7.24 Alternatives Analysis

7.24.1 Introduction

This section provides additional information about project Alternatives 1 through 5, including the environmental impacts and economic effects of each of these alternatives, and it describes how the environmental impacts and benefits of each alternative compare with the proposed Plan amendments. The proposed Plan amendments are summarized in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. As discussed in Section 7.1, the proposed Plan amendments are based on the 2018 State Water Board staff Framework for Possible Sacramento/Delta Updates to the Bay-Delta Plan (Framework) that was released in advance of the consideration of the 2018 updates to the Bay-Delta Plan and following completion of the 2017 *Scientific Basis Report in Support of New and Modified Requirements for Inflows from the Sacramento River and its Tributaries and Eastside Tributaries to the Delta, Delta Outflows, Cold Water Habitat, and Interior Delta Flows* (Scientific Basis Report). The proposed Plan amendments would establish: (1) new inflow requirements for the Sacramento/Delta tributaries; (2) new requirements for cold water habitat; (3) new and modified Delta outflow requirements; (4) new and modified interior Delta flow requirements for the protection of fish and wildlife (flow and water project operational requirements); and (5) monitoring, reporting, and evaluation measures, and other provisions. The environmental impacts of changes in hydrology and water supply—including compliance methods and response actions that do not involve construction under the proposed Plan amendments—are evaluated in the primary resource sections numbered 7.3 through 7.20 in Chapter 7, *Environmental Analysis*. Environmental impacts from compliance methods and response actions that involve construction are evaluated in Sections 7.21, *Physical Habitat Restoration and Other Ecosystem Projects*, and 7.22, *New or Modified Facilities*. Economic effects of the proposed Plan amendments are evaluated in Chapter 8, *Economic Analysis and Other Considerations*.

In 2022, when this draft Staff Report was nearing completion, the State Water Board received a memorandum of understanding (MOU) for proposed Voluntary Agreements (VAs)[1] for updating the Bay-Delta Plan from various water users in the watershed, including the California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (Reclamation), as well as the California Department of Fish and Wildlife (CDFW), California Natural Resources Agency, and California Environmental Protection Agency. Consistent with State Water Board Resolution No. 2018-0059 adopting the 2018 amendments to the Bay-Delta Plan, the State Water Board is also considering the proposed VAs as an alternative that could provide a possible path forward for updating the Bay-Delta Plan. The proposed VAs (Alternative 6) propose flow assets and habitat restoration measures on the Sacramento/Delta tributaries for an 8-year term. The proposed VAs would build on and work together with the proposed Plan amendments, which the VAs identify as a regulatory pathway that would apply to non-VA tributaries and could apply to VA tributaries in the event the VAs are discontinued. The proposed regulatory pathway is largely consistent with the proposed Plan amendments, except that instead of being amended into the water quality objectives, the inflow, inflow-based Delta outflow, and cold water habitat provisions of the proposed Plan amendments would be included in the program of implementation and could become applicable in the future if

[1] The MOU for proposed VAs is also referred to as the VA Term Sheet.

the VAs are not continued. Upon completion of the VA components, anticipated in late 2023, the State Water Board plans to hold additional public meetings and provide additional opportunities for public comments to receive input on possible incorporation of the VAs into the Bay-Delta Plan update and other input on the Plan update. The environmental impacts and economic effects of the proposed VAs (Alternative 6) are evaluated in Chapter 9, *Proposed Voluntary Agreements*.

This section provides additional information about project Alternatives 1 through 5, including the environmental impacts and economic effects of each of these alternatives. Alternatives 1 through 5 are described in Section 7.2, *Description of Alternatives*. The project alternatives evaluated in this section include the no project alternative, two stand-alone flow alternatives, and five modular alternatives that could be layered onto the stand-alone alternatives. The No Project Alternative (Alternative 1) is included to provide for a comparison of the impacts of approving the proposed Plan amendments with the impacts of not approving the proposed Plan amendments. The stand-alone alternatives evaluated in this section include a Low Flow Alternative (Alternative 2) and a High Flow Alternative (Alternative 3) (referred to as *other flow alternatives*) that would require either lower or higher amounts of inflow to the Delta but would otherwise be consistent with the proposed Plan amendments.

This section also evaluates several modular alternatives that could be layered onto the stand-alone alternatives. The modular alternatives include three interior Delta flow and fall Delta outflow variations. Alternative 4a (Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments) excludes interior Delta flow and fall Delta outflow provisions included the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) Biological Opinions (BiOps) for operation of the SWP and CVP and CDFW incidental take permit (ITP) for the operation of the SWP. Alternative 4b (Head of Old River Barrier Alternative) requires installation of the Head of Old River Barrier (HORB) or alternative mechanisms to prevent San Joaquin River origin anadromous fish from being drawn into the Delta export facilities. Alternative 4c (Extended Export Constraint Alternative) would require additional export constraints as a function of San Joaquin River flows (commonly referred to as the *San Joaquin River inflow to export ratio* or I:E). A modular drought alternative includes two variations that could help to address limited water supplies during drought. Alternative 5a (Instream Flow Protection Provision Alternative) would require water diverters (in addition to DWR and Reclamation) to bypass water needed to meet existing water quality objectives during drought circumstances, similar to existing standard water right Term 91. Alternative 5b (Shared Water Shortage Provision) would require all water users to reduce their use during drought conditions. Alternatives 4a, 4b, and 4c could be adopted in combination with the proposed Plan amendments or other flow alternatives. Alternatives 5a and 5b could be adopted in combination with the proposed Plan amendments, other flow alternatives, or proposed VAs. In addition, a modular alternative is evaluated in Chapter 9 that could be adopted in combination with the proposed VA alternative that would protect the base upon which VA flows are added(Alternative 6a). The environmental impacts of each of these modular alternatives are evaluated in isolation compared with existing conditions to properly characterize changes that could occur from each modular alternative, as distinguished from impacts of the stand-alone alternatives. Some discussion of the impacts of each modular alternative in combination with the proposed Plan amendments, other flow alternatives, and proposed VAs is also provided.

California water resource management is complex, and the project covers a broad range of compliance methods across a large area of the state. As a result, the impact analyses are necessarily broad and already cover a wide range of foreseeable compliance measures and responses that could also be considered alternative means of compliance. Many of the environmental effects of the

alternatives presented in this section are already assessed in detail in the primary analyses in Sections 7.3 through 7.20, and in 7.21, *Physical Habitat Restoration and Other Ecosystem Projects*, and 7.22, *New or Modified Facilities,* for compliance methods and response actions that involve construction. This section relies on the existing environmental analysis for efficiency, and it focusses on identifying any new or changed environmental impacts of each alternative as applicable.

7.24.2 No Project Alternative (Alternative 1)

The CEQA Guidelines provide that the potential impacts of not approving a proposed project be evaluated under a No Project Alternative. "The purpose of describing and analyzing a no project alternative is to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project" (Cal. Code Regs., tit. 14, § 15126.6(e)(1)). When the project is the revision of an existing regulatory plan, such as the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (2006 Bay-Delta Plan)[2], the No Project Alternative will be the continuation of the existing plan as currently implemented into the future (Cal. Code Regs., tit. 14, § 15126.6(e)(3)(A)). In general, the existing plan and the projects initiated under the existing plan would continue until the new Plan amendments[3] are approved. The No Project Alternative analysis must discuss the existing conditions "as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services" (Cal. Code Regs., tit. 14, § 15126.6(e)(2)).

For the purposes of this analysis, the No Project Alternative is the continuation of the Bay-Delta Plan as implemented by State Water Board Decision 1641 (D-1641) (revised March 15, 2000), with the existing hydrology and water supply conditions described in Chapter 2, *Hydrology and Water Supply*. However, No Project Alternative conditions differ from the existing condition baseline because existing flows in the Sacramento/Delta watershed, including baseline Sacramento/Delta flows, are generally substantially higher than the minimum flows required under the current Bay-Delta Plan and D-1641 and other regulatory requirements. Existing Delta outflows are often higher than minimum required Delta outflows (MRDO) (see Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, for additional discussion) and often include unprotected Delta outflows that could be diminished in the future as a result of further development of existing water rights and new water rights in the absence of additional instream flow protections, which could be exacerbated by climate change. In addition, there are very limited existing requirements for inflows in the Bay-Delta Plan, and many streams have limited or no requirements that prevent flows from being substantially or entirely reduced. Therefore, under the No Project Alternative, Delta inflows and Delta outflows would be expected to be reduced over time to levels below baseline conditions.

In addition, the No Project Alternative assumes that flows and water quality conditions required under D-1641 could be suspended at times through approval of possible future Temporary Urgency Change Petitions (TUCPs) that could occur during future drought and drought recovery periods. If approved by the State Water Board, future TUCPs could result in reduced Delta inflows and Delta

[2] In December 2018, the State Water Board revised the Bay-Delta Plan to include new and revised southern Delta salinity and Lower San Joaquin River flow objectives and a revised program of implementation to achieve those objectives. It did not amend elements of the Bay-Delta Plan that are now being considered for revision in this Staff Report. The State Water Board is currently in the process of implementing the 2018 updates to the Bay-Delta Plan, but has not completed that process. Accordingly, these updates are not reflected in the No Project Alternative.

[3] These proposed Plan amendments are the *project* as identified in State CEQA Guidelines, Section 15378.

outflows that are lower than flows required under D-1641 at times, and associated increases in salinity levels. Under D-1641, DWR and Reclamation currently have responsibility for meeting Delta outflow and salinity objectives. During drought and drought periods and periods following droughts, DWR and Reclamation have submitted TUCPs to the State Water Board requesting modification of these obligations. The purpose of these TUCP requests was in large part to provide for maintaining reservoir storage supplies for salinity control, minimal water supplies, and minimal temperature management. Exhaustion of these supplies is exacerbated in drought conditions due to the focused responsibility of DWR and Reclamation to meet these requirements rather than those obligations being distributed broadly over the watershed.

The State Water Board has approved multiple TUCPs in recent years related to the Projects' D-1641 requirements, including TUCPs submitted by the Projects in 2014, 2015, 2016, 2021, 2022, and 2023 (petitions were also submitted in 2008/2009). California law identifies TUCPs as limited to urgencies that cannot otherwise be avoided through the exercise of due diligence (Wat. Code § 1435, subd. (c)). However, it is foreseeable that the State Water Board may receive and could approve TUCPs during future drought and drought recovery periods. It is not possible to precisely quantify the effect that potential TUCPs could have on Delta outflow and salinity conditions under the No Project Alternative, given that the scope and extent of TUCPs could be variable, consistent with the experience of prior TUCPs, and the State Water Board may or may not approve such TUCPs. The ability to consider TUCPs involving changes to water right requirements to implement water quality objectives is also contingent on temporary suspension of other requirements through Executive Orders issued pursuant to proclaimed states of drought emergency or other mechanisms that are uncertain. However, it is reasonable to assume that future TUCPs could be submitted and could result in temporary approval of reductions to certain D-1641 flow requirements and increases in allowable flow-dependent salinity levels.

Future conditions resulting from climate change would also affect instream flows in the Sacramento/Delta watershed. Multiple scientific studies have suggested that climate change will bring changes in precipitation patterns (including a shift from more snow to more rain), higher temperatures, vegetation expansion, and longer growing seasons, which would result in warmer water temperatures and could also affect runoff patterns in the state and southwestern United States (Milly and Dunne 2020; Goulden and Bales 2014). Section 4.6, *Climate Change*, also discusses that climate change could exacerbate other aquatic ecosystem stressors.

Potential environmental impacts of the No Project Alternative are discussed in this section and detailed comprehensively in Table F-1 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*. Table F-1 identifies the potentially significant and less-than-significant environmental impacts of the No Project Alternative on various environmental resource areas. Table F-1 also provides information to compare the environmental impacts of the No Project Alternative with the environmental impacts of the proposed Plan amendments. Since no new project would be approved or carried out in association with the No Project Alternative, potential mitigation is not included in Table F-1 or the discussion of the impacts below.

Multiple environmental impacts, including impacts associated with reduced water supplies, would be less under the No Project Alternative compared with the proposed Plan amendments. However, the No Project Alternative would not provide for improvements in protection of fish and wildlife beneficial uses and associated project purposes and goals.

The following subsections provide additional information on the impacts of the No Project Alternative.

7.24.2.1 Changes in Hydrology

Under the No Project Alternative, it is expected that Sacramento/Delta inflows and Delta outflows would decrease over time due to increasing water demands in the absence of additional instream flow protections. Water users could increase diversions for consumptive use in the future as a result of exercising existing water rights and claims more fully, since many water rights are not currently fully exercised, or due to new water rights that may be approved pursuant to existing and possible future proposals.

Although increased diversions and diminished flows in the Sacramento/Delta watershed are reasonably expected to occur in the future in the absence of additional regulatory requirements, it is not possible to precisely quantify the expected increase in diversions and reduction in Delta inflows and Delta outflows that would occur under the No Project Alternative. The degree to which increased diversions would occur would depend on the types, amounts, and timing of additional water diversions and any constraints placed on those diversions. Therefore, a range of conditions and effects is possible under the No Project Alternative. At one end of the range, future diversions under the No Project Alternative would be similar to those under baseline conditions. This scenario is unlikely because there are currently numerous infrastructure project proposals involving new or modified water diversions in the Sacramento/Delta watershed, and it is foreseeable that Delta outflows would be reduced in the future as a result of additional water development projects. At the other end of the range, future diversions could reduce flows to regulatory minimums, including MRDO. The likely future condition would be somewhere in between, meaning that water users likely would increase diversions beyond current levels, but not to minimum required flows (including MRDO) for all months and hydrologic conditions. This likely future condition is assumed in the analysis below.

Although it is not possible to precisely quantify the effects that new and expanded water infrastructure and diversion projects could have on hydrology and water supply under the No Project Alternative, this section provides information on existing water rights and claims, pending water right applications, and proposed water infrastructure projects that could result in increased demands for Sacramento/Delta water supplies under the No Project Alternative. Section 3.14.1.1, *Achievement of Flow Thresholds*, presents an analysis to compare the existing Delta outflow objectives with estimated current outflow levels and observed historical flows. This information shows that there is a significant difference between MRDO and existing flow levels that could be diminished in the future as the result of additional diversions in the absence of additional regulatory flow requirements. MRDO represents existing regulatory minimum flows, and it is often substantially lower than flows observed under current conditions. The most significant difference between required and observed flows is seen during winter and spring of wetter years, when both modeled and observed flows greatly exceed regulatory minimums.

Figure 7.24-1 summarizes the modeled January through June D-1641–required Delta outflow and the average unprotected Delta outflow under existing conditions, by water year type (Wet [W], Above Normal [AN], Below Normal [BN], Dry [D], and Critical [C]). The red bars are the average January through June total unprotected Delta outflow, and the blue bars are MRDO from D-1641 for agricultural, municipal and fish and wildlife beneficial uses. In all year types, there is some unprotected Delta outflow with much larger amounts in the wetter year types than the drier year

types. Over time with increasing water development and climate change, it is expected that flows under future conditions could be reduced below current conditions without additional regulatory requirements, perhaps to a substantial degree and possibly to a level approaching MRDO flows, which are not protective of fish and wildlife.

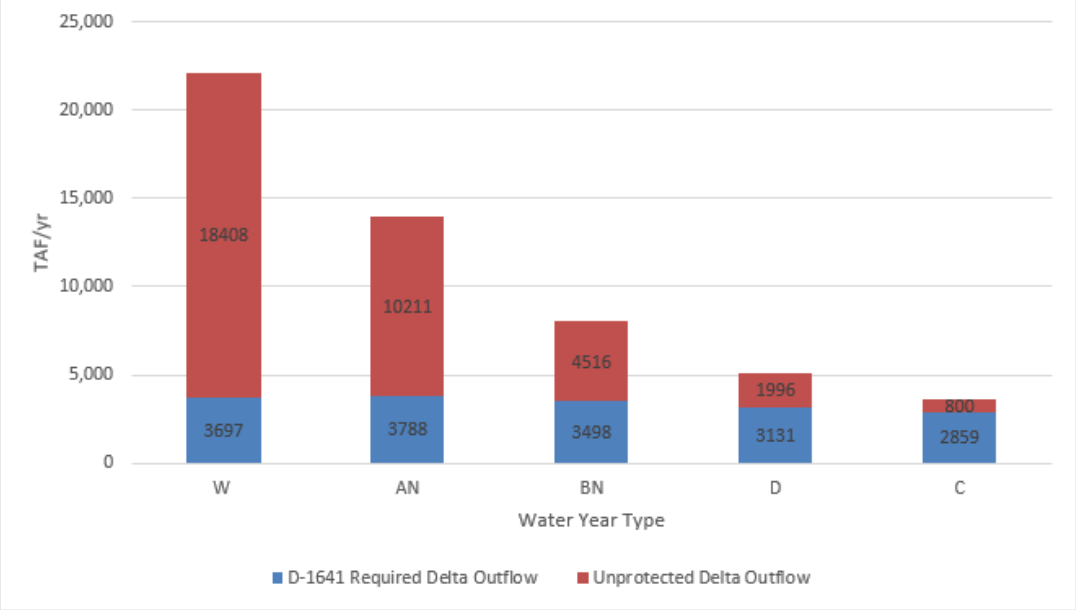

Figure 7.24-1. SacWAM Modeled D-1641–Required Delta Outflow and Existing Average Unprotected Delta Outflow (January–June) by Water Year Type

Section 2.7, *Existing and Future Water Rights in the Sacramento/Delta Watershed,* provides information on California's water right system and existing water rights and claims in the Sacramento/Delta watershed. Section 2.7 discusses that the total volume of water authorized for diversion in the Sacramento/Delta watershed is very large and exceeds the total average unimpaired outflow from the Bay-Delta watershed. While there are some reasons for large discrepancies between the total water right face value and supply available, the fact remains that under existing water right records, a large volume of water is authorized for diversion in the Bay-Delta watershed, and there is the potential for future development to increase the diversion and reduce Delta outflow.

In addition to the potential for water users to exercise existing water rights more fully, there are multiple pending water right applications for new water right permits and licenses within the Bay-Delta watershed that could result in increased diversions in the future. Several pending water right applications propose new diversions during the winter and spring months, many of which request several hundred thousand acre-feet of water to a few million acre-feet and total several million acre-feet of water in combination. Section 2.7 discusses pending water right applications in the Bay-Delta watershed.

In addition to possible new and expanded diversions under existing water rights and claims and pending water right applications in the future, there are multiple state filed water rights in the Sacramento/Delta watershed that are currently unassigned and, if assigned to water users, could also affect future Delta inflows and Delta outflows. Water Code section 10500 sets aside reservations of post-1914 water rights (referred to *state filed water rights* or *state filings*) for future

assignment. These filings maintain the water right priority of the date they were established, and some date back to as early as 1927. There are approximately 70 unassigned state filings in the Sacramento/Delta watershed. Section 2.7 provides additional discussion on state filings.

Multiple water infrastructure projects involving construction of new and expanded reservoirs and water diversion and conveyance facilities have also been proposed in recent years. If approved, these projects could also affect tributary and Delta inflows and Delta outflows, and other related conditions. An analysis was completed to summarize the potential change to Delta outflow that could occur as a result of several current infrastructure project proposals where site-specific environmental impact analyses, and an environmental impact report (EIR) or environmental impact statement (EIS) has been prepared[4]. Modeling results presented in the most recent version of the environmental documentation available prepared by each project's lead agency were reviewed to determine the potential effect of the proposed project on Delta outflows. This assessment does not include a substantial number of proposed projects where estimates of changes to Delta outflows are not yet available through draft or final EIR or EIS documentation.

Table 7.24-1 below presents the estimated change to Delta outflow that could occur as a result of these water infrastructure projects if each project was fully constructed and operated consistent with the associated EIR/EIS analyses prepared for the projects. Table 7.24-1 shows that Delta outflows could be reduced by over 900 TAF annually, cumulatively on average if all of these projects were operated in combination. The environmental documentation prepared for these projects may have assumed different baseline conditions to reflect existing regulatory requirements and conditions at the time that each project was proposed. The modeling results and analyses presented in the environmental documentation for the Del Puerto Canyon Reservoir Project and the Pacheco Reservoir Expansion Project do not provide sufficient information to estimate the effects of these projects on Delta outflows; however, these projects could result in additional increases in Delta exports and reductions in Delta outflows at times as they would receive water exported from the Delta. Additional appropriations of water and other water infrastructure projects beyond those considered in this analysis could also result in increased diversions in the Sacramento/Delta watershed and additional changes in Delta outflows at times.

Table 7.24-1. Change in Delta Outflow (TAF per year) that Could Occur as a Result of Several Proposed Water Infrastructure Projects

Proposed Projects and Documentation	Wet	Above Normal	Below Normal	Dry	Critical	All Years
Delta Conveyance Project (July 2022 Draft EIR)	-758	-1061	-649	-326	-156	-608
Shasta Dam and Reservoir Enlargement Project (December 2014 EIS; updated modeling in 2020)	-38	-135	-108	-41	1	-59
Sites Reservoir Project (February 2023	-275	-227	-121	-25	-20	-149

[4] Delta Conveyance Project, Shasta Dam and Reservoir Enlargement Project, Sites Reservoir Project, B.F. Sisk Dam Raise and Reservoir Expansion Project, Los Vaqueros Reservoir Expansion Project, Pacheco Reservoir Expansion Project, and Del Puerto Canyon Reservoir Project.

Proposed Projects and Documentation	Wet	Above Normal	Below Normal	Dry	Critical	All Years
Administrative Final EIR/EIS)						
B.F. Sisk Dam Raise and Reservoir Expansion Project (August 2020 EIR/SEIS)	-32	-35	7	2	1	-14
Los Vaqueros Reservoir Expansion Project (February 2020 Supplement to Final EIS/EIR)	-116	-69	-51	-44	-26	-79
Pacheco Reservoir Expansion Project (November 2021 Draft EIR)	Not identified	Not identified	Not identified	Not identified	Not identified	Not identified
Del Puerto Canyon Reservoir Project (October 2020 Final EIR)	Not identified	Not identified	Not identified	Not identified	Not identified	Not identified
Total	**-1,219**	**-1,528**	**-921**	**-433**	**-199**	**-909**

The results provided in Table 7.24-1 are not intended to precisely predict the change in Delta outflows that would occur under the No Project Alternative, but these results show that Delta outflows could be reduced in the future under the No Project Alternative, and possibly to a substantial degree. The proposed infrastructure projects included in Table 7.24-1 are in various stages of planning and development, and they may be subject to additional regulatory approvals including water right approvals. Therefore, some aspects of the construction and operation of these projects may differ from the current proposals, and the effects on Delta outflows could be different than the estimates shown in Table 7.24-1.

The water infrastructure projects identified in Table 2.74-1 could result in new or expanded water supplies that could encourage some growth in some locations. However, these water supplies would not significantly induce population growth statewide. Population growth is known to occur in California in the absence of new surface water sources. For example, numerous water suppliers in southern California currently implement water use efficiency programs, water recycling programs, groundwater desalination facilities, and seawater desalination facilities to meet a portion of their water supply needs. Water recycling has also been used successfully in southern California since the 1960s. In addition, transfers from agriculture have also been used to support municipal needs. In general, water availability is not the limiting factor preventing or slowing population growth in California, with the exception of a few, mostly coastal, areas (such as parts of Monterey County or Bolinas) that have imposed development or water connection moratoria because of limited municipal supply. Additional information on potential growth-inducing effects is provided in Section 7.23, *Cumulative Impact Analysis, Growth-Inducing Impacts, and Significant Irreversible Environmental Changes*. Changes to other regulatory requirements, including BiOp and ITP provisions could also occur under the No Project that would affect inflows, outflows, and interior Delta flows. However, those effects are uncertain. As discussed in prior chapters and sections.

Overall, under the No Project Alternative, changes in hydrology, including changes in streamflow and reservoir levels, could result in potentially significant impacts on the following resource areas: aesthetics, agriculture and forest resources, terrestrial biological resources, aquatic biological resources, cultural resources, hydrology and water quality (surface water and groundwater), recreation, and utilities and service systems. The impact mechanisms and potentially significant environmental impacts are discussed below and comprehensively identified in Table F-1 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Changes in Streamflows

Under the No Project Alternative, flows in the Sacramento/Delta could decrease at times compared with baseline conditions. In particular, as discussed above, flows could be diminished at times in the future as a result of entities exercising existing water rights more fully, since many water rights are not currently fully exercised, or due to new water rights in the absence of additional regulatory requirements. Based on available information regarding several proposed water diversion and conveyance projects and pending water right applications that propose surface water diversions during the wet season, it is assumed that streamflows may be reduced during the winter and spring under the no project alternative, which could result in potentially significant impacts on aquatic and terrestrial species and habitats in the Sacramento/Delta watershed. Decreased flows during the winter and spring months could reduce the frequency and duration of floodplain inundation, which would affect habitat availability for native fish species, wintering waterfowl, and other wildlife species. Reduced flushing flows during the winter and spring could also exacerbate harmful algal blooms and could contribute to the spread of invasive aquatic vegetation in some locations.

Increased water demands in the absence of instream flow protections could also result in increased Delta exports and reduced Delta outflows at times compared with baseline conditions. These changes would result in additional potentially significant impacts on biological resources, including native anadromous and estuarine fish and other aquatic-dependent species that rely on habitat in the Delta and Suisun Marsh. Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, discusses the importance of the flow regime in protecting the aquatic ecosystem that supports fish and wildlife beneficial uses and discusses how altered flow regimes negatively affect native fish communities and their aquatic ecosystem. Chapter 3 identifies winter-spring outflows that support improved population abundance for certain species (bay shrimp, green and white sturgeon, longfin smelt, Sacramento splittail, and starry flounder) based on species flow-abundance relationships. Because Delta outflows would be reduced under the No Project Alternative, the winter-spring outflows correlated with increases in abundance of native species would be met less frequently and would be expected to impact the population abundance for numerous native species. Decreased Delta inflows and Delta outflows could also affect water quality in the Delta, which would affect native fish, including anadromous and estuarine fish species.

Increased Delta exports and reduced Delta outflows could also affect interior Delta flows. Increased Delta exports would result in greater net flows toward south Delta pumping facilities. This could further alter migration cues and transport flows and lead to greater entrainment of native fish species into the interior Delta, which would be expected to result in greater direct and indirect mortality of native species migrating through and residing in the Delta, including special-status species.

Changes in Reservoir Levels

Under the No Project Alternative, future water development projects could lead to changes in reservoir operations and could affect reservoir storage levels in some locations. It is not known how each existing reservoir would be operated in the future under the No Project Alternative, particularly in conjunction with new or expanded reservoirs and points of diversion. Therefore, it is not possible to anticipate the changes in reservoir levels that would occur under the No Project Alternative. However, some changes are likely for several reasons. Modification of reservoir release schedules could result in reduced reservoir levels at times in some locations, particularly if some reservoirs are operated to increase water supply deliveries at times in the future. However, reservoir levels could be higher at times in some locations due to additional storage capacity for Sacramento/Delta surface water supplies within and outside of the plan area. For example, new and expanded water storage for Sacramento/Delta water supplies exported from the Delta could result in additional Delta exports at times when lack of storage space and real time demand would limit exports in the absence of new or expanded water storage projects. These changes could result in additional Sacramento/Delta supplies to other regions, and could result in higher reservoir levels at times in some export reservoirs. It would be speculative to anticipate how reservoirs might take advantage of possible storage opportunities for increased Sacramento/Delta supplies, but is likely that some reservoirs could store additional Sacramento/Delta supplies under the No Project Alternative.

Overall, under the No Project Alternative, some reservoirs could exhibit higher storage levels at times and some reservoirs could exhibit lower storage levels at times compared with baseline conditions. The effects of climate change could further reduce or increase reservoir levels as precipitation patterns become more extreme.

Changes in some reservoirs would have potentially significant impacts because of reservoir drawdown or fluctuations beyond historical levels. For example, reservoir level changes may result in exposure of more unvegetated ground; expose previously inundated cultural resources to increased wave action, erosion, and human activity; and affect boat ramp accessibility, thereby affecting recreation opportunities. Changes in reservoir levels could exacerbate existing water quality issues associated with reservoirs, including bioaccumulation of methylmercury in fish and production of harmful algal blooms in some locations.

Changes in reservoir levels could also result in increased temperature in some locations and times of year absent additional temperature management measures. Section 7.6.2, *Aquatic Biological Resources*, discusses that temperature management is an ongoing concern for multiple regulated tributaries in the Sacramento/Delta watershed under existing conditions. These temperature management issues could be exacerbated under the No Project Alternative in the absence of a cold water management objective and in combination with additional water development projects and the continuation of increasing water demands over time in the absence of instream flow protections. The effects of climate change and drought would also exacerbate temperature management issues in the future under the No Project Alternative. Some reservoir operators are currently implementing cold water management efforts, and it is possible that cold water management efforts could be undertaken through other proceedings in the future to more effectively manage cold water habitat. However, it would be speculative to assume which reservoirs and reservoir operators might implement changes in cold water management efforts in the future in the absence of the project. It is also speculative to anticipate precisely how these changes could affect fish and wildlife.

Beneficial Environmental Effects

The No Project Alternative would not result in beneficial environmental effects, and it would not benefit native aquatic and aquatic-dependent species, aquatic and riparian habitats and natural communities, or ecosystems functions in the Sacramento/Delta watershed that are supported by a natural flow regime. Under the No Project Alternative, it is expected that inflows and outflows would decrease over time due to increasing water demands over time in the absence of additional instream flow protections, which would further impair conditions for native fish and wildlife.

7.24.2.2 Changes in Water Supply

Changes in Sacramento/Delta Surface Water Supply for Agricultural, Municipal, and Wildlife Refuge Uses

Under the No Project Alternative, it is expected that inflows and outflows would decrease over time due to continuation of increasing water demands over time in the absence of additional instream flow protections. It is not possible to anticipate the magnitude of increasing water demands over time under the No Project Alternative. However, it is assumed that Sacramento/Delta supply would increase for agricultural, municipal, and wildlife refuge uses under the No Project Alternative. This differs from the proposed Plan amendments and other alternatives, which would result in decreases in Sacramento/Delta water supply for agricultural, municipal, and wildlife refuge uses.

Under the No Project Alternative, some localized impacts associated with reductions in Sacramento/Delta water supply for consumptive uses could occur at times for certain water users. It is anticipated that climate change may affect precipitation and runoff in the Sacramento/Delta watershed, and could affect surface water supplies for some water users. Under the No Project Alternative, the Projects would continue to be solely responsible for meeting Bay-Delta Plan flow and water quality requirements identified in D-1641. Currently, nearly all of the water users in the basin do not have limitations on their diversions to ensure that the Bay-Delta Plan objectives are met. Because the existing Bay-Delta Plan objectives in the Sacramento/Delta watershed are fairly minimal, much of the time the existing Delta outflow and salinity requirements are met incidentally. However, in most years, the Projects must release some water from storage to comply with Bay-Delta Plan objectives during the summer and fall. This results in reduced storage to meet water quality objectives and to provide for cold water releases. Specific issues arose during multiple recent drought years with the current requirements that illustrate issues that will be exacerbated with climate change and additional water development. The Projects could have challenges in providing water supplies to contractors during severe drought conditions in the future while also meeting Bay-Delta Plan objectives and cold water releases, and it is possible that water supplies to project contractors could be affected at times. However, affected water users could acquire other sources of water under the No Project Alternative. While there could be some water supply–related impacts on specific water users, overall, environmental impacts associated with reduced water supply would be less than significant under the No Project Alternative. These impacts are identified in Table F-1.

Groundwater

The No Project Alternative would likely result in overall increased Sacramento/Delta surface water supplies for agriculture, municipal, and wildlife refuge uses in the future. As a result, water users would not be expected to increase groundwater pumping as a substitute supply to replace reduced Sacramento/Delta surface water supplies under the No Project Alternative. However, as discussed

above, some localized impacts associated with reductions in Sacramento/Delta water supply for consumptive uses could occur at times for certain water users, such as Project contractors. These water users could increase groundwater pumping as a substitute supply (where available and not locally restricted), which could result in potentially significant impacts related to lower groundwater levels and groundwater quality.

Changing agricultural practices, including a shift from annual to permanent crops in many locations, could also exacerbate the effects of surface water supply shortages that occur at times such as during periods of drought, and some water users could choose to pump additional groundwater as a response action (where available and not locally restricted). Section 7.4, *Agriculture and Forest Resources*, discusses that certain permanent crops have increased significantly in acreage in recent years, and certain annual crops have declined in acreage during the same period. From an irrigation perspective, the difference between annual and permanent crops is that permanent crops require water every year, whereas annual cropland can be fallowed if there is insufficient irrigation water supply. This change from annual to permanent crops results in an inability to fallow fields during times of water shortage.

Overall, under the No Project Alternative, water users would continue to use groundwater and could expand existing groundwater supplies in the future where available and not restricted.

Lower groundwater levels could reduce groundwater available for agricultural use and could affect water supplies for communities that rely on groundwater as their primary municipal water source, including economically disadvantaged communities. Lower groundwater levels could affect groundwater quality and potentially affect drinking water wells in some areas. Lower groundwater levels could have localized effects on groundwater quality by concentrating pollutants where groundwater contamination already exists. Additionally, in some locations, lower groundwater levels may concentrate salts and nutrients in groundwater over time through evaporative enrichment. Decreased infiltration from stream-aquifer interactions from reduced flows in the Sacramento/Delta watershed could also affect groundwater quality.

Lower groundwater levels could affect natural communities that are dependent on groundwater and sensitive species that are reliant on groundwater-dependent ecosystems. Lower groundwater levels could also affect riparian and wetland habitat, and sensitive groundwater-dependent natural communities and wetlands.

Increased groundwater pumping from wells with diesel-powered pumps could generate additional greenhouse gas emissions and affect air quality. In addition, increased groundwater pumping from wells with diesel-powered pumps could result in emissions in excess of existing thresholds and could conflict with the state's long-term emission reduction trajectory.

Compared to the proposed Plan amendments, the magnitude of potential groundwater-related response actions and environmental impacts would be expected to be less, although these impacts remain potentially significant. Impact mechanisms and potentially significant environmental impacts associated with lower groundwater levels and groundwater quality are detailed comprehensively in Table F-1 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Other Water Management Actions

Other water management actions include several activities that water users may choose to modify their water supply portfolios by increasing the use of other sources of water and maximizing the use

of existing water supplies. Other water management actions include groundwater storage and recovery, water transfers, water recycling, and water conservation.

Water users throughout the state are currently pursuing development of new water supplies to support existing and future water demands and to address limited Sacramento/Delta surface water supplies during drought. The environmental analyses presented in Sections 7.3 through 7.20 consider that the proposed Plan amendments may accelerate and increase the need for other water management actions and efforts to manage water sustainably. Although these efforts would not accelerate under the No Project Alternative, water users would still be expected to modify their water supply portfolios by maximizing the use of existing water supplies and increasing the use of other sources of water. Although other water management actions could be less under the No Project Alternative than the proposed Plan amendments, the types of impacts and significance determinations would remain similar to those made for the proposed Plan amendments.

Other water management actions could result in potentially significant impacts on the following resource areas: agriculture and forest resources, terrestrial biological resources, aquatic biological resources, energy, greenhouse gas emissions, hydrology and water quality (surface water and groundwater), and utilities and service systems. Specific impacts are detailed comprehensively in Table F-1 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

7.24.2.3 New or Modified Facilities

Actions that could be undertaken by water users and other entities to expand water supplies include infrastructure projects involving construction such as new or modified reservoirs and points of diversion, new groundwater wells and groundwater storage and recovery projects, new or modified wastewater treatment plants (WWTPs) for water recycling, and new or modified drinking water treatment facilities, including desalination facilities. Other water management actions that involve construction of new or modification of existing infrastructure are described in detail and evaluated in Section 7.22, *New or Modified Facilities*.

Under the No Project Alternative, it is expected that water users would continue to increase water demands in the absence of instream flow protections. Although the No Project Alternative would not lead to the development of other water supply sources as a response to reduced surface water supplies, water users would continue to pursue the development of new water supplies to support existing and future water demands and to address limited Sacramento/Delta surface water supplies during drought. Therefore, efforts to construct new or expanded reservoirs and points of diversion within the Sacramento/Delta watershed would likely be similar to or less than those expected under the proposed Plan amendments. Other infrastructure projects involving construction—including new groundwater wells and groundwater storage and recovery, new or modified wastewater treatment plants for water recycling, and new or modified drinking water treatment facilities, including desalination facilities—could also occur under the No Project Alternative, and the impacts would be expected to be similar to or less than those under the proposed Plan amendments.

Table 7.22-1 in Section 7.22, *New or Modified Facilities,* details impacts and mitigation measures, including temporary construction impacts from these types of actions. Impacts on the following resource areas could be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation, transportation and traffic, and utilities and service systems. The

potential impacts would vary according to site-specific conditions but could be potentially significant.

7.24.2.4 Habitat Restoration and Other Ecosystem Projects

Habitat restoration and other ecosystem projects include physical habitat restoration projects, as well as predation and invasive species control measures. Habitat restoration and other ecosystem measures can also include certain activities related to cold water management, such as reservoir temperature management facilities or fish passage facilities. These types of projects are described in detail and analyzed in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*.

Under existing conditions, numerous habitat restoration and other ecosystem projects are in various stages of development and implementation in the Sacramento/Delta watershed. Under the No Project Alternative, the Bay-Delta Plan would not be updated to recommend and support physical habitat restoration projects that complement flow actions, and the cold water habitat objective—which could lead to temperature control and fish passage projects—would not be adopted. However, habitat restoration projects would also occur under the No Project Alternative. Many programs, initiatives, plans, strategies, partnerships, and legislation have been established to advance physical habitat restoration and other complementary ecosystem projects with the overall goal of improving conditions for fish and wildlife, and these efforts would continue to occur under the No Project Alternative. Various recent actions and programs are intended to implement NMFS' 2014 *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the DPS of California Central Valley Steelhead* and the California Natural Resources Agency's 2017 *Sacramento Valley Salmon Resiliency Strategy*, such as the Sacramento Valley Salmon Recovery Program to promote salmon recovery in the Sacramento Valley. The Sacramento Valley Salmon Recovery Program has completed more than 140 projects since 2000 and continues to build on these efforts (Northern California Water Association 2018).

Multiple efforts are also underway or have recently been completed to restore tidal, sub-tidal, and floodplain habitat in the plan area, including in the Delta and Suisun Marsh. For example, California EcoRestore is a multiagency initiative to advance the restoration of more than 30,000 acres of habitat in the Delta, Suisun Marsh, and the Yolo Bypass. The initiative consists of a variety of habitat restoration actions to meet the goal of restoring 9,000 acres of tidal and sub-tidal habitat, 17,500 acres of floodplain, 3,500 acres of managed wetlands, and up to 1,000 acres of Proposition 1 and 1E funded restoration projects. EcoRestore initiatives also support other related actions such as fish passage improvement projects, levee infrastructure maintenance, and fish rescue facility improvements. Several EcoRestore projects have already been completed, including the Knight's Landing Outfall Gates Positive Fish Barrier Project, the Dutch Slough Tidal Habitat Restoration Project, and the Fremont Weir Adult Fish Passage Modification Project. In 2022, construction began on the Fremont Weir Big Notch Project, which will restore 30,000 acres of floodplain rearing habitat for salmonids in the Yolo Bypass (DWR 2022).

Overall, under the No Project Alternative, the impacts of habitat restoration and other ecosystem projects would be similar to the types of impacts that would occur under the proposed Plan amendments. Significance determinations would also remain similar to those made for the proposed Plan amendments. Table 7.21-1 in Section 7.21, *Habitat Restoration and Other Ecosystem Projects,* details impacts and mitigation measures, including impacts and mitigation measures from temporary construction impacts, from these types of actions. Impacts on the following resource

areas could be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation, transportation and traffic, and utilities and service systems.

7.24.2.5 Economic Effects

As discussed above, the No Project Alternative assumes the continued implementation of the Bay-Delta Plan, as implemented by D-1641 (revised March 15, 2000). Under the No Project Alternative, it is expected that inflows and outflows would decrease over time due to increasing water demands over time in the absence of additional instream flow requirements. It is assumed that Sacramento/Delta supply would increase for agricultural, municipal, and wildlife refuge uses under the No Project Alternative. However continued reliance on groundwater by irrigators for supplemental supply, along with implementation of the Sustainable Groundwater Management Act, would result in increased pressures for development of alternative supplies under the No Project Alternative. This could include construction of additional reservoir storage capacity, either through the raising of existing dams or building of new reservoirs. New storage may also be considered in the context of future droughts and climate change. Construction of new storage would require additional repayment capacity of irrigators and, when combined with other crop market forces, may lead to additional changes in cropping patterns and associated revenue (and profit) impacts on growers and the agriculture-based economy.

Under the No Project Alternative, municipal water providers would likely see few changes to existing operations in the near term. In general, municipal water providers manage water portfolios through implementation of long-term plans (see Section 8.5.1, *Approach to Analysis*). This includes ensuring that future water needs, accounting for anticipated population growth, can be met with existing and new water supplies. For many water providers, developing and/or acquiring additional water is part of current and future plans. In some parts of the state where competition for water is high, there would be increased pressure for developing new water sources, additional storage, banking, and transfer agreements among municipal providers and between agriculture and urban providers.

The economic effects of the No Project Alternative on commercial fisheries would be expected to be adverse and considerable. Sustained periods of low catch levels by commercial harvesters could lead to their exit from the industry, with accompanying effects on employment for crew and loss of economic activity in fishing-dependent communities. There would also be a loss of benefits to recreational fishing in the watershed, and the associated trip-related spending.

7.24.2.6 Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The No Project Alternative would not result in beneficial environmental effects, and it would not satisfy the purpose and goals of the State Water Board's current efforts to update and implement the Bay-Delta Plan, including providing reasonable protection of fish and wildlife beneficial uses. As discussed in prior chapters, implementation of the current Sacramento/Delta provisions of the Bay-Delta Plan has not been adequate to protect fish and wildlife throughout the watershed and throughout the year. Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, discusses that native species in the Bay-Delta ecosystem are experiencing an ecological crisis. For decades, valuable habitat has been disconnected

and converted to farmland and urban uses, the quality of water in the channels has been degraded, there has been a substantial overall reduction in flows and significant changes in the timing and distribution of those flows, and species have been cut off from natal waters. This has led to severe declines, and in some cases extinctions, of native fish and other aquatic species. If the Bay-Delta Plan is not updated to provide for reasonable protection of fish and wildlife beneficial uses, ecological conditions are expected to continue to degrade, and populations of native fish and other aquatic species would continue to decline.

7.24.3 Low Flow Alternative (Alternative 2)

The Low Flow Alternative is similar to the proposed Plan amendments in that it would establish new and modified objectives and implementation measures for the protection of fish and wildlife for: (1) inflows for the Sacramento/Delta tributaries; (2) cold water habitat; (3) Delta outflows; (4) interior Delta flows (flow and water project operational requirements); and (5) other monitoring, special studies, and other associated provisions. However, under the Low Flow Alternative, the new numeric inflow objective for the Sacramento/Delta tributaries would require between 35 and 45 percent unimpaired flow. This differs from the numeric inflow objective under the proposed Plan amendments, which would require flows of 55 percent unimpaired flow with an adaptive range from 45 to 65 percent unimpaired flow. The numeric inflow objectives and Delta outflow objective under the Low Flow Alternative would require a smaller amount of inflow to the Delta, and required Delta outflows would be less than those required under the proposed Plan amendments.

Potential environmental impacts of the Low Flow Alternative are discussed in this section and detailed comprehensively in Table F-2 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*. Table F-2 identifies the potentially significant impacts, less-than-significant impacts, and beneficial environmental effects of changes in hydrology and supply under the Low Flow Alternative on various environmental resource areas. Table F-2 also identifies if the impact or benefit would be reduced, similar, or increased compared to the proposed Plan amendments. Table F-2 also identifies mitigation measures that could reduce potentially significant impacts of the Low Flow Alternative. In many cases, potentially significant impacts could be reduced to less-than-significant levels with mitigation incorporated. Table F-2 identifies the potentially significant impacts that would be reduced to less-than-significant levels with mitigation incorporated for mitigation activities within the State Water Board's jurisdiction. Because the State Water Board has authority to ensure that mitigation is implemented for these actions, these impacts would be reduced to less-than-significant levels with mitigation incorporated. However, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. Accordingly, the State Water Board cannot guarantee that measures will always be adopted or applied to fully mitigate potentially significant impacts. Therefore, unless and until the mitigation is fully implemented, the impacts would remain potentially significant.

Implementation of this alternative would result in changes in Sacramento/Delta tributary inflows, reservoir levels, Delta inflows, Delta interior flows, and Delta outflows compared with baseline conditions. Implementation of the Low Flow Alternative would also result in reductions of Sacramento/Delta supply for agricultural, municipal, and wildlife refuge uses. Chapter 2, *Hydrology and Water Supply*, provides details about current conditions as a percentage of unimpaired flow for individual tributaries in the Sacramento/Delta watershed. Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*, provide details regarding modeled changes in hydrology and changes in water supply under the Low Flow

Alternative, the proposed Plan amendments, and the High Flow Alternative. Overall, the changes in hydrology and water supply that would occur under the Low Flow Alternative are similar to but less than those that would occur under the proposed Plan amendments. The changes in hydrology and water supply that would occur under the Low Flow Alternative would generally be smaller in magnitude and closer to baseline conditions compared with the changes that would occur under the proposed Plan amendments. At the same time, many of the beneficial environmental effects under the Low Flow Alternative would be more limited compared with those under the proposed Plan amendments.

7.24.3.1 Changes in Hydrology

Details regarding the modeled changes in hydrology that would occur under the Low Flow Alternative are presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results.* Chapter 6 summarizes Sacramento Water Allocation Model (SacWAM) results for changes in hydrology, including changes in streamflows and reservoir levels under various percent unimpaired flow scenarios. Modeling results are presented in ranges of potential instream flows in increments of 10 percent unimpaired flow, from 35 percent unimpaired flow up to 75 percent (referred to as scenarios). Overall, the trends described in Chapter 6 regarding changes in Sacramento/Delta tributary flows, reservoir levels, Delta inflows, interior Delta flows, and Delta outflows under the Low Flow Alternative (35–45 scenarios) are similar to those under the proposed Plan amendments (45–65 scenarios). However, the change from baseline conditions under the Low Flow Alternative would be generally less than under the proposed Plan amendments. At the same time, environmental benefits of the Low Flow Alternative would be expected to be less than those under the proposed Plan amendments. Nonetheless, the potentially significant environmental impacts identified for the proposed Plan amendments would also be potentially significant under the Low Flow Alternative.

Changes in hydrology would result in potentially significant impacts on the following resource areas: aesthetics, agriculture and forest resources, terrestrial biological resources, aquatic biological resources, cultural resources, energy, hydrology and water quality (surface water), recreation, and utilities and service systems. Detailed descriptions of the impact mechanisms and corresponding mitigation measures are provided in Sections 7.3 through 7.20.

Changes in Streamflows

Under the Low Flow Alternative, as under the proposed Plan amendments, flows in some streams would increase at times compared with baseline conditions. For example, streamflows on some Sacramento/Delta tributaries (including on many regulated tributaries) could increase in the late winter and spring months compared with baseline conditions, though to a lesser extent than under the proposed Plan amendments. These increases in streamflows could also result in increased inundation of the Sutter and Yolo Bypasses, particularly during the late winter through spring months. While these changes in hydrology would benefit native aquatic species, these changes could also result in potentially significant environmental impacts. For example, increased inundation in the Sutter and Yolo Bypasses during the planting season could reduce crop acreage and could also adversely affect special-status wildlife species that use croplands as habitat. These impacts would be less than under the proposed Plan amendments, though they would still be potentially significant. Increased flows could result in increased input of mercury and methylmercury production in bypass areas. Generally, changes in hydrology do not result in increased flood risks in the plan area. However, increases in Clear Creek flow downstream of Whiskeytown Lake could increase risk of

erosion and flooding in and downstream of this area because some flows that pass from Whiskeytown Lake through Spring Creek Tunnel to Keswick Reservoir under baseline conditions would instead flow out of Whiskeytown Lake into Clear Creek.

Under the Low Flow Alternative, as under the proposed Plan amendments, flows in some streams could be reduced at times compared with baseline conditions. Streamflows on some Sacramento/Delta tributaries (including many regulated tributaries) could be lower, particularly in the summer and early fall compared with baseline conditions, though to a lesser extent than under the proposed Plan amendments. In addition, streamflows could be reduced at times in some streams below export reservoirs. These reductions in streamflows could result in potentially significant environmental impacts. These impacts would be less than under the proposed Plan amendments, though they would still be potentially significant. For example, reduced streamflows during the summer months would result in a decrease in hydropower generation in the summer, which could be significant for an individual project or community, though this is less likely than under the proposed Plan amendments or High Flow alternative. Hydropower calculations and energy grid (power flow modeling) results for the Low Flow Alternative are presented in Appendix A5, *Hydropower, Energy Grid, and Export Energy Analyses,* and are summarized in Section 7.8, *Energy*.

Changes in Reservoir Levels

Implementation of the Low Flow Alternative could result in changes in reservoir levels, including lower reservoir levels in some locations. While changes in reservoir levels compared with baseline conditions would be less under the Low Flow Alternative than under the proposed Plan amendments, changes at some reservoirs in the Sacramento/Delta watershed as well as certain export reservoirs could have potentially significant impacts because of reservoir drawdown or fluctuations beyond historical levels. These changes could result in potentially significant environmental impacts. For example, reservoir level changes may result in exposure of more unvegetated ground; expose previously inundated cultural resources to increased wave action, erosion, and human activity; and affect boat ramp accessibility, affecting recreation opportunities. Changes in reservoir levels could exacerbate existing water quality issues associated with reservoirs, including bioaccumulation of methylmercury in fish and production of harmful algal blooms in some locations. Changes in reservoir levels and lowered streamflows below reservoirs could result in increased temperature in some locations and times of year, particularly while specific cold water habitat implementation measures are refined. Water temperature results for the Low Flow Alternative are presented in Section 7.6.2, *Aquatic Biological Resources*, and Appendix A6, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers*.

Beneficial Environmental Effects

Although changes in hydrology under the Low Flow Alternative would result in potentially significant environmental impacts, these changes would also provide beneficial environmental effects on native aquatic and aquatic-dependent species, aquatic and riparian habitats and natural communities, and ecosystem functions in the Sacramento/Delta watershed. In addition, the Low Flow Alternative would provide certain water quality benefits, particularly during periods when streamflows would increase compared with baseline conditions. A number of beneficial environmental effects resulting from changes in hydrology are discussed below and also identified in Table F-2 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*. However, these beneficial environmental effects would be less than under the proposed Plan amendments.

A more natural flow regime would support a connected and functioning ecosystem and would be expected to benefit native fish in the Sacramento/Delta watershed. Additionally, provision of minimum flows and restoration and maintenance of a more natural flow regime would be expected to improve conditions for special-status plants and wildlife, and would be expected to benefit native resident and migratory wildlife that use riverine and associated wetland and riparian habitat and natural communities as migratory corridors or nursery sites. In addition, improving ecosystem functions would support recreational opportunities.

Increases in Delta outflows would to some degree reduced seawater intrusion which could result in water quality improvements in the Delta, including dilution and flushing of some contaminants and reduction in EC, bromide, and chloride. DSM2 results for the Low Flow Alternative are presented in Appendix A2, *Delta Simulation Model II (DSM2) Methods and Results*, and are summarized in Section 7.12.1, *Surface Water*.

Increases in Delta inflows and Delta outflows would also be expected to improve to some degree habitat conditions for freshwater and tidal marshes and associated plant and wildlife species in the Delta and Suisun Marsh. In addition, increases in Delta inflows and outflows in the winter and spring would be expected to benefit native anadromous, estuarine, and resident fish species to some degree. Higher flushing flows in winter and spring could also reduce harmful algal blooms and invasive vegetation to some degree.

7.24.3.2 Changes in Water Supply

Changes in Sacramento/Delta Surface Water Supply for Agricultural, Municipal, and Wildlife Refuge Uses

Details regarding the modeled changes in water supply that could occur under the Low Flow Alternative are presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*. Chapter 6 summarizes SacWAM results for changes in Sacramento/Delta water supply under various percent unimpaired flow scenarios. More detailed discussion of SacWAM results for changes in water supply for agriculture and municipal use for the Low Flow Alternative are presented in Section 7.4, *Agriculture and Forest Resources*; Section 7.12.2, *Groundwater*; and Section 7.20, *Utilities and Service Systems*.

Implementation of the Low Flow Alternative would result in changes in Sacramento/Delta water supply, including reductions to agricultural and municipal uses, and wildlife refuge uses; however, the change from baseline conditions under the Low Flow Alternative would be generally less than under the proposed Plan amendments. Nonetheless, potentially significant environmental impacts identified for the proposed Plan amendments would also be potentially significant under the Low Flow Alternative.

Changes in water supply could result in potentially significant impacts on the following resource areas: agriculture and forest resources, air quality, terrestrial biological resources, aquatic biological resources, energy, geology and soils, greenhouse gas emissions, hydrology and water quality (surface water and groundwater), noise, and utilities and service systems. Detailed descriptions of the impact mechanisms and corresponding mitigation measures are provided in Sections 7.3 through 7.20, and they are discussed below and detailed comprehensively in Table F-2 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Under the Low Flow Alternative, Sacramento/Delta agricultural water supplies and wildlife refuge water supplies would be reduced compared with baseline conditions, although to a lesser extent than under the proposed Plan amendments. Statewide Agricultural Production Model (SWAP) results for the Low Flow Alternative are presented in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*, and are summarized in Section 7.4, *Agriculture and Forest Resources*; Section 7.6.1, *Terrestrial Biological Resources*; and Section 7.12.2, *Groundwater*. Reduced Sacramento/Delta supply to agriculture could lead to changes in distribution of crop types and acreage and conversion of farmland to nonagricultural use. Reduced Sacramento/Delta supply to wildlife refuges and agricultural lands could affect habitat for special-status species, including giant garter snake, Swainson's hawk, greater sandhill crane, tricolored blackbird, and California black rail. In addition, reduced Sacramento/Delta supply for wildlife refuges and agricultural lands could decrease the amount of habitat available for resident and migratory waterfowl and shorebirds.

Under the Low Flow Alternative, Sacramento/Delta municipal water supplies could be reduced compared with baseline conditions, although to a lesser extent than under the proposed Plan amendments. Reduced municipal supply and increased indoor water conservation could lead to a decrease in the production of wastewater and increase in chemical constituent concentrations in WWTP influent and effluent. Changes in water supply could result in the use of other lower quality water supply sources that also affect WWTP influent and effluent, leading to construction to modify or expand existing treatment facilities.

Groundwater

Reduced Sacramento/Delta supply could also result in potentially significant impacts related to lower groundwater levels and groundwater quality from increased groundwater pumping as a substitute supply (where available and not locally restricted) and reductions in applied irrigation water, including from increased water use efficiencies, which would reduce incidental groundwater recharge. Overall, because the magnitude of reductions in Sacramento/Delta supply under the Low Flow Alternative would be less than under the proposed Plan amendments, the magnitude of these potential groundwater-related response actions and environmental impacts would also be expected to be less, although these impacts would remain potentially significant. Potentially significant environmental impacts on groundwater levels and groundwater quality are discussed below and detailed comprehensively in Table F-2 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Lower groundwater levels could reduce groundwater available for agricultural use and could affect water supplies for communities that rely on groundwater as their primary municipal water source, including economically disadvantaged communities. Lower groundwater levels could affect groundwater quality and potentially affect drinking water wells in some areas. Lower groundwater levels could have localized effects on groundwater quality by concentrating pollutants where groundwater contamination already exists. Additionally, in some locations, lower groundwater levels may concentrate salts and nutrients in groundwater over time through evaporative enrichment.

Lower groundwater levels could affect natural communities that are dependent on groundwater, and sensitive species that are reliant on groundwater-dependent ecosystems. Lower groundwater levels could also affect riparian and wetland habitat, and sensitive groundwater-dependent natural communities and wetlands.

Increased groundwater pumping from wells with diesel-powered pumps could generate additional greenhouse gas emissions and affect air quality. In addition, increased groundwater pumping from wells with diesel-powered pumps could result in emissions in excess of existing thresholds and could conflict with the state's long-term emission reduction trajectory.

Other Water Management Actions

In response to changes in Sacramento/Delta supply that would occur under the Low Flow Alternative, water users may choose to modify their water supply portfolios by increasing the use of other sources of water and maximizing the use of existing water supplies. These other water management actions include groundwater storage and recovery, water transfers, water recycling, and water conservation. Changes in Sacramento/Delta water supply from baseline conditions would be smaller in magnitude under the Low Flow Alternative than the changes that would occur under the proposed Plan amendments. Therefore, other water management actions that would occur as a result of changes in water supply would be less under this alternative than the proposed Plan amendments, although these impacts would remain potentially significant.

Other water management actions could result in potentially significant impacts on the following resource areas: agriculture and forest resources, terrestrial biological resources, aquatic biological resources, energy, greenhouse gas emissions, hydrology and water quality (surface water and groundwater), and utilities and service systems. Specific impacts are discussed below and detailed comprehensively in Table F-2 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*, and are further discussed in Sections 7.3 through 7.20. For example, changes in water supply could cause an increase in energy use to replace Sacramento/Delta supplies from actions such as increased water recycling, which requires electricity to produce. Other actions, such as water conservation, can result in energy savings. Mitigation measures are also discussed in Sections 7.3 through 7.20.

While impacts from other water management actions under the Low Flow Alternative would be less compared with the proposed Plan amendments (e.g., less frequent, lower magnitude, shorter duration), these actions are still expected to occur in response to changes in hydrology and water supply and could result in potentially significant impacts. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Sections 7.3 through 7.20.

7.24.3.3 New or Modified Facilities

Implementation of the Low Flow Alternative could result in reduced Sacramento/Delta water supplies, which could increase efforts to prioritize limited available supplies and lead to the development of other water supply sources. Response actions that could be undertaken by water users and other entities to expand water supplies include infrastructure projects involving construction such as new or modified reservoirs and points of diversion, new groundwater wells and groundwater storage and recovery projects, new or modified WWTPs for water recycling, and new or modified drinking water treatment facilities, including desalination facilities. Water users and other entities may also implement other actions in response to changes in hydrology and changes in water supply that would require construction activities, such as building new or modified boat ramps, installing streamflow or temperature monitoring devices to monitor and report compliance with instream flow and cold water habitat requirements, and developing agricultural water conservation projects such as canal lining and encasement. Other water management actions that involve construction of new or modification of existing infrastructure are described in detail and evaluated in Section 7.22, *New or Modified Facilities.*

Changes in Sacramento/Delta water supply from baseline conditions would be smaller in magnitude under the Low Flow Alternative than the changes that would occur under the proposed Plan amendments. Therefore, the increased use or accelerated development of new and modified facilities would be less under this alternative than under the proposed Plan amendments. However, construction of larger water supply projects (e.g., new storage reservoirs, desalination plants) that could occur as a response to changes in water supply could result in the same types of impacts as under the proposed Plan amendments, including potentially significant construction impacts on environmental resource areas, depending on site-specific locations. The types and nature of potential environmental impacts associated with construction of new stream gages or implementation of agricultural conservation measures would be similar or the same as under the proposed Plan amendments. Table 7.22-1 in Section 7.22, *New or Modified Facilities,* details impacts and mitigation measures, including impacts and mitigation measures from temporary construction impacts, from these types of actions. Impacts on the following resource areas could be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation, transportation and traffic, and utilities and service systems. The potential impacts would vary according to the type of project and site-specific conditions but could be potentially significant. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Table 7.22-1. The precise location and magnitude of new and modified facilities are not known. Unless and until such time that mitigation measures are implemented, the impacts would remain potentially significant.

7.24.3.4 Habitat Restoration and Other Ecosystem Projects

Similar to the proposed Plan amendments, the Low Flow Alternative provides a framework that would allow stakeholders to implement complementary ecosystem projects in addition to flow requirements, and actions that other entities could take that would contribute to the overall goal of providing reasonable protection to fish and wildlife in the Sacramento/Delta watershed. These actions include physical habitat restoration projects as well as predation and invasive species control measures. In addition, the narrative cold water habitat objective would address tributary-specific temperature needs by requiring that cold water flows from reservoirs be maintained and timed to provide for downstream temperatures to protect salmon species at critical times of year, or that alternate protective measures are implemented to ensure that fish below dams are kept in good condition (consistent with Fish and Game Code section 5937). The cold water habitat objective could be implemented in part through certain construction projects such as reservoir temperature management facilities or fish passage facilities. These types of habitat restoration and other ecosystem projects are described in detail and analyzed in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*.

Under the Low Flow Alternative, the impacts of habitat restoration and other ecosystem projects could be less compared with the proposed Plan amendments if habitat restoration and other ecosystem projects are not implemented in the Sacramento/Delta watershed, or more if the lower numeric inflow requirement leads to an overall greater dependence on habitat restoration and other ecosystem projects to improve conditions for native fish. In either case, significance determinations would remain similar to those made for the proposed Plan amendments. Habitat restoration and other ecosystem projects could occur under the Low Flow Alternative and impacts would be potentially significant.

Table 7.21-1 in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, details impacts and mitigation measures, including impacts and mitigation measures from temporary construction impacts, from these types of actions. Impacts on the following resource areas could be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation, transportation and traffic, and utilities and service systems. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Table 7.21-1. The precise location and magnitude of habitat restoration actions are not known. Unless and until such time that mitigation measures are implemented, the impacts would remain potentially significant.

7.24.3.5 Economic Effects

The estimation of economic effects of the Low Flow Alternative are shown in the analysis of the 35 scenario and 45 scenario, and detailed results are presented in Chapter 8, *Economic Analysis and Other Considerations*. Based upon Statewide Agricultural Production Model (SWAP) results presented in Section 8.4.2, *Agricultural Economic Effects*, the Low Flow Alternative could result in adverse economic effects on irrigated agriculture, but the effects would be smaller compared to the proposed Plan amendments. In the Sacramento/Delta watershed, the loss of crop revenues would be expected to be approximately $12 million to $120 million per year, or approximately 0.1-1.3 percent of total crop sales, based on SWAP average year model results. Most of the effects would be expected to fall on rice and alfalfa and pasture. In the San Joaquin Valley, crop revenues could be reduced by up to approximately $149 million per year, or up to 0.6 percent of total crop sales, based on SWAP average year model results. Almonds and pistachios, alfalfa and pasture, corn and other silage, and wheat and other field crops would be expected to account for the majority of the effects. In other regions that receive Sacramento/Delta water supplies, there may be additional smaller effects on crop revenue, including wine grapes and deciduous orchards.

Providers of agricultural services, food processors, and other farming-dependent industries such as dairies and livestock could be affected by changes in crop production in both the Sacramento/Delta and San Joaquin Valley, as discussed in Section 8.4. Economic effects on farming-dependent industries would be expected to be less under the Low Flow Alternative compared to the proposed Plan amendments.

Section 8.4.3, *Regional Economic Effects*, presents a regional economic analysis to estimate how changes in water supply and resulting changes at the local agricultural economy would affect regional economic activity in the Sacramento/Delta watershed and the State of California. The results show that most of the effects are concentrated in agriculture and related sectors, but some effects are distributed throughout other sectors in the regional economy. Detailed economic effects results are presented in Chapter 8, and the effects would be expected to be less under the Low Flow Alternative compared to the proposed Plan amendments.

The Low Flow Alternative could result in water supply reductions to municipal water users. Section 8.5, *Municipal Water Supply Economic Effects*, estimates the potential costs to affected municipal service providers of securing reliable water supplies. Some municipal water providers in the study area could incur additional expenses in providing water to customers, but the total economic effect under the Low Flow Alternative would be less than under the proposed Plan amendments. Detailed results for estimated costs for municipalities to respond to reduced Sacramento/Delta supply are provided in Section 8.5.

Commercial and recreational fisheries would be expected to experience a positive economic effect under the Low Flow Alternative, although the economic benefits would be expected to be more limited compared to the proposed Plan amendments. There would also be expected to be positive effects on some ecosystem services.

7.24.3.6 Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis.* The Low Flow Alternative would establish inflow, cold water habitat, interior Delta flow, and Delta outflow objectives and a program of implementation for the reasonable protection of fish and wildlife beneficial uses in the Sacramento/Delta. However, the numeric inflow objective under the Low Flow Alternative would be less compared with the proposed Plan amendments, and it would be expected to provide less benefits to native fish and wildlife. For example, analyses presented in Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, based on flow-abundance relationships indicate that the population abundance of native aquatic species would be greater under the proposed Plan amendments (55 scenario) compared with the Low Flow Alternative (35 scenario). The analyses presented in Chapter 3 generally show some incremental benefit to native fish species for all percent unimpaired flow scenarios from 35 to 75 percent (including the Low Flow Alternative) relative to existing conditions. However, as discussed in Chapter 3, modeling indicates that abundance indices of targeted species may be expected to increase by a larger percentage under the proposed Plan amendments.

7.24.4 High Flow Alternative (Alternative 3)

The High Flow Alternative is similar to the proposed Plan amendments and the Low Flow Alternative (Alternative 2) in that it would establish new and modified objectives and implementation measures for the protection of fish and wildlife for: (1) inflows for the Sacramento/Delta tributaries; (2) cold water habitat; (3) Delta outflows; (4) interior Delta flows (flow and water project operational requirements); and (5) other monitoring, special studies, and other associated provisions. However, under the High Flow Alternative, the new numeric inflow objective for the Sacramento/Delta tributaries would require between 65 and 75 percent of unimpaired flow. This differs from the numeric inflow objective under the proposed Plan amendments, which would require flows of 55 percent unimpaired flow with an adaptive range from 45 to 65 percent unimpaired flow. The numeric inflow objective and Delta outflow objective under the High Flow Alternative would require a larger amount of inflow to the Delta, and required Delta outflows would be greater than those under the proposed Plan amendments.

This alternative could provide for Delta inflows and Delta outflows identified in the State Water Board's 2010 report titled *Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem* (Delta Flow Criteria Report) (^SWRCB 2010). The Delta Flow Criteria Report made a number of findings and identified specific criteria for inflows, outflows, and interior Delta flows if fishery protection was the sole purpose for which waters were put to beneficial use without considering the need for cold water reserves and balancing of supplies for other beneficial uses of water. The Delta Flow Criteria Report specifically identified a Delta outflow criteria of 75 percent of unimpaired Delta outflow from January through June and an inflow criteria of 75 percent of unimpaired Sacramento River inflow from November through June.

However, the Delta Flow Criteria Report acknowledged that it may not be possible to attain all of the identified flow criteria in all years and maintain adequate storage for temperature management for

the various runs of Chinook salmon and other sensitive species. The report also noted that there are many other important beneficial uses that these waters support such as municipal, industrial, agricultural, hydropower, recreation, and environmental uses such as wetlands and refuge water supplies that must be considered when determining regulatory flow requirements. Those other considerations are part of the analysis of this alternative, the proposed Plan amendments, and the other alternatives.

Potential environmental impacts of the High Flow Alternative are discussed in this section and detailed comprehensively in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*. Table F-3 identifies the potentially significant impacts, less-than-significant impacts, and beneficial environmental effects of the High Flow Alternative on various environmental resource areas. Table F-3 also identifies if the impact or benefit would be reduced, similar, or increased compared to the proposed Plan amendments. The mitigation measures that could reduce potentially significant impacts of the High Flow Alternative are the same as the mitigation measures that could reduce potentially significant impacts of the proposed Plan amendments, and are detailed in Sections 7.3 through 7.20. Table F-3 identifies the potentially significant impacts that would be reduced to less-than-significant levels with mitigation incorporated for mitigation activities within the State Water Board's jurisdiction. Because the State Water Board has authority to ensure that mitigation is implemented for these actions, these impacts would be reduced to less-than-significant levels with mitigation incorporated. However, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. Accordingly, the State Water Board cannot guarantee that measures will always be adopted or applied to fully mitigate potentially significant impacts. Therefore, unless and until the mitigation is fully implemented, the impacts would remain potentially significant. In addition, it may not be possible to fully mitigate all environmental impacts under the High Flow Alternative, even after mitigation is implemented.

The High Flow Alternative would result in changes in Sacramento/Delta tributary inflows, reservoir levels, Delta inflows, Delta interior flows, and Delta outflows compared to baseline conditions. The High Flow Alternative would also result in reductions of Sacramento/Delta supply for agricultural and municipal uses, and wildlife refuge uses. Chapter 2, *Hydrology and Water Supply*, provides details about current conditions as a percentage of unimpaired flow for individual tributaries in the Sacramento/Delta watershed. Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*, provide details regarding modeled changes in hydrology and changes in water supply under the Low Flow Alternative, the proposed Plan amendments, and the High Flow Alternative. Overall, the changes in hydrology and water supply that could occur under the High Flow Alternative are similar to but greater than those that could occur under the proposed Plan amendments. Compared with baseline conditions, the changes in hydrology that could occur under the High Flow Alternative would generally be larger in magnitude and further from baseline conditions compared with the changes that would occur under the proposed Plan amendments. With respect to carryover storage in rim reservoirs (needed for cold water habitat), with higher instream flow requirements, it would be difficult to maintain storage levels while maintaining even greatly reduced levels of water supplies. In addition, the changes in water supply that would occur under the High Flow Alternative would also be greater in magnitude and further from baseline conditions compared with the changes that would be expected to occur under the proposed Plan amendments. Because environmental impacts would be expected to be greater under the High Flow Alternative than the proposed Plan amendments, many of the potentially significant impacts are not likely to be mitigated to less-than-significant levels.

Although the required Delta inflows would be higher under the High Flow Alternative compared with the proposed Plan amendments and would provide ecosystem benefits, the beneficial environmental effects under the High Flow Alternative would be limited due to significant challenges in maintaining suitable water temperatures for cold water aquatic species and carryover storage for environmental and water supply purposes. The Delta Flow Criteria Report acknowledged that the identified flow criteria should be tempered by the additional need to maintain cold water resources in reservoirs on tributaries to the Delta until improved passage and other measures are taken that would reduce the need for maintaining cold water supplies in reservoirs. Reservoir storage results presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*, suggest that carryover storage levels would be greatly reduced under the High Flow Alternative (particularly the 75 scenario) in numerous reservoirs in the Sacramento/Delta watershed. Without adequate carryover storage, there would be significant challenges in maintaining suitable downstream water temperatures to support native cold water fish species such as Chinook salmon and steelhead. Temperature modeling results presented in Appendix A6, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers*, specifically suggest significant challenges in maintaining suitable water temperatures on the Sacramento, Feather, and American Rivers under the High Flow Alternative.

7.24.4.1 Changes in Hydrology

Details regarding the modeled changes in hydrology that could occur under the High Flow Alternative are presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results.* Chapter 6 summarizes SacWAM results for changes in hydrology, including changes in streamflows and reservoir levels under various percent unimpaired flow scenarios. Modeling results are presented in ranges of potential instream flows in increments of 10 percent unimpaired flow levels, from 35 percent unimpaired flow up to 75 percent (referred to as scenarios). Overall, the trends described in Chapter 6 regarding changes in Sacramento/Delta tributary flows, reservoir levels, and Delta inflows, interior Delta flows, and Delta outflows under the High Flow Alternative (65–75 scenarios) are similar to those under the proposed Plan amendments (45–65 scenarios). However, the change from baseline conditions under the High Flow Alternative would be generally greater than under the proposed Plan amendments. While the higher Delta inflows and Delta outflows required under the High Flow Alternative would provide environmental benefits, these benefits could be limited due to significant challenges in maintaining adequate carryover storage in reservoirs and suitable downstream water temperatures for native cold water species.

Changes in hydrology could result in potentially significant impacts on the following resource areas: aesthetics, agriculture and forest resources, terrestrial biological resources, aquatic biological resources, cultural resources, energy, hydrology and water quality (surface water), recreation, and utilities and service systems. Detailed descriptions of the impact mechanisms and corresponding mitigation measures are provided in Sections 7.3 through 7.20. The impacts are discussed below and detailed comprehensively in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Changes in Streamflows

Under the High Flow Alternative, as under the proposed Plan amendments, flows in some streams would increase at times compared with baseline conditions. For example, streamflows on some

Sacramento/Delta tributaries (including many regulated tributaries) could increase in the late winter and spring months compared with baseline conditions, and to a greater extent than under the proposed Plan amendments. These increases in streamflows could also result in increased inundation of the Sutter and Yolo Bypasses, particularly during the late winter through spring months. While these changes in hydrology would benefit native aquatic species, these changes could also result in potentially significant environmental impacts. For example, increased inundation in the Sutter and Yolo Bypasses during the planting season could reduce crop acreage, and could also adversely affect special-status wildlife species that use croplands as habitat. These impacts would be greater than under the proposed Plan amendments. Increased flows could result in increased input of mercury and methylmercury production in bypass areas. Generally, changes in hydrology do not result in increased flood risks in the plan area. However, increases in Clear Creek flow downstream of Whiskeytown Lake could increase risk of erosion and flooding in and downstream of this area because some flows that pass from Whiskeytown Lake through Spring Creek Tunnel to Keswick Reservoir under baseline conditions would instead flow out of Whiskeytown Lake into Clear Creek.

Under the High Flow Alternative, flows in some streams could be reduced at times compared with baseline conditions. Streamflows on some Sacramento/Delta tributaries (including many regulated tributaries) could be lower, particularly in the summer and early fall compared with baseline conditions, and to a greater extent than under the proposed Plan amendments. In addition, streamflows could be reduced at times in some streams below export reservoirs. These reductions in streamflows could result in potentially significant environmental impacts, and impacts would be greater than under the proposed Plan amendments. For example, reduced water levels at some locations could affect the ability of existing diversion intakes to divert water for agricultural and municipal uses if the diversion intakes are not modified. Reduced streamflows during the summer months would result in a decrease in hydropower generation in the summer, which could be significant for an individual project or community. Reduced Delta inflows during the summer and fall months could also exacerbate water quality issues associated with harmful algal blooms in the Delta. Hydropower calculations and energy grid (power flow modeling) results for the High Flow Alternative are presented in Appendix A5, *Hydropower, Energy Grid, and Export Energy Analyses,* and are summarized in Section 7.8, *Energy*. In addition, as discussed above, reduced flows during the summer months would present significant challenges in maintaining suitable water temperatures for cold water aquatic species.

Changes in Reservoir Levels

Implementation of the High Flow Alternative could result in changes in reservoir levels, including lower reservoir levels in some locations, that would be larger in magnitude compared with the changes that would occur under the proposed Plan amendments. While some reservoirs show little change from baseline, others show substantial decreases in storage under the High Flow Alternative. Many smaller reservoirs in the upper watersheds that are operated primarily for hydropower are not affected by the new inflow requirements in the modeling. However, under the High Flow Alternative, the larger rim reservoirs and reservoirs that receive Sacramento/Delta supplies (e.g., San Luis Reservoir) typically exhibit storage levels lower than baseline. Reservoir storage at the end of April is much lower for all large rim reservoirs in the plan area because the new instream flow requirements necessitate bypassing reservoir inflow during the winter and spring runoff period, which reduces the ability of reservoirs to build storage in the spring. Summer reservoir releases for downstream water supply are assumed to be much lower under the High Flow Alternative than baseline. Therefore, the end of September reservoir storage levels are closer to baseline than end of

April reservoir storage levels; however, storage levels in many reservoirs are still much lower at the end of the irrigation season. Under this alternative, some valley floor reservoirs that are subject to more heating and have other challenging temperature management characteristics, such as Camp Far West, Folsom, New Bullards Bar, and Camanche, could particularly be impacted by higher instream flow requirements and the ability to maintain cold water supplies, while still providing for water supplies for other uses.

Changes at some reservoirs in the Sacramento/Delta watershed as well as certain export reservoirs could have potentially significant impacts because of reservoir drawdown or fluctuations beyond historical levels. These changes in reservoir levels would be greater under the High Flow Alternative than under the proposed Plan amendments, and carryover storage levels would be expected to be lower under the High Flow Alternative than under the proposed Plan amendments for some reservoirs. These reduced reservoir storage levels would also likely result in significant challenges in maintaining adequate downstream water temperatures needed to support Chinook salmon, steelhead, and other native cold water fish species. Reservoir storage results presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*, suggest that carryover storage levels would be greatly reduced under the High Flow Alternative (particularly the 75 scenario) in numerous reservoirs in the Sacramento/Delta watershed. Without adequate carryover storage, there would be significant challenges in maintaining suitable downstream water temperatures to support native cold water fish species such as Chinook salmon and steelhead.

These changes could result in potentially significant environmental impacts. For example, reservoir level changes may result in exposure of more unvegetated ground; expose previously inundated cultural resources to increased wave action, erosion, and human activity; and affect boat ramp accessibility affecting recreation opportunities. Changes in reservoir levels could exacerbate existing water quality issues associated with reservoirs, including bioaccumulation of methylmercury in fish and production of harmful algal blooms in some locations. Changes in reservoir levels and lowered streamflows below reservoirs could result in increased temperature in some locations and times of year. Because the changes in reservoir levels would be greater under the High Flow Alternative than under the proposed Plan amendments, the impacts would be greater (e.g., larger in magnitude, more frequent, longer in duration) under the High Flow Alternative compared with the proposed Plan amendments.

Beneficial Environmental Effects

Although changes in hydrology under the High Flow Alternative would be expected to result in potentially significant environmental impacts, these changes would also be expected to provide beneficial environmental effects on native aquatic and aquatic-dependent species, aquatic and riparian habitats and natural communities, and ecosystem functions in the Sacramento/Delta watershed. In addition, the High Flow Alternative would be expected to provide certain water quality benefits, particularly during periods when streamflows would increase compared with baseline conditions. A number of beneficial environmental effects expected to result from changes in hydrology are discussed below and also identified in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*. However, these beneficial environmental effects would be limited due to significant challenges in maintaining suitable water temperatures for native cold water species such as Chinook salmon and steelhead on regulated tributaries, as well as carryover storage needed to maintain water quality during dry periods.

A more natural flow regime would be expected to support a connected and functioning ecosystem and would be expected to benefit native fish in the Sacramento/Delta watershed. Additionally, restoration and maintenance of more natural flow patterns would be expected to improve conditions for special-status plants and wildlife, and native resident and migratory wildlife that use riverine and associated wetland and riparian habitat and natural communities as migratory corridors or nursery sites. In addition, improved ecological processes would support recreational opportunities.

Increased Delta outflows could result in water quality improvements in the Delta, including dilution and flushing of some contaminants and reduction in EC, bromide, and chloride. DSM2 results for the High Flow Alternative are presented in Appendix A2, *Delta Simulation Model II (DSM2) Methods and Results,* and are summarized in Section 7.12.1, *Surface Water.*

Increases in Delta inflows and Delta outflows would also be expected to improve habitat conditions for freshwater and tidal marshes and associated plant and wildlife species in the Delta and Suisun Marsh. In addition, changes in Delta inflows and outflows would be expected to benefit native anadromous, estuarine, and resident fish species. Higher flushing flows in winter and spring could also reduce harmful algal blooms and invasive vegetation.

7.24.4.2 Changes in Water Supply

Changes in Sacramento/Delta Surface Water Supply for Agricultural, Municipal, and Wildlife Refuge Uses

Details regarding the modeled changes in water supply that could occur under the High Flow Alternative are presented in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*. Chapter 6 summarizes SacWAM results for changes in Sacramento/Delta water supply under various percent unimpaired flow scenarios. More detailed discussion of SacWAM results for changes in water supply for agriculture and municipal use for the High Flow Alternative are presented in Section 7.4, *Agriculture and Forest Resources*; Section 7.12.2, *Groundwater*; and Section 7.20, *Utilities and Service Systems*.

Implementation of the High Flow Alternative would result in changes in Sacramento/Delta water supply, including reductions to agricultural and municipal uses, and wildlife refuge uses. The change from baseline conditions under the High Flow Alternative would be greater than under the proposed Plan amendments.

Changes in water supply would result in potentially significant impacts on the following resource areas: agriculture and forest resources, air quality, terrestrial biological resources, aquatic biological resources, energy, geology and soils, greenhouse gas emissions, hydrology and water quality (surface water and groundwater), noise, and utilities and service systems. Detailed descriptions of the impact mechanisms and corresponding mitigation measures are provided in Sections 7.3 through 7.20. The impacts are also discussed below and detailed comprehensively in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Under the High Flow Alternative, Sacramento/Delta agricultural water supplies and refuge water supplies would be reduced compared with baseline conditions, and to a greater extent than under the proposed Plan amendments. SWAP results for the High Flow Alternative are presented in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*, and are summarized in Section 7.4, *Agriculture and Forest Resources*; Section 7.6.1, *Terrestrial Biological*

Resources; and Section 7.12.2, *Groundwater*. Reduced Sacramento/Delta supply to agriculture could lead to changes in distribution of crop types and acreage and conversion of farmland to nonagricultural use. Reduced Sacramento/Delta supply to wildlife refuges and agricultural lands could affect habitat for special-status species, including giant gartersnake, Swainson's hawk, greater sandhill crane, tricolored blackbird, and California black rail. In addition, reduced Sacramento/Delta supply for wildlife refuges and agricultural lands could decrease the amount of habitat available for resident and migratory waterfowl and shorebirds.

Under the High Flow Alternative, Sacramento/Delta municipal water supplies could be reduced compared with baseline conditions, and to a greater extent than under the proposed Plan amendments. Reduced municipal supply and increased indoor water conservation could lead to a decrease in the production of wastewater and increase chemical constituent concentrations in WWTP influent and effluent. Changes in water supply source could result in temporary exceedances of maximum contaminant levels in municipal water supply. Changes in water supply could result in the use of other lower quality water supply sources that also affect WWTP influent and effluent, leading to construction to modify or expand existing treatment facilities.

Groundwater

Reduced Sacramento/Delta supply could also result in potentially significant impacts related to lower groundwater levels and groundwater quality from increased groundwater pumping as a substitute supply (where available and not locally restricted), and reductions in applied irrigation water, including from increased water use efficiencies, which would reduce incidental groundwater recharge. Overall, because the magnitude of reductions in Sacramento/Delta supply under the High Flow Alternative would be greater than those under the proposed Plan amendments, these impacts would remain potentially significant and the magnitude of these potential groundwater-related response actions and environmental impacts would also be expected to be greater. Potentially significant environmental impacts on groundwater levels and groundwater quality are discussed below and detailed comprehensively in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3*.

Lower groundwater levels could reduce groundwater available for agricultural use, and could affect water supplies for communities that rely on groundwater as their primary municipal water source, including economically disadvantaged communities. Lower groundwater levels could affect groundwater quality and could affect drinking water wells in some areas. Lower groundwater levels could have localized effects on groundwater quality by concentrating pollutants where groundwater contamination already exists. Additionally, in some locations, lower groundwater levels may concentrate salts and nutrients in groundwater over time through evaporative enrichment.

Lower groundwater levels could affect natural communities that are dependent on groundwater, and sensitive species that are reliant on groundwater-dependent ecosystems. Lower groundwater levels could also affect riparian and wetland habitat and sensitive groundwater-dependent natural communities and wetlands.

Increased groundwater pumping from wells with diesel-powered pumps could generate additional greenhouse gas emissions and affect air quality. In addition, increased groundwater pumping from wells with diesel-powered pumps could result in emissions in excess of existing thresholds and could conflict with the state's long-term emission reduction trajectory.

Other Water Management Actions

In response to changes in Sacramento/Delta supply that would occur under the High Flow Alternative, water users may choose to modify their water supply portfolios by increasing the use of other sources of water and maximizing the use of existing water supplies. These other water management actions include: groundwater storage and recovery, water transfers, water recycling, and water conservation. Changes in Sacramento/Delta water supply from baseline conditions would be greater in magnitude under the High Flow Alternative than the changes that would occur under the proposed Plan amendments. Therefore, other water management actions that would occur as a result of changes in water supply would be greater under this alternative than the proposed Plan amendments.

Other water management actions could result in potentially significant impacts on the following resource areas: agriculture and forest resources, terrestrial biological resources, aquatic biological resources, energy, greenhouse gas emissions, hydrology and water quality (surface water and groundwater), and utilities and service systems. Specific impacts are discussed below and detailed comprehensively in Table F-3 in Appendix F, *Impact Summary Tables for Alternatives 1, 2, and 3,* and are further discussed in Sections 7.3 through 7.20. For example, changes in water supply could cause an increase in energy use to replace Sacramento/Delta supplies from actions such as increased water recycling, which requires electricity to produce. Other actions, such as water conservation, can have result in energy savings. Mitigation measures are also discussed in Sections 7.3 through 7.20.

Impacts from other water management actions under the High Flow Alternative would result in potentially significant impacts that would be greater than those under the proposed Plan amendments (e.g., more frequent, higher in magnitude, longer duration). Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Sections 7.3 through 7.20.

7.24.4.3 New or Modified Facilities

Implementation of the High Flow Alternative could result in reduced Sacramento/Delta water supplies, which could increase efforts to prioritize limited available supplies and lead to the development of other water supply sources. Response actions that could be undertaken by water users and other entities to expand water supplies include infrastructure projects involving construction such as new or modified reservoirs and points of diversion, new groundwater wells and groundwater storage and recovery projects, new or modified WWTPs for water recycling, and new or modified drinking water treatment facilities, including desalination facilities. Water users and other entities may also implement other actions in response to changes in hydrology and changes in water supply that would require construction activities, such as building new or modified boat ramps, installing streamflow or temperature monitoring devices to monitor and report compliance with instream flow and cold water habitat requirements, and developing agricultural water conservation projects such as canal lining and encasement. Other water management actions that involve construction of new or modification of existing infrastructure are described in detail and evaluated in Section 7.22, *New or Modified Facilities.*

Changes in Sacramento/Delta water supply from baseline conditions would be larger in magnitude under the High Flow Alternative than the changes that would occur under the proposed Plan amendments. Therefore, the increased use or accelerated development of new and modified facilities would be greater under this alternative than the proposed Plan amendments. Construction

of larger water supply projects (e.g., new storage reservoirs, desalination plants) that could occur as a response to changes in water supply would result in the same types of impacts as under the proposed Plan amendments, including potentially significant construction impacts on environmental resource areas, depending on site-specific locations.

Table 7.22-1 in Section 7.22, *New or Modified Facilities*, details impacts and mitigation measures, including impacts and mitigation measures from temporary construction impacts, from these types of actions. Impacts on the following resource areas would be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation, transportation and traffic, and utilities and service systems. The potential impacts would vary according to the type of project and site-specific conditions but could be potentially significant. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Table 7.22-1. The precise location and magnitude of new and modified facilities are not known. Unless and until such time that mitigation measures are implemented, the impacts would remain potentially significant.

7.24.4.4 Habitat Restoration and Other Ecosystem Projects

Similar to the proposed Plan amendments, the High Flow Alternative provides a framework that would allow stakeholders to implement complementary ecosystem projects in addition to flow requirements, and actions that other entities could take that would contribute to the overall goal of providing reasonable protection to fish and wildlife in the Sacramento/Delta watershed. These actions include physical habitat restoration projects as well as predation and invasive species control measures. In addition, the narrative cold water habitat objective would address tributary-specific temperature needs by requiring that cold water flows from reservoirs be maintained and timed to provide for downstream temperatures to protect salmon species at critical times of year, or that alternate protective measures are implemented to ensure that fish below dams are kept in good condition (consistent with Fish and Game Code section 5937). The cold water habitat objective could be implemented in part through certain construction projects such as reservoir temperature management facilities or fish passage facilities. These types of habitat restoration and other ecosystem projects are described in detail and analyzed in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*.

Under the High Flow Alternative, the impacts of habitat restoration and other ecosystem projects could be less than under the proposed Plan amendments if habitat restoration and other ecosystem projects are not implemented in the Sacramento/Delta watershed, or more if the higher numeric inflow requirement leads to an overall greater dependence on habitat restoration and other ecosystem projects to improve conditions for native fish. In either case, significance determinations would remain similar to those made for the proposed Plan amendments. Habitat restoration and other ecosystem projects would occur under the High Flow Alternative, and impacts would be potentially significant.

Table 7.21-1 in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, details impacts and mitigation measures, including impacts and mitigation measures from temporary construction impacts, from these types of actions. Impacts on the following resource areas would be potentially significant: aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, energy and greenhouse gas emissions, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, recreation,

transportation and traffic, and utilities and service systems. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Table 7.21-1. The precise location and magnitude of habitat restoration actions are not known. Unless and until such time that mitigation measures are implemented, the impacts would remain potentially significant.

7.24.4.5 Economic Effects

The estimation of economic effects of the High Flow Alternative are shown in the analysis of the 65 scenario and 75 scenario, and detailed results are presented in Chapter 8, *Economic Analysis and Other Considerations*. Based on SWAP results presented in Section 8.4.2, *Agricultural Economic Effects*, the High Flow Alternative could result in adverse economic effects on irrigated agriculture, and the effects would be higher compared to the proposed Plan amendments. In the Sacramento/Delta watershed, the loss of crop revenues would be expected to be approximately $90 to $775 million per year, or about 1-8 percent of total crop sales, based on SWAP average year model results. Most of the economic effects would be expected to fall on rice growers. Other crop types, including alfalfa, pasture, and almond production could also be affected. Modeling indicates that economic effects could be higher in the San Joaquin Valley with total revenues potentially reduced by up to 1.2 million per year, or up to nearly 5 percent of regional crop sales. The range of effects reflects available groundwater supply. Several crop types, including almonds and pistachios, cotton, wheat and other field crops, processing tomatoes, corn and other silage, and vegetables are estimated to account for much of the economic effects. In other regions that receive Sacramento/Delta export water, there may be additional economic effects on crop revenue, including to wine grapes, vegetables, deciduous orchards, and processing tomatoes.

Providers of agricultural services, food processors, and other farming-dependent industries such as dairies and livestock could be affected by changes in crop production in both the Sacramento/Delta and San Joaquin Valley, as discussed in Section 8.4. Economic effects on farming-dependent industries would be expected to be greater under the High Flow Alternative compared to the proposed Plan amendments.

Section 8.4.3, *Regional Economic Effects*, presents a regional economic analysis to estimate how changes in water supply and resulting changes at the local agricultural economy would affect regional economic activity in the Sacramento/Delta watershed and the State of California. The results show that most of the effects are concentrated in agriculture and related sectors, but some effects are distributed throughout other sectors in the regional economy. Detailed economic effects results are presented in Chapter 8, and the effects would be expected to be greater under the High Flow Alternative compared to the proposed Plan amendments.

The High Flow Alternative could result in water supply reductions to municipal water users. Section 8.5, *Municipal Water Supply Economic Effects*, estimates the potential costs to affected municipal service providers of securing reliable water supplies. Some municipal water providers in the study are could incur additional expenses in providing water to customers, and the total economic effect under the High Flow Alternative would be larger than under the proposed Plan amendments. Detailed results for estimated costs for municipalities to respond to reduced Sacramento/Delta supply are provided in Section 8.5.

Commercial and recreational fisheries would be expected to experience some positive economic effects under the High Flow Alternative as a result of beneficial environmental effects of higher flows in the winter and spring on native fish habitat. However, those effects would be diminished by

impacts from reduced reservoir storage needed for temperature management and maintaining minimum outflows during dry periods. Accordingly, the positive economic effects would likely be less than those of the proposed Plan amendments. Without adequate carryover storage, there could be significant challenges in maintaining suitable downstream water temperatures to support native cold water fish species such as Chinook salmon and steelhead.

7.24.4.6 Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The High Flow Alternative would establish water quality objectives and a program of implementation for the reasonable protection of fish and wildlife beneficial uses in the Sacramento/Delta watershed. The High Flow Alternative would provide additional flows that would be expected to provide ecosystem benefits consistent with the project purposes and goals. However, the beneficial environmental effects of the High Flow Alternative would be limited in many years due to significant challenges in maintaining suitable water temperatures for cold water aquatic species, as discussed above which would not be consistent with the project purposes and goals. The very significant water supply and related impacts may also not be reasonable which would be inconsistent with the project purposes and goals.

7.24.5 Modular Alternatives for Interior Flows/Fall Delta Outflow (Alternatives 4a, 4b, and 4c)

As discussed in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta,* the Bay-Delta Plan includes objectives in the interior Delta to protect fish and wildlife from impacts related to the operations of the SWP and CVP that limit exports and require closing of the Delta Cross Channel (DCC) gates at specified times. As described in more detail in Chapter 5 and Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*, the proposed Plan amendments (and other flow alternatives) would add restrictions on exports as a function of San Joaquin River flows (I:E), DCC gate requirements, Old and Middle reverse flow constraints, and fall Delta outflow requirements that are based on constraints from NMFS and USFWS BiOps and the CDFW ITP for the operations of the SWP and CVP.

Alternative 4 includes three modular alternatives that could modify the interior Delta flow and fall Delta outflow provisions of the proposed Plan amendments or the other flow alternatives. In recognition that it may not be necessary or supported to incorporate interior Delta flow and fall Delta outflow constraints that are addressed in BiOps and the ITP for the operations of the SWP and CVP in the Bay-Delta Plan, Alternative 4a (Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments) was developed to evaluate impacts if these provisions were removed from the proposed Plan amendments. Alternative 4b (Head of Old River Barrier Alternative) was developed in response to scoping comments and would require DWR and Reclamation to install the HORB during April and May, or similar measures to achieve equivalent benefits as the HORB, to protect outmigrating juvenile Chinook salmon and steelhead from the Lower San Joaquin River from entrainment and related impacts of exports. Alternative 4c (Extended Export Constraint Alternative) was also developed in response to scoping comments and would extend the export constraints based on San Joaquin River flows during the entire February through June period of the Lower San Joaquin River flow objectives adopted in 2018 to provide additional protection from export-related effects on juvenile fish species that are present in the interior Delta during the spring, including

outmigrating juvenile salmonids that are intended to be protected by the Lower San Joaquin River flow objectives adopted in 2018.

The analyses of modular alternatives below are focused on environmental impacts that may result in changes in hydrology and changes in water supply. The analyses below do not repeat impacts from response actions, including increased use of groundwater and other water management actions that entities may choose to take to offset reductions in Sacramento/Delta surface water supply. These other water management actions include increased use of groundwater, groundwater storage and recovery, water transfers, water recycling, and agricultural and municipal water conservation. The impacts of other water management actions are evaluated in Sections 7.3 through 7.20 for the proposed Plan amendments, and are also discussed above in Section 7.24.3 for the Low Flow Alternative and Section 7.24.4 for the High Flow Alternative. Increased use of groundwater and other water management actions could result in potentially significant impacts on multiple resource areas, and specific impacts and mitigation measures are discussed and detailed comprehensively in Sections 7.3 through 7.20. While Alternatives 4a, 4b, and 4c could result in changes in groundwater use and other water management actions if adopted in combination with the proposed Plan amendments or other flow alternative, these actions are still expected to occur in response to change in hydrology and water supply and would result in potentially significant impacts. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Sections 7.3 through 7.20. Similarly, the analyses below do not repeat impacts associated with construction of new or modified facilities and habitat restoration and other ecosystem projects as these are already evaluated under the stand-alone alternatives.

7.24.5.1 Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative (Alternative 4a)

The proposed Plan amendments and other flow alternatives include interior Delta flows and fall Delta outflow provisions that are based on BiOp and ITP provisions, including additional restrictions on exports as function of San Joaquin River flows (I:E), Old and Middle River reverse flow constraints, additional DCC gate closure requirements, and fall Delta outflow requirements that are based on constraints from NMFS and USFWS BiOps and the CDFW ITP for the operations of the SWP and CVP. As discussed in Chapter 5, the BiOps and ITP have changed since the 2018 Framework was released identifying the proposed Plan amendments. As also discussed in Chapter 5 the 2019 changes to the BiOps are under litigation and associated court orders and the BiOps and ITP are in the process of being updated further, in part to resolve the litigation. Those updates are expected to result in changes to interior Delta flow constraints. As described further in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta,* and Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*, the proposed Plan amendments (and other flow alternatives) include flexibility in the proposed Old and Middle River flow provisions that can provide for consistency with updated BiOp and ITP provisions as appropriate. The export constraints based on San Joaquin River flows included in the proposed Plan amendments and other flow alternatives, however, do not reflect removal of these constraints from the CVP. The DCC gate closure and fall Delta outflow provisions that are included in the proposed Plan amendments and other flow alternatives are consistent with the existing BiOps and ITP and are not expected to change significantly.

Alternative 4a (Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative) evaluates the effects of excluding the new interior Delta flow and fall Delta outflow components of the proposed Plan amendments and other flow alternatives that are based on BiOp

and ITP provisions. Because the Old and Middle River flow, DCC gate closure, and fall Delta outflow provisions of the proposed Plan amendments are largely consistent with current and expected future conditions, removal of these provisions would not be expected to result in substantial changes to Project operations. However, removal of the export constraints based on San Joaquin River inflows (I:E) could have a larger effect if those provisions are not maintained into the future. Accordingly, this alternative largely evaluates removal of the new I:E provisions from the proposed Plan amendments and other flow alternatives.

Changes in Hydrology

SacWAM results for changes in Delta outflows resulting from the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative are provided below for existing conditions and in combination with the proposed Plan amendments (55 scenario). The SacWAM results presented below show the potential effects on Delta outflow that could result from excluding the San Joaquin I:E requirement partially, which would occur if the San Joaquin I:E constraint was excluded from the BiOps but retained in the ITP for the SWP (SWP only San Joaquin I:E Requirement), or entirely, which could occur if the San Joaquin I:E constraint was excluded from both the BiOps and ITP (No San Joaquin I:E Requirement). Table 7.24-2 presents SacWAM modeled results for the change in average annual Delta outflow that could occur for the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative under existing conditions. Table 7.24-3 presents modeled results for the change in average annual Delta outflow that could occur for the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative in combination with the proposed Plan amendments (55 scenario) assuming these provisions are entirely removed for the CVP or both the CVP and SWP, which is unlikely to occur. It is expected that the reconsultation process for the BiOps and ITP will result in measures that avoid jeopardy to listed species that would result in smaller changes to Delta outflows than shown below. However, it is uncertain what those changes will be. Accordingly, the below analysis represents a conservative analysis that likely overestimates possible changes to Delta outflows. It is possible that the reconsultation process will not result in any significant changes in Delta outflows or lower changes than those identified below.

Table 7.24-2. SacWAM Results for Average Annual Delta Outflow (TAF): Baseline and Change from Baseline for Interior Delta Flow and Fall Delta Outflow Related Amendments Scenarios

Water Year Type	Baseline	Change from Baseline: SWP only San Joaquin I:E Requirement	Change from Baseline: No San Joaquin I:E Requirement
Critical	5,535	-21	32
Dry	7,439	-94	-130
Below Normal	10,657	-227	-379
Above Normal	18,005	-232	-450
Wet	28,714	-117	-221
All	15,489	-131	-218

Table 7.24-3. SacWAM Results for Average Annual Delta Outflow (TAF): 55 Scenario and Change from 55 Scenario for Interior Delta Flow and Fall Delta Outflow Related Amendments Scenarios

Water Year Type	55 scenario	Change from 55 scenario: SWP only San Joaquin I:E Requirement	Change from 55 scenario: No San Joaquin I:E Requirement
Critical	6,594	-3	-2
Dry	9,445	-25	-23
Below Normal	12,735	-60	-100
Above Normal	19,808	-172	-303
Wet	29,476	-86	-149
All	16,955	-65	-108

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would also be expected to possibly result in reduced Delta outflows if adopted in combination with the Low Flow Alternative or High Flow Alternative. The decrease in Delta outflows would be larger for the Low Flow Alternative than the High Flow Alternative.

Changes in Streamflows and Reservoir Levels

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would not require changes to streamflows. However, it is possible that reservoir operators in the Sacramento/Delta watershed could choose to modify reservoir storage and release operations in response to the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative, which could affect streamflows in some locations. These potential changes in reservoir operations and effects on tributary flows would be expected to be minor and within the range of conditions that would occur in the absence of this modular alternative. If implemented in combination with any of the flow alternatives, the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative could affect reservoir levels and the magnitude of streamflows at some times and some locations in the Sacramento/Delta watershed, but the types of impacts and significance determinations would remain similar to those made without the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative.

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative could also affect reservoir levels in export reservoirs and streamflows below export reservoirs as a result of changes in Delta exports, which could at times result in higher reservoir levels in export reservoirs and streamflows below reservoirs. If implemented in combination with any of the flow alternatives, the types of impacts and significance determinations associated with changes in export reservoir levels and streamflows below export reservoirs would remain similar to those made without the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative, but the impacts would be less.

Changes in Interior Delta Flows and Delta Outflows

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative could affect interior Delta flows and Delta outflows. In particular, this alternative could result in greater net flows toward south Delta Project pumping facilities during April and May. These changes could further alter migration cues and transport flows and lead to greater entrainment of native fish

species into the interior Delta, which could result in greater direct and indirect mortality of special-status species. Additionally, lower Delta outflows during April and May could have impacts on habitat quantity and quality for estuarine-dependent species. These changes in interior Delta flows and Delta outflows could have potentially significant impacts on biological resources, including native anadromous and estuarine fish species. Overall, these changes and associated impacts on biological resources could reduce some of the benefits of the proposed Plan amendments, Low Flow Alternative, or High Flow Alternative. However, it is expected that the reconsultation process for the BiOps and ITP will result in measures that avoid jeopardy to listed species that would result in smaller changes to interior Delta flows than indicated in the modeling. Accordingly, this analysis likely overestimates potential changes in interior Delta flows. It is possible that the reconsultation process will not result in any changes in interior Delta flows or smaller changes than indicated by the modeling.

Beneficial Environmental Effects

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would not result in beneficial environmental effects for native fish and wildlife in the Bay-Delta.

Changes in Water Supply

SacWAM results for changes in Delta exports resulting from the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative are provided below for existing conditions and the proposed Plan amendments (55 scenario). The SacWAM results presented below show the potential effects on Delta exports that could result from excluding the San Joaquin I:E Requirement partially, which would occur if the San Joaquin I:E constraint was excluded from the BiOps but retained in the ITP for the SWP (SWP only San Joaquin I:E Requirement), or entirely, which would occur if the San Joaquin I:E constraint was excluded from the BiOps and ITP (No San Joaquin I:E Requirement). Table 7.24-4 presents SacWAM modeled results for the change in average annual Delta exports that could occur for the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative under existing conditions. Table 7.24-5 presents modeled results for the change in average annual Delta exports that could occur for the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative under the proposed Plan amendments (55 scenario) It is expected that the reconsultation process for the BiOps and ITP will include provisions that will avoid jeopardy to listed species that would result in smaller increases in exports than indicated by the modeling. Accordingly, this analysis likely overestimates potential changes in exports. It is possible that the reconsultation process will not result in any changes in exports or smaller changes than indicated by the modeling.

However, it is uncertain what those changes will be. Accordingly, the below analysis represents a very conservative analysis that likely overestimates possible changes to Delta exports.

Table 7.24-4. SacWAM Results for Average Annual South of Delta Exports (TAF): Baseline and Change from Baseline for Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Scenarios

Water Year Type	Baseline	Change from Baseline: SWP only San Joaquin I:E Requirement	Change from Baseline: No San Joaquin I:E Requirement
Critical	2,890	59	46
Dry	4,570	151	215
Below Normal	5,113	181	345
Above Normal	5,436	229	427
Wet	6,432	117	210
All	5,068	141	237

Table 7.24-5. SacWAM Results for Average Annual South of Delta Exports (TAF): 55 Scenario and Change from 55 Scenario for Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Scenarios

Water Year Type	55 scenario	Change from Baseline: 55 scenario and SWP only San Joaquin I:E Requirement	Change from Baseline: 55 scenario and No San Joaquin I:E Requirement
Critical	2,329	-25	-32
Dry	3,095	69	70
Below Normal	3,783	152	230
Above Normal	4,437	129	266
Wet	6,035	67	116
All	4,156	76	122

The Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would also result in increased Delta exports if adopted in combination with the Low Flow Alternative or High Flow Alternative. The increase in Delta exports would be larger for the Low Flow Alternative than for the High Flow Alternative.

Overall, the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would lessen the reduction in Sacramento/Delta water supply that would occur as a result of the Sacramento/Delta update of the Bay-Delta Plan. If implemented in combination with the proposed Plan amendments or other flow alternative, the types of impacts and significance determinations would remain similar to those made without the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative, but the impacts from reduced Sacramento/Delta water supply would be less.

Economic Effects

As described above, this alternative could decrease the reductions in Sacramento/Delta water supply that would occur under the proposed Plan amendments or other flow alternatives. Chapter 8, *Economic Analysis and Other Considerations*, presents economic analyses, including economic modeling information, for various flow scenarios. If adopted in combination with the proposed Plan

amendments or other flow alternatives, the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative could reduce the economic effects on agriculture and on municipal water providers. However, exact changes depend on the outcomes of the reconsultation process on the BiOps and ITP.

Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1.1, *Introduction*. Overall, the Exclusion of Interior Delta Flow and Fall Delta Outflow Related Amendments Alternative would not further support the project purposes and goals related to the protection of fish and wildlife beneficial uses in the Sacramento/Delta watershed. However, it may be unnecessarily redundant, complex, and inefficient to include these provisions in the Bay-Delta Plan when similar provisions are included in the BiOps and ITP.

7.24.5.2 Head of Old River Barrier Alternative (Alternative 4b)

The Head of Old River Barrier (HORB) Alternative (Alternative 4b) could be combined with the proposed Plan amendments or Low or High Flow alternatives and would require DWR and Reclamation to install and operate a barrier in the spring to increase survival of outmigrating juvenile salmonids and in the fall to enhance adult migration. Historically, a spring barrier has been constructed as early as March 1, operated up to 60 days during April 1 through May 31, and removed by May 31; a fall barrier has been constructed any time after September 1 with removal by November 30. Construction and operation of HORB should be accompanied by fish and water quality monitoring studies. As part of this alternative, DWR and Reclamation could propose other measures to the State Water Board for approval that would achieve equivalent or better protection to migrating fish than HORB.

The construction of a seasonal barrier at the Head of Old River was required under the Central Valley Improvement Act Section 3406(b)(15) "to increase the survival of young out-migrating salmon" from the San Joaquin River that might be routed to the Old River corridor and ultimately entrained at the CVP and SWP diversion facilities. The spring HORB is installed to keep migrating San Joaquin River Chinook salmon in the mainstem San Joaquin River channel and away from the Old River that would expose fish to impacts from the SWP and CVP water diversions and predation in the interior Delta, and associated low survival. The fall HORB is installed to benefit migrating adult salmon by improving flow and dissolved oxygen conditions in the San Joaquin River corridor. While a seasonal barrier at the Head of Old River in the fall has been installed since 1968, the installation of a spring barrier began in 1992. The HORB was also included as part of the Vernalis Adaptive Management Program (VAMP) that was implemented as an experiment pursuant to D-1641 in lieu of implementation of the 1995 Bay-Delta Plan Lower San Joaquin River flow objectives for an interim period. However, the HORB installation was discontinued as part of the 2019 BiOp reconsultation process.

Alternative 4b would require installation and seasonal operation of the HORB for an interim period (10 years) and would require associated monitoring and experimental studies to further assess its effectiveness, including independent peer review to confirm the findings of those analyses. Under this alternative, if the HORB is found to be effective, operation of HORB could be required to be continued beyond the initial 10-year period. As part of this alternative, DWR and Reclamation could also propose a similar alternative and/or other complementing measures to the State Water Board for approval to protect the migrating fish that would achieve equivalent or greater benefits as the

HORB. This includes, for example, a non-physical barrier, a fish guidance structure, and habitat restoration and improvement projects (e.g., modifying the bathymetry of the scour hole near the Head of Old River) along the salmonid migration corridors in the south Delta that would facilitate fish migration and enhance survival.

Changes in Hydrology

Installation of the HORB under Alternative 4b would result in changes to flow routing and net flows in the Delta by affecting the routing or relative proportions of the San Joaquin River inflows to Old River and the mainstem San Joaquin River below the Head of Old River. These flow routing effects interact with operations of Project export facilities in the South Delta. When the HORB is closed in the spring, the export facilities are generally operated to capture unstored water flowing into the Delta that is not otherwise needed to meet water quality objectives, as opposed to export of previously stored water. When the HORB is closed in the fall, export operations are not subject to Old and Middle River reverse flow limitations that may limit opportunities to export previously stored water. Accordingly, installation of the HORB would not be expected to interact with operations of upstream facilities, such as Project reservoirs in the Sacramento/Delta Watershed.

Changes in Streamflows and Reservoir Levels

Because the HORB Alternative is not expected to affect operations of Project reservoirs upstream of the Delta, streamflows and reservoir levels in the Sacramento/Delta watershed upstream of the Delta are unlikely to change. Therefore, the HORB Alternative would not be expected to result in significant impacts related to changes in streamflows and reservoir levels within the Sacramento/Delta watershed.

Changes to Interior Delta Flows and Delta Outflows

Hydrodynamic effects of the HORB are described with the assumption that installation of agricultural barriers under the South Delta Temporary Barriers Project would continue. Flow patterns in the southern interior Delta are determined by operations of the CVP and SWP, tides, river inflows to the Delta, and the operations of the seasonal temporary barriers (NMFS ^2009 BiOp, 2018; DWR 2015). When the HORB is installed, San Joaquin River flows remain in the main channel of the San Joaquin River and flows from the San Joaquin River into Old River and toward the CVP and SWP export facilities are mostly blocked by HORB. Flows remaining in the mainstem San Joaquin River travel downstream and may be routed back to the southern Delta at Columbia Cut and Turner Cut channel junctions in the central Delta or continue to travel downstream to the confluence with the Sacramento River and contribute to Delta outflow.

The HORB reduces the effect of CVP and SWP operations on San Joaquin River flows and migrating salmonids at the head of Old River by blocking San Joaquin River flows and migrating fish from entering Old River and moving toward the CVP and SWP export facilities and poor habitats in the southern Delta. However, when HORB is in place, the force of CVP and SWP export operations is redirected from the head of Old River to Turner and Columbia cuts, which increases the effect of CVP and SWP export operations at these locations and the magnitude of OMR reverse flows, and therefore may increase to some degree the entrainment risk for Delta smelt, longfin smelt, and migrating salmonids in the east and Central Delta (^Kimmerer and Nobriga 2008). In years with substantial numbers of adult Delta smelt, longfin smelt, and migrating salmonids moving into the Central Delta, increases in flows moving toward the CVP and SWP southern Delta facilities can increase fish entrainment, especially larval and juvenile Delta smelt and Longfin smelt that are

vulnerable to the directional forces of these flows (^USFWS 2008 BiOp; DWR 2019). These effects would be expected to be limited to the spring, when sensitive species may be distributed in the Central Delta.

Under baseline conditions, the proposed Plan amendments, Low Flow Alternative, and High Flow Alternative, exports during April and May are maintained at or near minimum levels due to I:E constraints. Exports in these months are well below the levels that result when OMR reverse flow limits control exports in other months during the January through June period (Appendix A1, *Sacramento Water Allocation Model Methods and Results*). Exceptions occur when Delta inflows are high enough that I:E constraints do not apply, or allow higher export levels, at which times OMR reverse flow management is also unlikely to control export operations. Under these high flow circumstances, safety considerations have historically limited installation of the HORB.

Overall, the HORB Alternative would have small incremental effects on interior Delta flows toward the export facilities that would occur as a result of the Sacramento/Delta update of the Bay-Delta Plan.

Beneficial Environmental Effects

The area near the HORB functions primarily as a migratory corridor for adult and juvenile salmonids originating in the San Joaquin River watershed. HORB would be expected to primarily benefit the salmonid populations in the San Joaquin River basin. Operating HORB would be expected to direct migrating fish toward better migratory habitat with higher survival rates during their passage through the south Delta channels. HORB would result in juvenile salmonid migrating from the San Joaquin River basin staying in the mainstem San Joaquin River route at the HORB junction and preventing them from being entrained into the Old River corridor where they would be exposed to the CVP and SWP water pumping facilities and unfavorable habitat conditions with high predation rates. Installation of the physical barrier had a large effect on flows and fish routing at the Head of Old River (San Joaquin River Group Authority 2013; DWR 2015; Dodrill et al. 2022). Scientific research conducted using acoustic tagging of juvenile salmonids demonstrates that the HORB increased the level of protection for migrating juvenile salmonids and higher overall survival than without HORB installation (^NMFS 2012; Buchanan 2019; Buchanan et al. 2018, 2021).

Construction-Related Impacts

Impacts associated with construction of facilities like HORB are generally described in Chapter 7.22.2 and are consistent with descriptions of HORB construction activities (NMFS 2018). Specifically, the construction of HORB is expected to generate underwater noise from both terrestrial and underwater sources that would have short term impacts to native fish species in the vicinity and the placement of rock below the waterline is expected to cause physical disturbance that could displace juvenile and adult fish into adjacent habitats (NMFS 2018). However, construction would occur for a short time, only during daylight hours, and the repetitive frequency of noise from rocks being dumped would be managed to reduce the risk of accumulated sound levels and other risks experienced by the fish in the vicinity of the construction area. Construction activities in or near waterways could release sediment affecting water quality and macroinvertebrates which are prey for fish and other aquatic species. Water quality impairments such as increased turbidity can negatively affect aquatic species and habitats, however HORB would not expected to increase turbidity levels to deleterious levels (NMFS 2018).

Changes in Water Supply

For the reasons described in the discussion of changes in hydrology, the HORB alternative is unlikely to affect water supply. If implemented in combination with the proposed Plan amendments or another flow alternative, the types of impacts and significance determinations would remain similar to those made without the HORB Alternative.

Economic Effects

As described above, if adopted with any of the proposed Plan amendments or Low or High Flow alternatives, this provision would not be expected to result in additional reductions in Delta exports or Sacramento/Delta water supplies relative to baseline. Chapter 8, Economic Analysis and Other Considerations, presents economic analyses including economic modeling information for the proposed Plan amendments and other flow alternatives. If adopted, the HORB alternative would not be expected to increase the economic effects on agriculture and municipal water providers. Commercial and recreational fisheries could experience a positive economic effect of the HORB alternative by increasing survival of fall-run Chinook, a commercial and recreational fishery.

Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The HORB Alternative could increase survival of migrating San Joaquin River salmonids and other native species during the fall and spring by improving habitat conditions in the San Joaquin River migratory corridor for, and improving survival and condition of, out-migrating juveniles and up-migrating adults, which would support several of the project purposes and goals related to protection of fish and wildlife beneficial uses in the Sacramento/Delta watershed.

7.24.5.3 Extended Export Constraint (Alternative 4c)

Under Alternative 4c (Extended Export Constraint Alternative), the San Joaquin River flow-based export constraints would be expanded and extended to provide for improved protection of migrating San Joaquin River salmonids and other native species. This alternative would modify the San Joaquin export constraint portion of the proposed Plan amendments or other flow alternatives, but otherwise would not modify these alternatives. Under the current Bay-Delta Plan, exports are limited to 100 percent of the flow of the San Joaquin River at Vernalis or 1,500 cubic feet per second, whichever is larger, during the San Joaquin River 31-day pulse flow period of roughly April 15 through May 15 of each year. This constraint is referred to as the *inflow-to-export objective* or *I:E objective*. As discussed in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta,* under the proposed Plan amendments, the existing I:E objective would be made consistent with the 2020 ITP extended to the CVP, which requires limited exports of 25 to 100 percent of San Joaquin River flows based on water year type from April 1 through May 31. The proposed Plan amendments provide flexibility to shift the 61-day window to apply at any time during the February through June San Joaquin River flow and spring pulse flow period to maximize protection for fish species, if agreeable to NMFS and CDFW.

Under the Extended Export Constraint Alternative, the export constraints would be expanded to cover the entire San Joaquin River spring and spring pulse flow period of February through June to provide for expanded and enhanced protection of migrating San Joaquin River salmonids and other native species by providing more natural outflow conditions from the San Joaquin River to the Delta

and San Francisco Bay. As discussed in more detail in Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, currently, a significant portion of the San Joaquin River is diverted at the export facilities, resulting in altered flow patterns and inhospitable conditions for native fish species in the Delta and migrating in the San Joaquin River. This modular alternative would be expected to provide for improved, more natural flow patterns to benefit native species. However, this alternative would also result in significant additional water supply impacts that may not be reasonable.

Changes in Hydrology

Overall, extending the San Joaquin I:E Requirement for the entire February through June period would result in increased Delta outflows under both existing conditions and in combination with the proposed Plan amendments, Low Flow Alternative, or High Flow Alternative. These changes would be expected to provide beneficial environmental effects on native anadromous and estuarine fish species that rely on habitat in the Delta, but these changes would also result in environmental impacts. The following paragraphs highlight impact mechanisms and impacts and beneficial environmental effects of the Extended Export Constraint Alternative.

Changes in Streamflows and Reservoir Levels

The Extended Export Constraint Alternative would not require changes to streamflows. However, it is possible that reservoir operators in the Sacramento/Delta watershed could choose to modify reservoir storage and release operations in response to this Alternative, which could also affect streamflows in some locations. The potential effects on reservoir operations and tributary flows would be minor and within the range of conditions that would occur without the Extended Export Constraint Alternative. If implemented in combination with the proposed Plan amendments or other flow alternatives, the Extended Export Constraint Alternative could affect reservoir storage levels and the magnitude of streamflows at some times and some locations in the Sacramento/Delta watershed, but the types of impacts and significance determinations would remain similar to those made without the Extended Export Constraint Alternative.

The Extended Export Curtailment Alternative could also affect reservoir levels in export reservoirs and streamflows below export reservoirs as a result of reduced Delta exports. These changes could result in potentially significant impacts because of reservoir drawdown or fluctuations beyond historical levels. For example, reservoir level changes may result in exposure of more unvegetated ground; expose previously inundated cultural resources to increased wave action, erosion, and human activity; and affect boat ramp accessibility affecting recreation opportunities. Changes in reservoir levels could exacerbate existing water quality issues associated with reservoirs, including bioaccumulation of methylmercury in fish and production of harmful algal blooms in some locations. In addition, changes in streamflow below export reservoirs could affect habitat for special-status terrestrial species, which could result in potentially significant impacts. If implemented in combination with any of the stand-alone alternatives, the types of impacts and significance determinations resulting from changes in export reservoir levels and streamflows below export reservoirs would remain similar to those made without the Extended Export Constraint Alternative, but the impacts would be greater.

Changes in Interior Delta Flows

The Extended Export Constraint Alternative could also affect interior Delta flows. While changes in Delta interior flows and Delta exports would generally benefit native anadromous and estuarine

fish, as discussed below under *Beneficial Environmental Effects*, this alternative could also increase residence time of water in interior Delta channels under some conditions, which could affect harmful algal bloom production and increase the presence of invasive aquatic vegetation at times. This could lead to impacts on surface water quality in interior Delta channels. If implemented in combination with the proposed Plan amendments or other flow alternative, the impacts and significance determinations related to changes in interior Delta flows would remain similar to those made without the Extended Export Constraint Alternative, but certain water quality impacts could be greater at times.

Beneficial Environmental Effects

The Extended Export Constraint Alternative could provide for expanded and extended protection of migrating San Joaquin River salmonids and other native species during February through June by providing more natural outflow conditions from the San Joaquin River to the Delta and San Francisco Bay. As discussed in more detail in Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, currently, a significant portion of the San Joaquin River is often diverted at the export facilities, resulting in unnatural flow patterns and inhospitable conditions for native fish species in the Delta and migrating in the San Joaquin River. This alternative would be expected to provide for improved, more natural flow patterns to benefit native fish species. The Export Constraint Alternative could also result in beneficial environmental effects on hydrodynamics in the Delta by reducing net flows toward south Delta Project pumping facilities at times. This could result in beneficial habitat and migratory conditions for estuarine and anadromous fish in the Delta.

Changes in Water Supply

Overall, the Extended Export Constraint Alternative would result in reduced water supply for agricultural, municipal, and wildlife refuge uses. These effects would primarily occur in areas receiving Sacramento/Delta water supplies that are exported from the Delta to the San Francisco Bay Area, Central Coast, San Joaquin Valley, and southern California. However, some changes in Sacramento/Delta water supply are also possible within the Sacramento/Delta watershed.

Under the Extended Export Constraint Alternative, Sacramento/Delta agricultural, municipal, and refuge water supplies would be reduced, which could result in potentially significant impacts. For example, reduced agricultural supplies could lead to changes in distribution of crop types and acreage and conversion of farmland to nonagricultural use. Reduced Sacramento/Delta supply to wildlife refuges and agricultural lands could affect habitat for special-status terrestrial species, and could decrease the amount of habitat available for resident and migratory waterfowl and shorebirds. Reduced Sacramento/Delta supply to municipal uses and indoor water conservation could lead to a decrease in the production in wastewater and an increase in chemical constituent concentrations in WWTP influent and effluent. Changes in water supply source could result in temporary exceedances of maximum contaminant levels in municipal water supply. Changes in water supply could result in the use of other lower quality water supply courses that also affect WWTP influent and effluent, leading to construction to modify or expand existing treatment facilities. If implemented in combination with the proposed Plan amendments or other flow alternatives, the types of impacts and significance determinations would remain similar to those made without the Extended Export Constraint Alternative, but the impacts would be greater and could be more concentrated in areas that receive Sacramento/Delta supplies exported from the Delta.

Economic Effects

As described above, if adopted in combination with any of the stand-alone alternatives, this provision would result in additional reductions in Sacramento/Delta water supplies. Chapter 8, *Economic Analysis and Other Considerations*, presents economic analyses, including economic modeling information for the proposed Plan amendments and other flow alternatives. If adopted, the Extended Export Constraint Alternative would increase the economic effects on agriculture and to municipal water providers. However, commercial and recreational fisheries would likely experience a positive economic effect of the Extended Export Constraint Alternative provision.

Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The Extended Export Constraint Alternative could provide for expanded and enhanced protection of migrating San Joaquin River salmonids and other native species during February through June by providing more natural outflow conditions from the San Joaquin River to the Delta and San Francisco Bay, which would support several of the project purposes and goals related to protection of fish and wildlife beneficial uses in the Sacramento/Delta watershed. However, the water supply impacts of this alternative would be very significant and may not be considered reasonable, particularly in combination with the water supply impacts from the flow alternatives.

7.24.6 Modular Drought Alternatives (Alternative 5a and 5b)

During the adoption of the 2018 Bay-Delta Plan, the State Water Board directed staff to evaluate drought-related measures in the Sacramento/Delta update of the Bay-Delta Plan. Consistent with this direction and to address the issue of limited water supplies during dry periods, the modular drought alternatives include two possible implementation provisions that could be applied as part of the proposed Plan amendments, other flow alternatives, or the proposed VAs, during dry periods, such as declared drought emergencies, to address limited water supplies for meeting flow-based water quality objectives and related requirements. During all drought years since the 1995 Bay-Delta Plan was implemented, there have been difficulties meeting flow-based water quality objectives, and associated TUCPs have been submitted by the Projects requesting modification of terms of the CVP and SWP water right permits and licenses included in D-1641, including requirements to meet Delta outflow, salinity requirements, and other requirements.

The modular drought alternatives include two possible variations, including an Instream Flow Protection Provision and a Shared Water Shortage Provision. Alternative 5a (Instream Flow Protection Provision) would build upon recent drought-related curtailments under emergency regulations that required water right holders to curtail their water diversions when no water was available at their priority of right. Alternative 5b (Shared Water Shortage Provision) would require all water users in the Sacramento/Delta watershed to conserve water during times of drought in order to contribute toward meeting the Bay-Delta Plan objectives, including instream flows, cold water habitat, and salinity control.

Analyses in the subsections below are largely focused on environmental impacts that may result in changes in hydrology and changes in water supply. The analyses below do not repeat impacts from response actions, including increased use of groundwater and other water management actions that entities may choose to take to offset reductions in Sacramento/Delta surface water supply. These

other water management actions include increased use of groundwater, groundwater storage and recovery, water transfers, water recycling, and agricultural and municipal water conservation. The impacts of other water management actions are evaluated in Sections 7.3 through 7.20 for the proposed Plan amendments. They are also discussed above in Section 7.24.3 for the Low Flow Alternative; Section 7.24.4 for the High Flow Alternative; and Chapter 9, *Proposed Voluntary Agreements*, for the proposed VAs. Increased use of groundwater and other water management actions could result in potentially significant impacts on multiple resource areas, and specific impacts and mitigation measures are discussed and detailed comprehensively in Sections 7.3 through 7.20. While Alternatives 5a and 5b could result in changes in groundwater use and other water management actions if adopted in combination with the proposed Plan amendments, other flow alternatives, or proposed VAs, these actions are still expected to occur in response to changes in hydrology and water supply and would result in potentially significant impacts. Impacts can be avoided or reduced by implementation of the mitigation measures indicated in Sections 7.3 through 7.20. Similarly, the analyses below do not repeat impacts associated with construction of new or modified facilities and habitat restoration and other ecosystem projects, as these are already evaluated under the stand-alone alternatives.

7.24.6.1 Instream Flow Protection Provision (Alternative 5a)

Currently, pursuant to D-1641, DWR's water rights for the SWP and Reclamation's water rights for the CVP are conditioned on meeting Delta flow-dependent water quality objectives included in the Bay-Delta Plan. At times, DWR and Reclamation meet the flow and water quality objectives by bypassing flows and releasing previously stored water, or reducing Delta diversions. When natural and abandoned flows are inadequate to meet Delta flow and water quality requirements, diversions by other water users can also result in the need for the Projects to release previously stored water to meet water quality requirements. During drought conditions, these quantities of water can be significant and can deplete reservoir storage supplies needed for multiple purposes, including meeting water quality and temperature requirements later in the same year or in following years.

To protect previously stored Project water and to prevent water users from diverting natural flows contributing to Delta flow and water quality requirements, the State Water Board included Term 91 in the permits and licenses of the most junior water diverters in the Delta watershed. Term 91 provides for the State Water Board to curtail water diversions when the Projects are required to release previously stored water to meet Delta flow and water quality requirements and other in-basin (within the Delta watershed) non-Project demands, referred to as *supplemental Project water*. Term 91 effectively prevents water right holders subject to the term from diverting the Projects' stored water and makes those users partially responsible for bypassing natural and abandoned flows needed to meet Delta flow-dependent water quality objectives.

Term 91 has been in use for over 40 years. However, Term 91 currently applies only for a very small number (115) of the roughly 17,000 water rights and claims of right in the Delta watershed, which significantly limits the effectiveness of these curtailments. To address water supply shortages during drought for other users, this modular alternative would expand a Term 91–type approach to other more senior water right holders and claimants.

Expansion of a Term 91–type approach has been evaluated by the State Water Board in the past, including in the December 2021 Staff Workshop on Possible Alternative Approaches to Address Water Supply Shortages in the Delta Watershed, November 1999 Environmental Impact Report for the implementation of the 1995 Bay-Delta Plan, and a 2012 report from the State Water Board's

Delta Watermaster. Expansion of a Term 91–type approach would reduce the need for the Projects to release previously stored water to meet the existing Bay-Delta Plan objectives. Instead, other diverters in addition to the Projects would need to bypass natural flows until the objectives are met. The Projects would still have initial responsibility for bypassing flows to meet the objectives, but if more water was needed, others would also need to bypass flows. This could reduce or eliminate the need for the Projects to release previously stored water, which could reduce or avoid instances where TUCPs are submitted by the Projects during drought and drought recovery periods that request modifications of Delta outflow, salinity, and other requirements in the Bay-Delta Plan.

Changes in Hydrology

The Instream Flow Protection Provision would require water diverters in addition to DWR and Reclamation to bypass water needed to meet existing water quality objectives during drought circumstances, similar to existing standard water right Term 91. Although this provision would not establish new or revised flow or water quality objectives, the Instream Flow Protection Provision Alternative could affect streamflows and reservoir levels at certain times and locations, as discussed below.

Changes in Streamflows and Reservoir Levels

The Instream Flow Protection Provision Alternative has the potential to affect reservoir levels and streamflows in some locations in the Sacramento/Delta watershed. Streamflows could increase at times in some locations, including in reaches downstream of diversions that would be required to bypass water when this provision is in effect. However, streamflows could decrease at times in other locations, such as in reaches downstream of reservoirs that would have released additional supplemental Project water to meet Delta flow-dependent water quality objectives during times of water shortage in the absence of this provision. Similarly, the Instream Flow Protection Provision Alternative could result in higher reservoir levels at times in some locations in the Sacramento/Delta watershed, and lower reservoir levels at times in some locations. However, these changes in reservoir operations and effects on tributary flows would be expected to be within the range of conditions that would occur in the absence of this modular alternative.

Overall, the Instream Flow Provision could result in changes in streamflow and reservoir levels at times in some locations. If implemented in combination with the proposed Plan amendments, other flow alternatives, or proposed VAs, the Instream Flow Protection Provision Alternative could affect reservoir levels and streamflows at some times and some locations in the Sacramento/Delta watershed, but the types of impacts and significance determinations would remain similar to those made without the Instream Flow Protection Provision Alternative.

Beneficial Environmental Effects

The Instream Flow Protection Provision Alternative would be expected to benefit native fish and wildlife when this provision is in effect during specified drought conditions by requiring that all water right holders and claimants contribute to meeting Delta flow-dependent water quality objectives, which would be expected to reduce the use of TUCPs and associated impacts to fish and wildlife. This alternative could also help to avoid temperature management concerns below Project reservoirs.

Changes in Water Supply

Expansion of a Term 91–type approach would require other diverters in addition to the Projects to bypass natural and abandoned flows until the Delta flow-based water quality objectives are met. The Instream Flow Protection Provision could reduce the use of TUCPs and as such reduce to some degree the total amount of surface water available for diversion within the Sacramento/Delta watershed at times. However, the magnitudes of these water supply effects are already encompassed in the modeling for baseline which does not assume use of TUCPs. This provision could also reduce to some degree the water supply impacts to the Projects and their contractors and to carryover storage in Project reservoirs which may redistribute water supply impacts to some degree for other individual diverters during drought conditions. However, regardless of inclusions of this Alternative, there could still be drought related curtailments that could have similar effects, as occurred in 2021 and 2022.

Overall, changes in water supply could occur at times and in some locations under the Instream Flow Protection Provision Alternative, and could result in potentially significant impacts on certain water users, including more junior water diverters that do not currently have Term 91 in their water rights. If implemented in combination with the proposed Plan amendments or other flow alternatives, or proposed VAs, the Instream Flow Protection Provision Alternative could result in reduced water supplies for individual water users at times during drought conditions, but the types of impacts and significance determinations would remain similar to those made without the Instream Flow Protection Provision Alternative.

Economic Effects

The Instream Flow Protection Provision is a modular drought alternative that could help to address meeting Delta water quality and flow objectives and maintaining cold water storage during drought. Chapter 8, *Economic Analysis and Other Considerations*, presents economic analyses, including economic modeling information, for the proposed Plan amendments and other flow alternatives. Economic analyses for the proposed VAs are presented in Chapter 9, *Proposed Voluntary Agreements*. Some individual water users could experience reductions in Sacramento/Delta surface water supplies when this provision is in effect, which could result economic effects for agricultural and municipal water users. However, as discussed above these impacts are already assumed under the baseline which does not include use of TUCPs. Further, the economic effects of drought would exceed the economic effects of this provision.

Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The Instream Flow Protection Provision would help to avoid the use of TUCPs and may help to maintain cold water storage in Project reservoirs which would be expected to further the project purposes and goals related to protection of fish and wildlife beneficial uses.

7.24.6.2 Shared Water Shortage Provision (Alternative 5b)

Under the Shared Water Shortage Provision, all water right holders and claimants (except *de minimis* users) in the Sacramento/Delta watershed would be required to conserve water under drought conditions (including declared drought emergencies) in order to contribute toward meeting the Bay-Delta Plan objectives, including instream flow, cold water habitat, and salinity control

requirements. This provision would specify that all water users have an obligation to contribute toward meeting water quality and flow objectives. Under this alternative, all water right holders and claimants would be required to reduce their consumptive use of water by a specific percentage (e.g., 20 percent) to contribute toward instream flows under drought conditions. The flow contributions would be required to remain instream and would be unavailable for diversion by other users. This provision would be expected to help avoid TUCPs and degraded environmental conditions during drought and reduce concentrating water supply–related impacts on a smaller number of users.

Changes in Hydrology

The Shared Water Shortage Provision would require all diverters in the Sacramento/Delta watershed to conserve water in order to contribute toward meeting Bay-Delta Plan objectives. However, this provision would not establish additional Bay-Delta Plan objectives. As such, the effects of the Shared Water Shortage Provision Alternative on streamflows and reservoir levels would be limited. However, the Shared Water Shortage Provision Alternative could affect streamflows and reservoir levels at certain times and locations, as discussed below.

Changes in Streamflows and Reservoir Levels

The Shared Water Shortage Provision has the potential to affect reservoir levels and streamflows to some degree in some locations when this provision is in effect during droughts. Streamflows could increase in some stream reaches in the Sacramento/Delta watershed below diversions that would be required to conserve water in order to contribute to instream flow. However, streamflows could decrease in other stream reaches below diversions that would have been fully curtailed or required to bypass additional flow to satisfy the needs of downstream senior water right holders and claimants during times of water shortage in the absence of this provision. These changes would occur at times when the Shared Water Shortage Provision is in effect during drought periods.

Similarly, the Shared Water Shortage Provision could result to some degree in higher reservoir levels at times in some reservoirs in the Sacramento/Delta watershed, including those associated with junior water rights that may have otherwise been fully curtailed under drought conditions in the absence of this provision. However, the Shared Water Shortage Provision Alternative could result in lower reservoir levels at times in some reservoirs, including reservoirs in the Sacramento/Delta watershed associated with more senior water rights and claims that would not be required to conserve water or contribute to instream flow in the absence of this provision.

Overall, changes in reservoir levels and streamflows could occur at times and in some locations when the Shared Water Shortage Provision is in effect during droughts, but the types of impacts and significance determinations would be expected to be similar under the alternatives this alternative could be combined with.

Beneficial Environmental Effects

The Shared Water Shortage Provision would be expected to result in beneficial environmental effects on native fish and wildlife when this provision is in effect during drought conditions by requiring that all water right holders and claimants in the Sacramento/Delta watershed conserve water and contribute to instream flows. This provision would help to avoid TUCPs and could result in improved cold water storage in Project reservoirs for downstream fisheries protection.

Changes in Water Supply

Because the Shared Water Shortage Provision Alternative would require all water right holders and claimants in the Sacramento/Delta watershed to conserve water in order to contribute toward meeting the Bay-Delta Plan objectives, this provision would distribute the effects of Sacramento/Delta surface water supply shortages among a larger group of surface water diverters when this provision is in effect under drought conditions (including during declared drought emergencies). This would help to reduce concentrated water supply shortage effects on specific surface water diverters who would have been fully curtailed in the absence of this provision. However, the Shared Water Shortage Provision Alternative could result in water supply impacts on certain surface water diverters who would otherwise not be required to conserve water in order to contribute toward meeting the Bay-Delta Plan objectives in the absence of this provision.

Overall, changes in Sacramento/Delta water supply could occur at times when the Shared Water Shortage Provision is in effect and could result in potentially significant impacts. If implemented in combination with the proposed Plan amendments, other flow alternatives, or proposed VAs, the Shared Water Shortage Provision Alternative could affect Sacramento/Delta water supplies to individual water users, but the types of impacts and significance determinations would remain similar to those made without the Shared Water Shortage Provision.

Economic Effects

The Shared Water Shortage Provision could help to reduce TUCPs and low carryover storage and distribute water supply limitations more broadly during drought. If adopted, some individual water users would experience reductions in Sacramento/Delta surface water supplies, which could result economic effects for agriculture and municipal water users. However, the economic effects of drought would exceed the economic effects of this provision.

Achievement of Project Purpose and Goals

The purpose and goals of the project are described in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*. The Shared Water Shortage Provision would help to avoid the use of TUCPs and may help to maintain cold water storage which would be expected to further the project purposes and goals related to protection of fish and wildlife beneficial uses.

7.24.7 Environmentally Superior Alternative

CEQA requires a discussion of the environmentally superior alternative. If that alternative is the no project alternative, the environmental document shall also identify an environmentally superior alternative among the other alternatives. (Cal. Code Regs., tit. 14, § 15126.6(e).) In considering the selection of the environmentally superior alternative, this Staff Report evaluates which alternatives result in fewer significant impacts relative to the other alternatives.

The State Water Board adopts water quality control plans as part of a certified regulatory program under CEQA (Pub. Resources Code, § 21080.5, subd. (b)(2); Cal. Code Regs., tit. 23, § 3775 et seq.). These programs are exempt from CEQA's requirements for preparing an environmental impact report, negative declaration, and initial study (Pub. Resources Code § 21080.5; Cal. Code Regs., tit. 14, § 15251, subd, (g)). The purpose of the project, as elaborated in Section 7.1.2, *California Environmental Quality Act*, is to establish water quality objectives and a program of implementation for the reasonable protection of fish and wildlife beneficial uses in the Sacramento/Delta watershed.

Fundamentally, the project is a restoration project that is intending to improve aquatic habitat conditions in the broad geographic area of the Sacramento/Delta watershed from current impaired and declining conditions. Implementation of the proposed Plan amendments is expected to benefit aquatic biological resources that are associated with healthy rivers, healthy estuaries, and a functioning watershed.

Although required flows would be higher under the High Flow Alternative compared to the proposed Plan amendments and would provide potentially greater ecosystem benefits, overall beneficial environmental effects under the High Flow Alternative would be limited due to significant challenges in maintaining suitable water temperatures for cold water aquatic species and carryover storage for environmental and water supply purposes with the higher flows. In addition, compared to baseline conditions, impacts from changes in hydrology and supply that would occur under the High Flow Alternative would generally be larger in magnitude compared with the changes that would occur under the proposed Plan amendments. Under the Low Flow Alternative, impacts from changes in hydrology and supply would generally be smaller in magnitude than the changes that would occur under the proposed Plan amendments. At the same time, many of the beneficial environmental effects under the Low Flow Alternative would be more limited compared to those under the proposed Plan amendments. Compared to the proposed Plan amendments, this alternative would be expected to be less effective at meeting the project's fish and wildlife protection goals.

Although the primary purpose of the project is to improve and protect fish and wildlife beneficial uses, CEQA requires the identification of impacts compared to baseline existing conditions, which in this case is an impaired aquatic habitat condition. Nevertheless, increases in flows and associated impacts on water supply could potentially have negative effects on the environment at certain times and in specific locations. When determining the environmentally superior alternative the benefits of the alternatives must be weighed against the impacts. In terms of benefits, among the proposed Plan amendments and other flow alternatives, the proposed Plan amendments would be the environmentally superior alternative at this time.

The State Water Board is also considering proposed VAs for updating the Bay-Delta Plan from various water users in the watershed, including DWR and Reclamation, as well as CDFW, the California Natural Resources Agency, and the California Environmental Protection Agency. Consistent with State Water Board Resolution 2018-0059 adopting the 2018 amendments to the Bay-Delta Plan, the State Water Board is considering the proposed VAs as an approach that could provide a possible path forward for updating the Bay-Delta Plan. The proposed VAs include a combination of proposed flow and habitat restoration measures on a portion of the Sacramento/Delta tributaries. Measures, which would run for 8 years with the possibility of extension, include varying amounts of increased flows, depending on water year type, and non-flow habitat restoration actions targeted at improving spawning and rearing capacity for juvenile salmonids, estuarine species, and other native fish and wildlife. The proposed VAs identify that there would be a regulatory pathway that would apply to VA tributaries in the event that VAs are discontinued. The draft Staff Report identifies the flows and cold water habitat measures included in the proposed Plan amendments as the regulatory pathway under the proposed VAs alternative. This draft Staff Report also identifies that this regulatory pathway would apply to non-VA parties as well.

Under the proposed VAs, impacts from changes in hydrology and supply would be smaller in magnitude and geographic scope than the changes that would occur under the proposed Plan

amendments. In many instances, the VAs would have no impact or less-than-significant impacts where the proposed Plan amendments would have potentially significant impacts.

Focusing on potential environmental impacts related to hydrology and water supply, the proposed VAs therefore could be viewed as the environmentally superior alternative, although the improvements in flows would be more limited than under the proposed Plan amendments. The proposed VAs also include physical habitat restoration that is expected to contribute toward the goal of improving conditions for native fish and wildlife. Based on public comments on this draft Staff Report, peer review of the VA Scientific Basis Report Supplement, and other relevant information, the State Water Board will refine the determination of the environmentally superior alternative for the final Staff Report.

7.24.8 References Cited

7.24.8.1 Common References

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