expected to continue to exceed criteria under all the action alternatives.

Under CM13 *Invasive Aquatic Vegetation Control*, the BDCP would contribute to the control of invasive species in the Plan Area, through chemical and mechanical treatment in BDCP restoration sites, to ensure that the benefits of these restoration projects are not eroded by invasive vegetation expansion. The BDCP will provide additional funding for project such as the current California Department of Boating and Waterways (DBW) water hyacinth and *Egeria densa* control programs, and the DWR Watercraft Inspection Program to reduce the spread of invasive aquatic vegetation. Under CM13 *Invasive Aquatic Vegetation Control*, BDCP is expected to treat an average of 1,679–3,358 acres per year of tidal habitat throughout the Delta (5–10% of the acreage of tidal habitat areas within and outside restoration sites).

The BDCP (CM14 *Stockton Deep Water Ship Channel Dissolved Oxygen Levels*) would provide funding for the continued operation of an aeration facility in the ship channel, as well as the implementation of measures to improve the facility's effectiveness in meeting BDCP biological goals and objectives. This conservation measure would also coordinate with the Central Valley Regional Water Quality Control Board to meet EPA water quality standards with regard to the established dissolve oxygen TMDL requirements.

While existing predator control measures would also continue to be implemented, the BDCP (CM15 *Predator Control*) would provide additional funding to expand the programs, and more effectively target specific predation hot spot areas. This conservation measure would be implemented in conjunction with other measures, such as *CM13, Invasive Aquatic Vegetation Control,* to reduce predator habitat as well the direct reduction of predator populations.

Similarly, the BDCP (CM16 *Nonphysical Fish Barriers*) would enhance and expand the current DWR program for installing non-physical fish barriers to increase survival of covered fish in the Delta. Non-physical barriers control the distribution of covered fish species to minimize movements into areas of high predation or entrainment risks. This conservation measure is expected to benefit some of the covered fish species (particularly juvenile salmonids), although these structures have not been proven to be effective to deter such species as delta smelt and longfin smelt.

The expansion of the existing DFG's Delta-Bay Enhanced Enforcement Program, through the BDCP (CM17 *Illegal Harvest Reduction*), would further reduce the illegal harvest of covered fish species. Implementation of this conservation measure will provide funds to DFG to hire and equip about 17 additional game wardens assigned to the Delta-Bay Enhanced Enforcement Program. Enhanced enforcement on poaching will contribute toward reducing mortality and potentially increasing population sizes of covered species, such as sturgeon, Chinook salmon (all races), steelhead and Sacramento splittail.

While the existing University of California, Davis conservation hatchery would continue to operate, the BDCP (CM18 *Conservation Hatcheries*) would provide additional funding and support to improve the performance and/or biological effectiveness of the program through the adaptive management and monitoring process. The goals of this conservation measure is to expand the refugial populations of delta smelt and longfin smelt, and maintain them over the long term.

The implementation of CM19 *Urban Stormwater Treatment*, under the BDCP, would provide an additional source of funding for grants to entities such as the Sacramento Stormwater Quality Partnership, and area cities and counties, whose stormwater contributes to Delta waterways under NPDES MS4 stormwater permits. These grants would help to implement actions from, and in addition to, their respective stormwater management plans. Reducing the amount of pollution in stormwater runoff entering Delta waterways will benefit delta smelt, white sturgeon, steelhead, and Chinook salmon (Essex Partnership DRERIP 2009).

Upgrades to existing nonproject diversions to reduce entrainment of covered fish species, and their prey, would also continue to occur over time under the BDCP (CM21 *Nonproject Diversions*). There are currently over 2,500 nonproject diversions in the Plan Area, used primarily for diverting water for agriculture, and about 95% of these diversions are unscreened (Herren and Kawasaki 2001). Currently, Reclamation's Anadromous Fish Screen Program and DFG's Fish Screen and Passage Program are available to update nonproject diversions, and have implemented over 30 projects in recent years throughout the Central Valley, but these programs primarily focus on providing benefits to anadromous salmonids. *CM21, Nonproject Diversions* would provide additional protection for salmonids, as well as for the other covered fish species. Addressing these other species is expected to reduce entrainment of all fish species occurring in the Plan Area.

Summary

As indicated above, the BDCP would provide a long-term comprehensive program to address stressors on the covered fish, and would also complement other existing and future conservation measures in the Plan Area. For example, CM12 *Methylmercury Management* will be developed and implemented in coordination with efforts of the Central Valley Regional Water Quality Control Board to comply with Methylmercury TMDL standards. Ongoing efforts to control invasive aquatic vegetation by DWR will be supplemented by the BDCP (CM13 *Invasive Aquatic Vegetation Control*) through additional programs and as a direct funding source. Implementation of CM14 *Stockton Deep Water Ship Channel Dissolved Oxygen Levels* would also provide funding for the continued operation of an aeration facility in the ship channel, as well as the implementation of measures to improve the facility's effectiveness in meeting BDCP biological goals and objectives. This conservation measure would also be coordinated with the Central Valley Regional Water Quality Control Board efforts, to meet EPA water quality standards with regard to the established dissolve oxygen TMDL requirements.

While existing predator control measures would also continue to be implemented, the BDCP (CM15 *Predator Control*) would expand these efforts and provide direct funding for some of these existing efforts. Similarly, implementation of CM16 *Nonphysical Fish Barriers* will supplement existing efforts by DWR to install non-physical fish barriers to increase survival of juvenile salmonids in the Delta, and expand similar protection to the other covered fish species. The expansion of the existing DFG's Delta-Bay Enhanced Enforcement Program, through the implementation of the BDCP (CM17 *Illegal Harvest Reduction*), would further reduce the illegal harvest of covered fish species, particularly sturgeon, salmon and steelhead. While the existing University of California, Davis conservation hatchery would also continue to operate, the BDCP (CM18 *Conservation Hatcheries*) would provide additional funding and monitoring efforts to improve the efficiency and effectiveness of the program into the future.

All major urban centers in the Delta, including Sacramento, Stockton, and Tracy, and multiple smaller cities will continue to comply with National Pollutant Discharge Elimination System (NPDES) MS4 permits to develop and implement a stormwater management plan or program with the goal of reducing the discharge of pollutants under the Clean Water Act (CWA). The implementation of CM19 *Urban Stormwater Treatment* under the BDCP, would provide an additional source of funding for these and other entities in the Plan Area to implement these programs.

NEPA Effects: These BDCP conservation measures are intended to reduce stressors to covered species and have overall neutral or beneficial effects. They would also be compatible with existing and expected future measures implemented in the Plan Area, thereby enhancing the prospects of benefitting the covered species. Therefore, the overall effects would be beneficial.

CEQA Conclusion: As indicated above, the conservation measures included in the BDCP are designed specifically to benefit the covered fish species. When these are implemented in coordination with, or in addition to, existing or future conservation measures occurring throughout the Plan Area, the cumulative effect would be an overall benefit to the covered species. Therefore, the effect would be less than significant.

11.3.5.3 Non-Covered Fish Species of Primary Concern

Construction and Maintenance of CM1

The cumulative effects of construction and maintenance activities occurring in the Plan Area, with the implementation of the BDCP, would be similar for both the covered and non-covered fish species. These effects would also be similar for all the non-covered species; therefore, the analysis below is combined for all non-covered species instead of analyzed by individual species.

Impact AQUA-CUM7: Effects of Construction of Facilities on Non-Covered Fish Species

Refer to Impact AQUA-199 under Alternative 1A for a detailed discussion of the types of effects that in-water and near water construction and restoration activities would have on the non-covered fish species of primary concern, as these types of effects would be similar for all such construction activities expected to occur in the Plan Area. As indicated above, for the covered fish species (Impact AQUA-CUM1), potential mechanisms of cumulative effects on non-covered fish species would include turbidity, accidental spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water work activities, loss of spawning, rearing or migration habitat, and increased predation. However, as described above for the covered fish species, the cumulative effects would not be adverse because of the limited extent, intensity, and duration of expected construction projects occurring outside of the BDCP activities.

In addition, any such construction projects would be subject to separate environmental compliance processes, with permit stipulations which would include the implementation of project-specific AMMs, BMPs, environmental commitments, and mitigation measures. This would include project-specific erosion and sediment control plans; hazardous materials management plans; SWPPPs; spill prevention and control plans; and limiting in-water activities to periods of low flow and/or to times when non-covered fish species are not likely to be present.

NEPA Effects: The cumulative effects of construction projects on the non-covered fish species of primary concern would not be adverse.

CEQA Conclusion: For any projects implemented within the NAA, that include in-water construction and maintenance activities, there would be the potential to stress, injure, or kill non-covered fish species through direct or indirect effects, and the potential to alter spawning, rearing and/or migration habitat of non-covered fish species through direct loss or modification. However, such projects would be subject to specific environmental permitting processes, which would minimize potential effects through the implementation of project-specific AMMs, BMPs, environmental commitments and/or mitigation measures. Thus, the construction-related cumulative effects would be less than significant, and no additional mitigation would be required.

Impact AQUA-CUM8: Effects of Maintenance of Facilities on Non-Covered Fish Species

NEPA Effects: The discussion of potential maintenance activity effects would be similar to the discussion provided above with the construction effects (Impact AQUA-CUM1) on the covered fish species, and as concluded, the effect would not be adverse.

CEQA Conclusion: The conclusion provided above for the construction activity effects (Impact AQUA-CUM1), would typically be very similar to those expected to occur during maintenance activities. Thus, the effect would be less than significant, and no additional mitigation would be required.

Water Operations of CM1

Impact AQUA-CUM9: Effects of Water Operations on Entrainment of Non-Covered Fish Species

Under Existing Conditions, non-covered fish species are expected to occur in salvage operations at the south Delta facilities throughout the year. This would include eggs, larvae, juvenile, and adult life stages of the various fish species entrained at varying times of the year. The implementation of the BDCP would reduce the use of the south Delta facilities, while proportionally increasing the use of the proposed north Delta facilities, which would be designed to minimize entrainment of all fish species. The increased flexibility in operations provided by the addition of the north Delta export facilities, improvements at the south Delta facilities over time in the water export operations and the salvage processes, and the continued implementation of retrofitting programs for other diversions throughout the Plan Area, are expected to reduce the overall rate of entrainment and loss for all fish species over time.

NEPA Effects: The cumulative effect on entrainment of the non-covered fish species would not be adverse.

CEQA Conclusion: The impact of water operations on entrainment of non-covered fish species would be the same as described immediately above. The cumulative effects would likely be a substantial reduction in the entrainment of all fish species occurring in the Plan Area, including the non-covered fish populations. Thus, the impact would be less than significant and no mitigation would be required.

Impact AQUA-CUM10: Effects of Water Operations on Spawning and Egg Incubation Habitat for Non-Covered Fish Species

NEPA Effects: Refer to Impact AQUA-202 under Alternative 1A for a detailed discussion of the types of effects expected to occur from water export operations on the non-covered fish species occurring in the Plan Area. These types of effects would continue into the future, although the distribution or magnitude of effects would vary depending on the differential use of the south and north Delta facilities. The overall results indicate that the operational effects would not be adverse, because they would not result in a substantial reduction in spawning habitat for any of the non-covered fish species of primary concern. In addition, the cumulative effects would also not be adverse for these same reasons.

CEQA Conclusion: As discussed above, and in Impact AQUA-202 under Alternative 1A for non-covered fish species, the increased operational flexibility provided by the north Delta facilities is expected to reduce potential effects of water operations on the non-covered fish species, compared to existing water operations. The results indicate that the operational effects would not result in a substantial reduction in spawning habitat for any of the non-covered fish species of primary concern. Therefore, the cumulative effects would be less than significant, and no mitigation is necessary.

Impact AQUA-CUM11: Effects of Water Operations on Rearing Habitat for Non-Covered Fish Species

NEPA Effects: Refer to Impact AQUA-203 under Alternative 1A for a detailed discussion of the types of effects expected to occur from water export operations on the non-covered fish species, as these types of effects would continue into the future. These results indicate that the operational effects would not be adverse, because they would not result in a substantial reduction in the rearing habitat for any of the non-covered fish species of primary concern. In addition, the cumulative effects would also not be adverse for these same reasons.

CEQA Conclusion: As discussed above, and in Impact AQUA-203 for Alternative 1A for non-covered fish species, the increased operational flexibility provided by the north Delta facilities, is expected to reduce potential effects on the non-covered fish species of primary concern to some degree. Overall, the operational effects would not result in a substantial reduction in rearing habitat for any of the non-covered fish species of primary concern. Similarly, the cumulative effects would be less than significant, and no mitigation is necessary.

Impact AQUA-CUM12: Effects of water operations on migration habitat for non-covered fish species

NEPA Effects: Refer to Impact AQUA-204 under Alternative 1A for a detailed discussion of the types of effects from water export operations on the migration habitat for non-covered fish species, as these types of effects would continue to occur into the future. The results indicate that the operational effects would not be adverse, because they would not result in a substantial change in migration habitat conditions for any of the non-covered fish species of primary concern. The cumulative effects would also not be adverse for these same reasons.

CEQA Conclusion: Refer to Impact AQUA-204 under Alternative 1A for non-covered fish species for a detailed discussion of the potential effects of water operations on the migration habitat for the non-covered fish species of primary concern. The results indicate that the operational effects would not result in a substantial reduction in migration habitat conditions for any of the non-covered fish species of primary concern. Similarly, the cumulative effects would be less than significant, and no mitigation is necessary.

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

As described in detail above for the covered fish species, the BDCP would implement a large-scale, long-term comprehensive habitat restoration program in the Plan Area. In addition, restoration activities from other programs in the region would also continue to be implemented, although the extent of these activities would typically be limited compared to the size and distribution of the BDCP activities. All of these restoration activities would include enhancing existing habitat, breaching levees and converting agricultural and other upland areas to tidal, shallow water, open water, and floodplain habitats, as well as enhancement of channel margin habitat.

NEPA Effects: The overall scope of these restoration actions are expected to result in a substantial improvement in the aquatic habitat condition in the Plan Area, improving conditions for all fish species, including the non-covered fish species of primary concern. As the intended purpose of these restoration measures is to benefit aquatic species, the cumulative effects would not be adverse.

CEQA Conclusion: As described above, the BDCP would implement a large-scale, long-term comprehensive habitat restoration program, which would be compatible with other restoration actions expected to occur in the Plan Area. The cumulative effect of these habitat improvements is expected to be beneficial to both the covered and non-covered fish species. Therefore the effect would be less than significant, and no additional mitigation would be required.

Other Conservation Measures (CM12–CM19 and CM21)

As indicated above for the covered fish species, the BDCP would provide a long-term comprehensive program to address various stressors on the non-covered fish species of primary concern. These measures would also complement other conservation measures expected to occur in the Plan Area, and the overall effects are expected to be beneficial on the non-covered fish species of primary concern. However, the conservation measures would not necessarily be beneficial for all the non-covered species of primary management concern. For example, the effects of invasive aquatic vegetation control would result in minor differences for predatory species (striped bass and largemouth bass), and for Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish which improves their hunting success, and Sacramento tule perch use the cover of aquatic plants for rearing. Consequently, reducing the amount of invasive aquatic vegetation would negatively affect these species. However, the effects would not substantially reduce the ability of the predatory species to hunt and there will still be substantial areas of suitable habitat in the Plan Area for these species.

NEPA Effects: In addition to the effects of aquatic vegetation control on habitat conditions for some non-covered aquatic species, the effects of *CM15, Predator Control* would have a direct effect the predatory species that are included as non-covered species of primary concern. These include largemouth and striped bass. However, the numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of this management would not be adverse.

CEQA Conclusion: As indicated above, the conservation measures included in the BDCP are designed to benefit both covered and non-covered fish species, and would complement other conservation measures expected to occur throughout the Plan Area in the future. The results of these measures are expected to be beneficial for most species of primary concern, although *CM13, Invasive Aquatic Vegetation Control* and *CM15, Predator Control* would negatively affect several of the species of primary concern. However, even when combined with similar programs occurring, or expected to occur, in the Plan Area in the future, the effects would be limited. In addition, the large population size of these predators, and the substantial amount of habitat available to these species in the Plan Area, would also minimize the potential for negative effects. Therefore, the cumulative effects of CMs 12–19 and 21 would be less than significant, and no mitigation would be required.

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11.4.2 Personal Communications

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Lindberg, Joan, PhD, Director, Fish Conservation and Culture Lab, Byron, Biological and Ag Engineering, University of California, Davis. December 15, 2011—Email communication with Willis (Chip) McConnaha, PhD, Ecosystem Biometrics Practice Leader, ICF International, Portland, OR.

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