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Managing Water in the West

Long-Term Plan to Protect Adult Salmon in the Lower Klamath River

Humboldt County, California

Draft Environmental Impact Statement

U.S. Department of the Interior
Bureau of Reclamation

October 2016

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Draft Environmental Impact Statement Long-Term Plan to Protect Adult Salmon in the Lower Klamath River

United States Department of the Interior
Bureau of Reclamation, Northern California Area Office
16349 Shasta Dam Blvd.
Shasta Lake, CA 96019

This Draft Environmental Impact Statement (EIS) for the Long-Term Plan to Protect Adult Salmon in the Lower Klamath River has been prepared by the U.S. Department of the Interior, Bureau of Reclamation, Northern California Area Office, consistent with requirements of the National Environmental Policy Act (NEPA). Cooperating agencies pursuant to NEPA are the Hoopa Valley Tribe, Karuk Tribe, Klamath Tribes, Yurok Tribe, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Bureau of Indian Affairs, California Department of Fish and Wildlife, Humboldt County, and the San Luis & Delta-Mendota Water Authority.

This Draft EIS describes the potential environmental effects of the No Action Alternative and the action alternatives to augment flows in the lower Klamath River to reduce the likelihood, and potentially reduce the severity, of any Ichthyophthirius multifiliis (Ich) epizootic event that could lead to an associated fish die-off in future years.

In accordance with NEPA review requirements, this Draft EIS will be circulated for public and agency review and comment for a 45-day period following the date when the U.S. Environmental Protection Agency publishes the notice of availability in the Federal Register. Written comments from the public, reviewing agencies, and stakeholders will be accepted throughout the public comment period, which ends on December 5, 2016. Comments can be emailed to BOR-SLO-sha-ltpeis-public-comments@usbr.gov or mailed to Julia Long, Bureau of Reclamation, Northern California Area Office, 16349 Shasta Dam Blvd., Shasta Lake, CA 96019. A public hearing will be held to solicit and receive public input on the Draft EIS. Comments received during the public comment period will be considered in the development of the Final EIS.

For further information, please contact Julia Long, Project Manager, at the address above, via telephone at (530) 276-2044, or by e-mail at jlong@usbr.gov.

Executive Summary

In conformance with the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508), and Department of Interior (DOI) Regulations (43 CFR Part 46), the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the lead agency, prepared this Environmental Impact Statement (EIS) to evaluate and disclose potential environmental impacts associated with implementing the Long-Term Plan to Protect Adult Salmon in the Lower Klamath River (LTP). The proposed action is to increase lower Klamath River flows to reduce the likelihood, and potentially reduce the severity, of any fish die-off in future years due to crowded holding conditions for pre-spawn adults, warm-water temperatures, and the presence of disease pathogens—which are likely the major factors contributing to adult mortalities.

Background and History

In September 2002, an unforeseen and unprecedented fish die-off occurred during a two-week period in the lower Klamath River. A subsequent U.S. Fish and Wildlife Service (USFWS) report indicated that of the approximately 34,000 anadromous salmonids estimated to have perished during this event, nearly all (98.4 percent) were adult salmonids. Of this total, 97 percent were fall-run Chinook Salmon, 1.8 percent were steelhead, and 1 percent were Coho Salmon. The two fish disease pathogens leading to the die-off were identified as *Ichthyophthirius multifiliis* (Ich) and *Flavobacter columnare* (Columnaris). High fish densities—due to the relatively large run size (approximately 170,000 adult Chinook Salmon), low flows, and relatively high water temperatures—were identified as causative factors for the rapid spread of disease. Although a larger number of Klamath River fall-run Chinook Salmon died, a greater proportion of the Trinity River run was lost because the die-off occurred during the peak migration of the Trinity River fish. Since 2002, Reclamation has been working with stakeholders to protect fall-run Chinook Salmon returning to the Klamath and Trinity Rivers.

Since the large-scale die-off of 2002, heightened concern over a disease outbreak and related large-scale adult salmon mortalities re-emerged, due to forecasted and observed fisheries and hydrologic conditions during 2003, 2004, 2012, 2013, 2014, 2015, and 2016. In response to this concern, Reclamation provided augmentation flows during these years to improve fishery conditions in the lower Klamath River. As shown in Figure ES-1, the volume of the augmentation flows ranged from 17.5 thousand acre-feet (TAF) in 2013 to 64 TAF in 2014, with an average volume of approximately 40 TAF. No large-scale adult salmon mortalities have occurred since 2002. During this time, Reclamation collaborated with tribes, regulatory agencies, and other basin partners, and consulted with water and power users, to develop and refine monitoring and flow augmentation criteria.

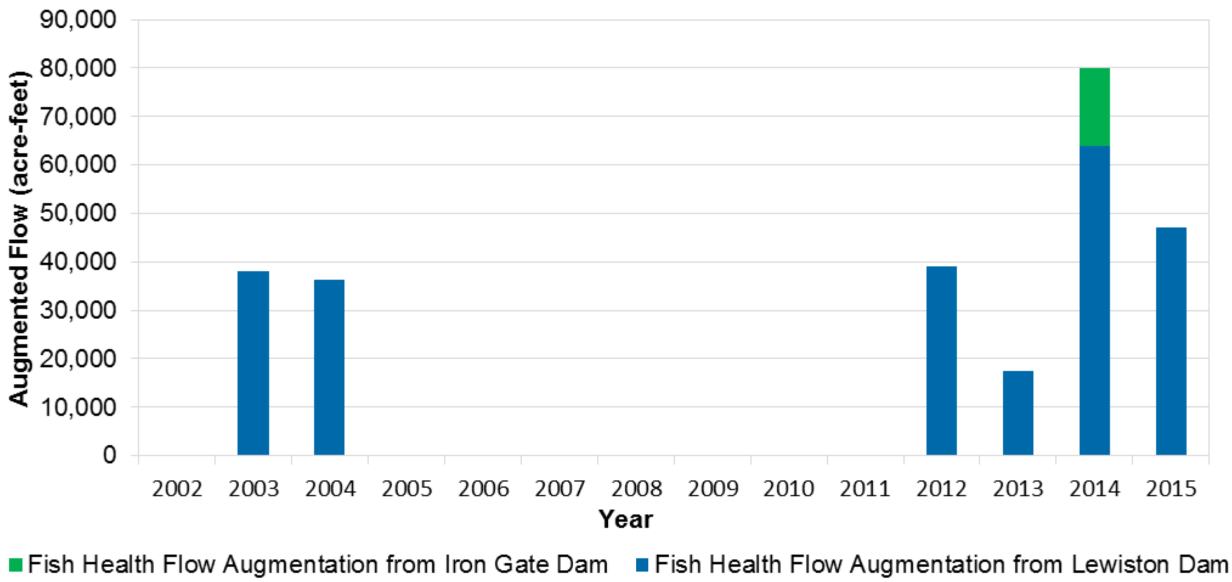


Figure ES-1. Flow Augmentation Releases Made by Reclamation and PacifiCorp from 2003 to 2015 to Reduce the Prevalence of Fish Disease in the Lower Klamath River

Development of the Draft Long-Term Plan for Protecting Late-Summer Adult Salmon in the Lower Klamath River

In response to the need for augmentation flows in the past several years, the indication that such flows may be needed in future years, and competing environmental and water supply demands for Trinity River Division (TRD) of the Central Valley Project (CVP) water supplies, Reclamation started developing the *Draft Long-Term Plan for Protecting Late-Summer Adult Salmon in the Lower Klamath River* (Draft LTP) in 2013. An initial Draft LTP was provided to key stakeholders on December 31, 2014. Reclamation received comments from tribes, fisheries agencies, water users, power users, and other stakeholders. The Draft LTP was revised and released to the public on April 17, 2015. Reclamation continues to refine the flow augmentation actions, processes, and monitoring that were identified in the Draft LTP, as outlined in this EIS.

Scoping Process

The EIS scoping process was initiated on July 14, 2015, with publication of the Notice of Intent (NOI) in the Federal Register. To date, Reclamation has held scoping, cooperating agency, and tribal information meetings, to inform the public and interested stakeholders about the project, and to solicit comments and input on this EIS. Comments received during the scoping process have covered a range of topics, including potential impacts to address in the EIS and suggested alternatives, many of which have come from cooperating agencies. The cooperating agencies for this EIS are the Hoopa Valley Tribe, Karuk Tribe, Klamath Tribes, Yurok Tribe, USFWS, National Marine Fisheries Service (NMFS), Bureau of Indian Affairs (BIA), California Department of Fish and Wildlife (CDFW), Humboldt County, and the San Luis & Delta-Mendota Water Authority.

Alternatives

Alternatives were developed to meet the Purpose and Need for the project, which is to reduce the likelihood, and potentially reduce the severity, of any Ich epizootic event that could lead to an associated fish die-off in future years. The need is based on the past extensive fish die-off in 2002.

Alternatives Development Process

During the alternatives development process, a number of alternatives or measures were identified and evaluated, in consideration of input received during the public scoping process. In determining which alternatives would be carried forward, Reclamation considered how effectively the alternatives would meet the Purpose and Need, including Reclamation's ability to implement the alternatives as necessary (potentially as early as August 2017). Specifically, Reclamation considered the alternatives' ability to address one or more of the significant contributing factors to Ich epizootic events. To be viable, alternatives need to have the capability of meaningfully and substantially reducing the likelihood—and potentially reducing the severity—of any Ich epizootic event that could lead to an associated fish die-off.

No Action Alternative

The No Action Alternative represents future conditions without implementation of the proposed action, and the resulting environmental effects from taking no action. Under the No Action Alternative, Reclamation would not implement flow augmentation actions to supplement flows in the lower Klamath River.

The No Action Alternative assumes continued implementation of existing projects, plans, ecosystem restoration projects (e.g., Trinity River Restoration Program), land or resource management plans, water supply management and wastewater facilities, flood management facilities, and recreational facilities. The No Action Alternative assumes future conditions such as climate change and sea-level rise, the development of lands in accordance with general plans in areas served by CVP water supplies, and continued operation of the CVP to the year 2030. The No Action Alternative also includes PacifiCorp operating their Klamath Hydroelectric Project under the current annual license, with the dams remaining in place.

Proposed Action (Alternative 1)

The Proposed Action (Alternative 1) includes supplemental flows from Lewiston Dam to prevent a disease outbreak in the lower Klamath River in years when the river's flow is projected to be less than 2,800 cubic feet per second (cfs). The water for these supplemental flows would come from water stored in Trinity Reservoir, to support "appropriate measures for the preservation and propagation of fish and wildlife" (Proviso 1) with releases of "not less than 50,000 acre-feet" for Humboldt County and downstream water users (Proviso 2), as provided in the 1955 Trinity River Division Act.

Flow Augmentation Components

The Proposed Action is comprised of three different flow augmentation components to be implemented as needed in a phased approach, based on environmental (e.g., flow) and biological conditions. The three components include: (1) a preventive base flow release that intends to increase the base flow of the lower Klamath River to 2,800 cfs, from mid-August to late

September, to improve environmental conditions; (2) a one-day 5,000 cfs preventive pulse flow to be used as a secondary measure, to alleviate continued poor environmental conditions and to respond to signs of Ich infection in the lower Klamath River; and (3) a five-day, 5,000 cfs emergency pulse flow, to be used on an emergency basis as a tertiary treatment, to avoid a significant die-off of adult salmon when the first two components of the Proposed Action are not successful at meeting their intended objectives. Reclamation would implement these flow augmentation components in coordination with Federal, State, and tribal resource specialists, including fisheries biologists and pathologists (i.e., LTP Technical Team).

Preventive Base Flow Augmentation Initiate preventive base flow augmentation from Lewiston Dam when one or more of the following conditions occur:

- Flow in the lower Klamath River is projected to be less than 2,800 cfs at the Klamath, California gage in August and September.
- Ich infection of adult salmon or steelhead is identified in July and early August, suggesting a low-level infection is present that could worsen with poor environmental conditions.
- Thermal regime of the lower Klamath River is inhibitory to the upstream migration of infected adult salmon.
- High densities of Chinook Salmon and steelhead are holding in the lower Klamath River.

In coordination with the LTP Technical Team, Reclamation will initiate preventive base flow augmentation releases by August 22 to meet the target flow (2,800 cfs) in the lower Klamath River, if the fish harvest metric above is not met. Reclamation will continue flow augmentation to target a flow of 2,800 cfs in the lower Klamath River, as measured at the Klamath, California gage through September 21. The LTP Technical Team would continue to implement fish pathology monitoring to determine the potential need for the secondary flow augmentation action (i.e., preventive pulse flow).

Preventive Pulse Flow During the preventive base flow period, a preventive pulse flow—targeting a rate of 5,000 cfs for one 24-hour period at the Klamath, California gage—would occur when the peak fall-run migration (typically the first or second week of September) is identified in the lower Klamath River, as indicated by fish density. This enhanced flow level, based on 2015 experience, intends to use a small volume of water to provide a change to the environmental conditions of the lower Klamath River, further reducing the Ich infection risk. Conditional release of this pulse flow requires confirmed low-level infections of Ich (less than 30 Ich per gill arch) on three fall-run adult salmon (of a maximum sample size of 60 fish), captured in the lower Klamath River in one day during typical peak migration, subject to LTP Technical Team review.

Emergency Pulse Flow Augmentation Initiate an emergency flow release to target a flow of 5,000 cfs in the lower Klamath River, for up to five days in August or September, if these emergency conditions exist as identified by USFWS and NMFS:

- Diagnosis of severe Ich infection of gills (30 or more parasites on a gill arch) in 5 percent or greater of a desired sample of 60 adult salmonids confirmed by the USFWS' California/Nevada (CA/NV) Fish Health Center, or
- Observed mortality of greater than 50 dead adult salmonids in a 20 kilometer reach in 24 hours, coupled with the confirmed presence of Ich by the USFWS CA/NV Fish Health Center.

Annual Implementation Process

The annual implementation process, beginning in late March, outlines a month-by-month process to determine: whether augmentation flows are required in a given year; which water source(s) would be used for augmentation flows; and, to finalize and implement augmentation flows. Table ES-1 presents the process by month that Reclamation would follow.

Table ES-1. Annual Implementation Schedule for Alternatives 1 and 2

Timeframe	Actions
March through May	1. Reclamation obtains Klamath Basin accretion forecasts from NOAA California Nevada River Forecast Center 2. Reclamation develops projections for lower Klamath River flows through September, based on: NOAA accretion forecast, 2013 USFWS and NMFS Klamath Project Biological Opinion release requirements from Iron Gate Dam; tribal boat dance flows (even years in the Klamath River, and odd years in the Trinity River); and the Trinity River ROD flows from Lewiston Dam 3. Reclamation assesses environmental conditions and the applicability of augmentation criteria in collaboration with tribes and resource agencies 4. Reclamation assesses hydrologic conditions (current and projected) and water supply allocations in the CVP 5. Reclamation coordinates with the USFWS, CDFW and NMFS
May through July	1. Reclamation collaborates with tribes, CVP water and power users, regulatory agencies, and other key stakeholders for additional input 2. The LTP Technical Team continues to assess environmental conditions and the need for augmentation flows[1] 3. Reclamation refines the augmentation flow regime, if applicable 4. Reclamation coordinates with Humboldt County on potential use of their Contractual Right for preventive and emergency flow actions
August through September	1. Preventive flow augmentation is implemented, if needed 2. The LTP Technical Team conducts monitoring, evaluates data and conditions, and determines the need for supplemental actions; including preventive pulse flow and emergency pulse flow augmentation[1]
October through December	1. The LTP Technical Team convenes to review and document outcomes from the year's activities

Notes:
[1] The LTP Technical Team would consist of Federal, State, and tribal resource specialists, including fisheries biologists or pathologists.

Key:
CDFW = California Department of Fish and Wildlife
CVP = Central Valley Project
NMFS = National Marine Fisheries Service
NOAA = National Oceanic and Atmospheric Administration
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
ROD = Record of Decision
LTP = Long-Term Plan to Protect Adult Salmon in the Lower Klamath River
USFWS= U.S. Fish and Wildlife Service

Monitoring and Research

Monitoring and research efforts will include both essential monitoring actions (e.g., monitoring required to measure the flow augmentation component triggers, such as Ich infestation level), as well as additional monitoring and research actions, to inform potential refinement of flow augmentation trigger criteria.

Essential Monitoring Actions The following required essential monitoring actions evaluate if the specific criteria have been triggered for the three flow augmentation components. Essential monitoring actions would be performed annually, including:

- **Flow and Water Temperature –** Real-time flow and water temperature data would be obtained from existing U.S. Geological Survey stream gages along the Klamath and Trinity Rivers.
- **Fish Density Including Estuary Counts –** The Yurok Tribe would collect harvest and catch effort data for the estuary. In addition, other methods for determining fish densities will be developed through research and monitoring actions.
- **Fish Health Monitoring (Ich) –** Monitoring and assessment of salmon and steelhead for the presence of Ich would be conducted along the lower Klamath River during late-summer and fall months (July through October).

Potential Additional Monitoring and Research Actions and Flow Component Trigger Criteria Refinement As part of the Proposed Action, additional monitoring and research actions would be conducted—furthering scientific understanding of causative factors of Ich infection and outbreak in the lower Klamath River. Based on the concept of adaptive management, and utilizing additional scientific information on causative factors, Reclamation may refine trigger criteria for the three flow components (i.e., preventive base flow augmentation, preventive pulse flows, and emergency pulse flow augmentation) to further reduce the likelihood—and potentially the severity—of any Ich epizootic event. The process for potential refinement of flow component trigger criteria will be based on adaptive management principles, as follows:

- Develop hypotheses and conceptual models to identify potential causative factors (e.g., identification of relationships between salmon and environmental conditions—including pathogens—between ecological processes and potential management actions).
- Develop and refine performance measures related to reducing the likelihood of Ich epizootic events and associated fish die-offs.
- Collect and evaluate relevant data and other information pertaining to physical and biotic components of the Klamath River system, salmon performance, pathogen presence, and Ich infestation.
- Propose modifications to flow augmentation trigger criteria that would decrease the likelihood—and potentially the severity—of Ich epizootic outbreaks.

- Recommend implementation of additional monitoring and research programs to examine how selected management actions meet performance measures.

The purpose of adaptive management is to allow for mid-course corrections that can be taken to better manage flow as new information becomes available. For example, the flow target of 2,800 cfs could be modified through an adaptive management approach, as could the frequency of flow augmentation actions. While it is likely that adjustments in flow may lead to using less water as causative factors become better understood, it is also possible that additional flow may be necessary. Reclamation would prepare supplemental environmental documentation, as necessary, as changes to the flow augmentation actions are contemplated based on new information gained through adaptive management.

Alternative 2 – Trinity River ROD Flow Rescheduling Alternative

The Trinity River Record of Decision (ROD) provides for annual instream flows below Lewiston Dam according to the recommendations provided in the Trinity River Mainstem Fishery Restoration Final EIS/Environmental Impact Report (EIR). The Trinity River ROD Flow Rescheduling Alternative (Alternative 2) includes supplemental flows from Lewiston Dam, to prevent a disease outbreak in the lower Klamath River, in years when the river's flow is projected to be less than 2,800 cfs. Supplemental flows would come sequentially from water stored in Trinity Reservoir, primarily through modifying the pattern of releases (i.e., rescheduling) for Trinity River ROD flows. If rescheduling of Trinity River ROD flows is insufficient to meet flow augmentation requirements, water would be released pursuant to authorities provided in the 1955 Trinity River Division Act, including Provisos 1 and 2. The supplemental flows would involve the same three components described for the Proposed Action (Alternative 1), including preventive base flow augmentation, preventive pulse flow, and emergency pulse flow augmentation.

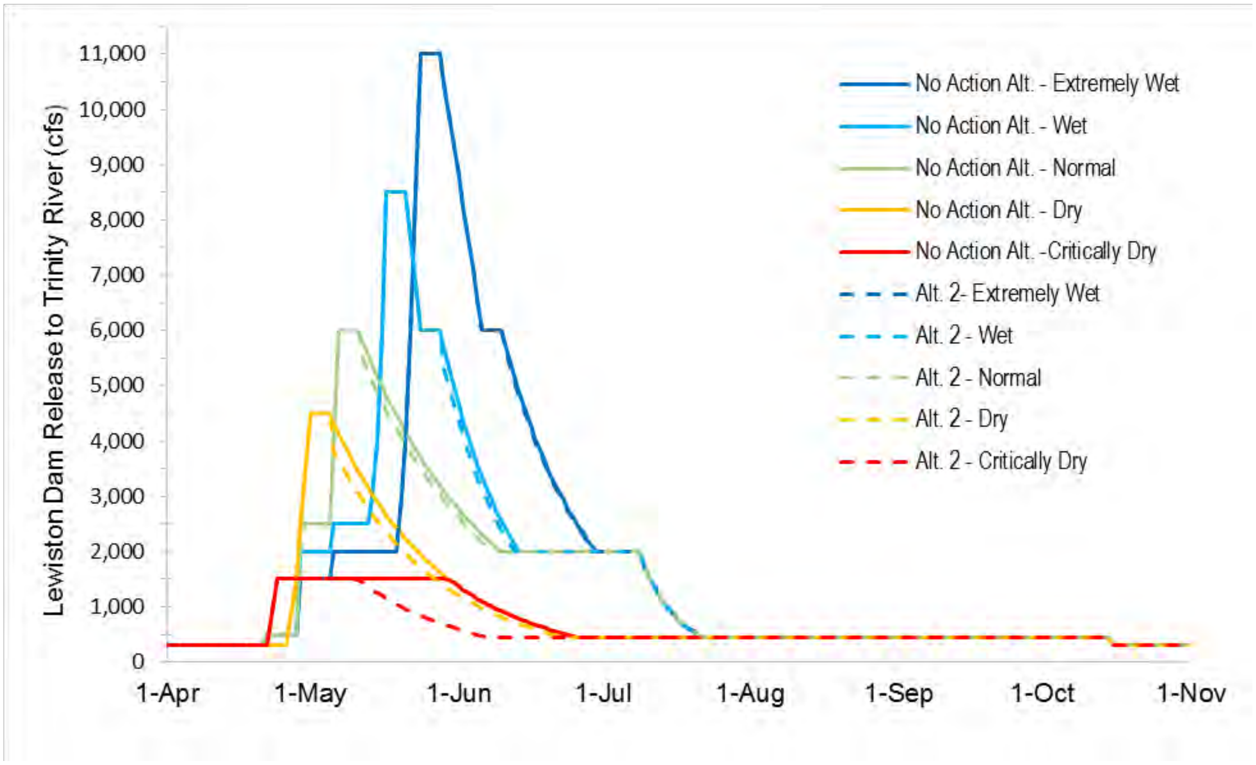
Under Alternative 2, Trinity River ROD flow releases would be reduced in earlier months to reserve a portion of the total release volume, to meet the estimated need for supplemental flows later in the season. Table ES-2 identifies the volume of water, based on the Trinity River ROD year type, to be rescheduled for release in August and September for flow augmentation.

Table ES-2. Trinity River ROD Flow Volumes by Water Year Type

Water Year Classification	Total Trinity Reservoir Inflow for Water Year Classification[1] (acre-feet)	Total Volume of Trinity River ROD Flows[1] (acre-feet)	Volume Rescheduled for Alternative 2[2] (acre-feet)
Extremely Wet	>=2,000,000	815,000	3,228
Wet	1,350,000-1,999,999	701,000	7,593
Normal	1,025,000-1,349,999	647,000	10,536
Dry	650,000-1,024,999	453,000	23,476
Critically Dry	<650,000	369,000	33,261

Notes:
[1] As described in the 2000 *Final Trinity Mainstem Fishery Restoration Environmental Impact Statement/Report*
[2] Volumes reflect average estimated preventive base flow augmentation by year type based upon CalSim inputs
Key:
ROD = Record of Decision

Figure ES-2 shows how the pattern of Trinity River ROD flows would be rescheduled during each year type, by reducing the flows early in the year to provide a reserve for release in August and September for flow augmentation. The Trinity Management Council will continue to guide the Adaptive Environmental Assessment and Management Program, recommending possible adjustments to the annual flow schedule (within the designated flow volumes provided in Table ES-2) to ensure that the restoration and maintenance of the Trinity River anadromous fishery continues, based on the best available scientific information and analysis.



Key:
Alt = Alternative

Figure ES-2. Rescheduling of Trinity River ROD Flow Release Pattern for All Year Types Under Alternative 2

The annual implementation schedule for Alternative 2 would be the same as described for the Proposed Action (Alternative 1). Monitoring and research actions would be the same as those described for the Proposed Action (Alternative 1).

Issues to be Resolved

Principle among the issues that will be resolved in choosing a preferred alternative is how and what water will be used to meet any additional flows released into the Trinity River and subsequently the lower Klamath River. Another issue is the use of available science to guide the release of water, to inform the development and implementation of an effective adaptive management strategy, and to identify potential mitigation for impacts associated with implementing the preferred alternative. Reclamation has not yet chosen a preferred alternative, and will consider comments received on the Draft EIS, in conjunction with the impact analysis contained in the Draft EIS, when making a decision.

The Trinity River ROD provides for adjustments to the annual flow schedule within the designated flow volumes approved by the Trinity Management Council. If Reclamation were to approve Alternative 2 as the preferred alternative, an issue was raised regarding Reclamation's ability to implement Alternative 2. Specifically, the issues are Reclamation's ability to modify the annual flow schedule by reducing the flows early in May and June to provide a reserve for release in August and September, and the subsequent disposition of unused water.

Areas of Controversy

Tribal, Federal, State, and local stakeholders have identified several areas of controversy during public and stakeholder outreach activities. The areas of controversy are: scientific uncertainty regarding causative factors of Ich outbreaks and potential fish die-off; associated flow augmentation trigger criteria; and selection of water sources for flow augmentation, including the use of Trinity River ROD flows.

Impact Analysis

Both Alternatives 1 and 2 have the ability to meet the Purpose and Need, though each alternative would require coordination from a host of agencies and interested parties to implement. Though both alternatives have similar environmental effects, the main differences between the alternatives are the effects on CVP water deliveries, temperature effects in the Trinity and Sacramento Rivers, and the effects to hydropower generation. In general, in some drier years, Alternative 1 would reduce CVP water deliveries by up to 24 TAF, while Alternative 2 would reduce those same deliveries by about 6 TAF. Both alternatives could lead to water temperature changes in the mainstem of the Trinity River, with Alternative 1 having effects primarily in July through December while Alternative 2 would have effects on water temperature in April through July. Alternative 1 would also have effects on water temperatures in the Sacramento River, which could affect various life stages for Chinook Salmon in critical years. In addition, both alternatives would change hydropower generation, with Alternative 1 having the maximum decrease in TRD energy production of 9.8 gigawatt-hours in critical years. Details of these differences are provided in each EIS resource chapter, and are summarized below in Table ES-3.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Surface Water Supply and Management	
Trinity River Lewiston Dam flow releases to the Trinity River would increase in August and September in all year types with a maximum increase of 115% in September of critically dry years. In addition, due to reduced spills, Trinity River flows below Lewiston Dam would decrease by 10% in November of extremely wet years, 10% in October of critically dry years, and 7% in February of normal years. Lewiston Dam flow releases would be similar to the No Action Alternative during other months and year types (less than a 5% change).	*Trinity River* Lewiston Dam flow releases to the Trinity River would increase in August and September in all year types with a maximum increase of 132% in September of critically dry years. Reductions in Lewiston Dam releases occur in most year types in May and June with the larger reductions in the drier years (up to 38% reduction in June of critically dry years). In addition, due to reduced spills, Trinity River flows below Lewiston Dam decrease by 8% in November of extremely wet years and 6% in February of normal years. Lewiston Dam flow releases would be similar to the No Action Alternative during other months and year types (less than a 5% change).
Trinity Lake storage would be similar to the No Action Alternative, with 4% or less change in all months and year types with the maximum change of a 4% decrease in September of critically dry years.	Trinity Lake storage would be similar to the No Action Alternative, with 4% or less change in all months and year types with the maximum change of a 4% increase in June of critically dry years.
Trinity Lake elevation would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months and year types.	Effects would be comparable to Alternative 1.
Long-term average TRD diversions from Lewiston Reservoir to the Sacramento Basin would be reduced by 13 TAF per year.	Long-term average TRD diversions from Lewiston Reservoir to the Sacramento Basin would be reduced by less than 1 TAF per year
Lower Klamath River Flows in the lower Klamath River, at Klamath, would increase in August and September in most year types with a maximum increase of 69% in September of critically dry years. In all other months and year types, changes were 1% or less.	*Lower Klamath River* Flows in the lower Klamath River, at Klamath, would increase in August and September in most year types with a maximum increase of 69% in September of critically dry years. Flows would be reduced in May and June of dry and critically dry years, with reductions up to 9% in June of critically dry years. In all other months and year types, changes were 1% or less.
Clear Creek, Sacramento River, Feather River, American River, and Stanislaus River Storage levels in Whiskeytown Lake, Shasta Lake, Lake Oroville, Folsom Lake, and New Melones Lake would be similar to the No Action Alternative with changes less than, or equal to, 2% in all months and year types.	*Clear Creek, Sacramento River, Feather River, American River, and Stanislaus River* Effects would be comparable to Alternative 1.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Surface Water Supply and Management (contd.)	
Clear Creek, Sacramento River, Feather River, American River, and Stanislaus River	*Clear Creek, Sacramento River, Feather River, American River, and Stanislaus River*
Water elevation levels in Whiskeytown Lake, Shasta Lake, Lake Oroville, Folsom Lake, and New Melones Lake would be similar to the No Action Alternative with changes less than 1% in all months and year types.	Effects would be comparable to Alternative 1.
Flows in Clear Creek, and the Sacramento, Feather, American, and Stanislaus Rivers, downstream of CVP and SWP dams, would be similar to the No Action Alternative with changes less than, or equal to, 5% in all months of all year types, except for increases in Feather River flows of 6% in critical years.	Effects would be comparable to Alternative 1.
Sacramento-San Joaquin Delta Inflow and Outflow	*Sacramento-San Joaquin Delta Inflow and Outflow*
Sacramento River inflow to the Delta, San Joaquin River inflow to the Delta, and Delta outflow would be similar to the No Action Alternative with changes of less than 1% in all months of all year types.	Effects would be comparable to Alternative 1.
Old and Middle River Flow (OMR)	*Old and Middle River Flow (OMR)*
OMR conditions would be similar to the No Action Alternative in all months of all year types with reductions up to 3%, except for increases of 6% in June of critical years.	OMR conditions would be similar to the No Action Alternative in all months of all year types with reductions up to 2%, except for increases of 6% in June of critical years.
Jones (CVP Exports) Pumping Plant	*Jones (CVP Exports) Pumping Plant*
Exports at Jones Pumping Plant would be similar to the No Action Alternative with changes less than, or equal to, 3% in all months of all year types, except for reductions of 7% in June of critical years.	Exports at Jones Pumping Plant would be similar to the No Action Alternative with changes less than, or equal to, 4% in all months of all year types.
Total CVP Deliveries	*Total CVP Deliveries*
Long-term average CVP water deliveries would be similar to the No Action Alternative with changes in all year types of less than 1%, with an average reduction of 13 TAF. This represents reductions of 22 TAF in critical years, 24 TAF in dry years, 13 TAF in below normal years, 4 TAF in above normal years, and 4 TAF in wet years.	Total CVP water deliveries would be similar to the No Action Alternative with changes to all contractors in all year types of less than 1%, with an average increase of 1 TAF. Changes by year type range from an increase of 4 TAF in above normal years to a decrease of 6 TAF in critical years.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Surface Water Quality	
Trinity River and Lower Klamath River	*Trinity River and Lower Klamath River*
The number of days in compliance with the temperature objectives for the Trinity River under the NCRWQCB Basin Plan and SWRCB Order WR-90-5 would decrease by approximately 1% (from 93% to 92% of the time) compared to the No Action Alternative.	The number of days of compliance with the temperature objectives for the Trinity River under the NCRWQCB Basin Plan and SWRCB Order WR-90-5 would be comparable to the No Action Alternative (both Alternative 2 and No Action Alternative would meet objectives 93% of the time).
The number of days that Trinity River temperatures below Lewiston Dam would meet temperature objectives identified in the Trinity River ROD would be similar to the No Action Alternative (both Alternative 1 and No Action Alternative would meet objectives 99% of the time).	Effects would be comparable to Alternative 1.
The number of days that Trinity River temperatures at Weitchpec would meet temperature objectives identified in the Trinity River ROD would be similar to the No Action Alternative (both Alternative 1 and the No Action meet objectives 69% of the time).	The number of days that Trinity River temperatures at Weitchpec would meet temperature objectives identified in the Trinity River ROD would decrease by approximately 2% in comparison to the No Action Alternative (from 69% to 67% of the time).
Water temperatures in the Trinity River would be similar to the No Action Alternative, with most months of the year changing by less than 1%. Exceptions occur in July (up to 5% increase) of critically dry years in the upper sections of the river; August (up to 4% decrease) of critically dry, dry and normal years); and September (3 to 9% decrease) of critically dry, dry and normal years).	Water temperatures in the Trinity River would be similar to the No Action Alternative, with most months of the year changing by less than 1%. Exceptions occur in June (up to 2% increase) of critically dry years; August (up to 4% decrease) of critically dry, dry and normal years); and September (3 to 9% decrease) of critically dry, dry and normal years).
Water temperatures in the lower Klamath River would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions occur in August (reductions of 2%) in critically dry and normal years, and in September (reductions of 3% to 6%) of critically dry, dry, and normal years.	Effects would be comparable to Alternative 1.
Nutrient concentrations, organic matter concentrations, and dissolved oxygen in the lower Klamath River would be similar to the No Action Alternative during most months and year types. Lower nutrient and organic matter concentrations are anticipated in August and September during flow augmentation actions, particularly in drier years.	Effects would be comparable to Alternative 1.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Surface Water Quality (contd.)	
Sacramento River and Clear Creek Water temperatures on the Sacramento River below Clear Creek, and at Balls Ferry, Jellys Ferry, and Bend Bridge, would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%. Water temperatures on Clear Creek at Igo would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	*Sacramento River and Clear Creek* Effects would be comparable to Alternative 1.
Delta Salinity and X2 Position X2 Position and salinities in the Delta at Rock Slough, Emmaton, Jersey Point, Collinsville, and at Banks and Jones Pumping Plants would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	*Delta Salinity and X2 Position* Effects would be comparable to Alternative 1.
Groundwater Resources/Groundwater Quality	
Groundwater use and elevation, land subsidence, and groundwater quality would be similar to the No Action Alterative for all year types except critical years. In portions of the Sacramento and San Joaquin Valleys, reduced surface water deliveries could increase demands on groundwater and potentially adversely impact groundwater use and elevation, groundwater levels, subsidence and water quality.	No effects on groundwater resources/groundwater quality. Groundwater use and elevation, land subsidence, and groundwater quality would be similar to the No Action Alterative for all year types.
Biological Resources – Fisheries	
Klamath and Trinity Rivers and Trinity Lake Coho Salmon, Spring-run Chinook Salmon, Fall-run Chinook Salmon, and Steelhead Late-summer pulse flows could increase juvenile stranding for Coho Salmon, spring-run Chinook Salmon and steelhead, and spring-run Chinook salmon holding and redd dewatering.	*Klamath and Trinity Rivers and Trinity Lake* Coho Salmon, Spring-run Chinook Salmon, Fall-run Chinook Salmon, and Steelhead Effects would be comparable to Alternative 1.
Water temperatures meet the temperature objectives for adult migration, juvenile rearing, and outmigration in a similar pattern as the No Action Alternative, with the difference in the number of days exceeding the objectives at less than 5 percent.	Water temperatures meet the temperature objectives for adult migration, juvenile rearing, and outmigration in a similar pattern as the No Action Alternative, with the difference in the number of days exceeding the objectives at less than 2 percent. Spawning and adult migration would not be affected by changes in fall temperatures under Alternative 2.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	**Alternative 2 Compared to the No Action Alternative**
Biological Resources – Fisheries (contd.)	
Klamath and Trinity Rivers and Trinity Lake Coho Salmon, Spring-run Chinook Salmon, Fall-run Chinook Salmon, and Steelhead Rearing habitat availability high up on alluvial bars would be similar to the No action alternative	*Klamath and Trinity Rivers and Trinity Lake* Coho Salmon, Spring-run Chinook Salmon, Fall-run Chinook Salmon, and Steelhead Habitat availability high up on alluvial bars (used by fry and juvenile salmonids for rearing) would be similar under Alternative 2 compared to the No Action Alternative, except for approximately two weeks during May and June in critically dry years. Low recession rates would remain gradual enough to allow for fish to move from side-channels and off-channel areas into the main river channel as flows decline.
The risk of Ich infection, epizootic events, and fish die-offs would be reduced compared to the No Action Alternative through increased habitat area, increased water velocities, improved migration cues, and a decrease in frequency of water temperatures exceeding 73.4°F. Pacific Lamprey Late summer augmentation flows may increase water velocities, causing juvenile lamprey to redistribute. Eulachon Affects to flows in the lower Klamath River and Estuary would be similar between Alternative 1 and the No Action Alternative. Reservoir Fishes Reservoir fish habitat, for both cold water and warm water in Trinity Lake, would be similar between Alternative 1 and the No Action Alternative. *Central Valley and Bay-Delta* Chinook Salmon and Steelhead SALMOD results indicate some critical years may result in decreased production of Chinook Salmon compared with the No Action Alternative. Overall averages show similar production levels (less than 3%) for all runs of Chinook Salmon (and through similar life stages, steelhead), except for fall-run Chinook Salmon which experience a higher potential mortality rate in critical water years (averaging 6% reduced survival) and spring-run, which experience a greater than 5% increase in survival in critical water years.	Effects would be comparable to Alternative 1. Pacific Lamprey Effects would be comparable to Alternative 1. Eulachon Effects would be comparable to Alternative 1. Reservoir Fishes Effects would be comparable to Alternative 1. *Central Valley and Bay-Delta* Chinook Salmon and Steelhead SALMOD results indicate some critical years may result in decreased production of Chinook Salmon compared with the No Action Alternative, however, the overall averages show similar production levels (less than 3% reduction) for all four runs of Chinook Salmon (and through similar life stages, steelhead).

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	**Alternative 2 Compared to the No Action Alternative**
Biological Resources – Fisheries (contd.)	
Central Valley and Bay-Delta	*Central Valley and Bay-Delta*
Chinook Salmon and Steelhead IOS results indicate winter-run Chinook Salmon would experience reduced survival during several critical water years, resulting in a less than 1% average reduction in spawning escapement, a 9% reduction in fry-to-smolt survival and 5% reduction in smolt production under Alternative 1. However, the average overall affects to winter-run Chinook Salmon are similar with a less than 1% reduction in spawning escapement to the No Action Alternative.	Chinook Salmon and Steelhead IOS results indicate winter-run Chinook Salmon would experience reduced survival during several critical water years, but the overall spawning escapement in critical water years would increase by about 2%. The average overall affects to winter-run Chinook Salmon are similar with a less than 1% reduction in spawning escapement to the No Action Alternative.
Water temperatures would be generally similar at temperature compliance locations in the upper Sacramento River compared to the No Action Alternative, except in critical water years in the Sacramento River below Clear Creek, Balls Ferry, and Jellys Ferry.	Water temperatures would be generally similar at temperature compliance locations in the upper Sacramento River compared to the No Action Alternative.
The WUA in the Sacramento, Feather and American Rivers and Clear Creek for Chinook Salmon and steelhead spawning, fry rearing, and juvenile rearing would be generally similar (less than 1% change) for suitable habitat to the No Action Alternative.	Effects would be comparable to Alternative 1.
Based on Delta hydrodynamics, habitat conditions and entrainment would be similar to the No Action Alternative.	Effects would be comparable to Alternative 1.
Green Sturgeon River water temperatures and Delta hydrodynamics suitable for Green Sturgeon would be similar to the No Action Alternative.	Green Sturgeon Effects would be comparable to Alternative 1.
Delta Smelt Habitat conditions (based on Delta hydrodynamics) and entrainment would be similar to the No Action Alternative.	Delta Smelt Effects would be comparable to Alternative 1.
Reservoir Fishes Reservoir fish habitat conditions for both cold water and warm water fishes would be similar in Whiskeytown Lake, Shasta Lake, Oroville Lake and Folsom Lake to the No Action Alternative.	Reservoir Fishes Effects would be comparable to Alternative 1.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Biological Resources – Terrestrial	
Trinity Lake and Trinity River Terrestrial resources at Trinity Lake and on the Trinity River would be similar to the No Action Alternative for most months and year types, except for: minor adverse effects on terrestrial wildlife species at Trinity Lake in September of critically dry water years due to decreased storage elevation; minor effects to Yellow-legged Frog and Western Pond Turtle from changes in flow and water temperature in Trinity River in late summer; and temporary minor positive effects on riparian terrestrial habitat and terrestrial wildlife on the Trinity River in August and September due to increased flows.	*Trinity Lake and Trinity River* Terrestrial resources at Trinity Lake and on the Trinity River would be similar to the No Action Alternative for most months and year types, except for: minor positive effects on terrestrial wildlife species at Trinity Lake during June through August of critical water years due to increased storage elevation and minor adverse effects in September in these years due to decreased storage elevation; minor adverse effect on terrestrial resources on Trinity River in May and June of critically dry water years due to flow reductions which may hinder TRRP efforts to control riparian vegetation; minor positive effect on Foothill Yellow-legged Frog breeding success and tadpole development, and Western Pond Turtles young-of-the-year and juveniles resulting from increased water temperatures in critically dry years; and minor effects to Yellow-legged Frog and Western Pond Turtle from changes in flow and water temperature in Trinity River in August and September.
Klamath River Terrestrial resources on the lower Klamath River would be similar to the No Action Alternative for most months and year types except for minor positive effects on riparian terrestrial habitat and terrestrial wildlife in August and September due to increased flows.	*Klamath River* Terrestrial resources on the lower Klamath River would be similar to the No Action Alternative for most months and year types, except for: minor adverse effect on terrestrial resources in late May and early June of critically dry water years due to reduction of Trinity River ROD flows; and temporary positive effects on riparian terrestrial habitat and terrestrial wildlife in the August and September due to increased flows.
Sacramento Valley Minor positive effects on terrestrial resources on the Feather River in June of critical water years and on the American River in September of critical water years. Alternative 1 would reduce habitat for Sacramento Valley wildlife which utilize agricultural lands due to reduced water supplies in critical water years.	*Sacramento Valley* Effects would be comparable to Alternative 1. Alternative 2 would have similar habitat for Sacramento Valley wildlife which utilize agricultural lands.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Hydropower Generation	
CVP and SWP annual energy generation, energy use, and net energy generation would be similar (less than 1% change). Long-term average decrease of 13.5 GWh in net energy generation for the CVP and SWP. Long-term average decrease of TRD generation by 7 GWh (1% change), with a maximum decrease of 9.8 GWh (2.5% change) in critical years.	CVP and SWP annual energy generation, energy use, and net energy generation would be similar (less than 1% change). Long-term average decrease of 3.7 GWh in net energy generation for the CVP and SWP. Long-term average change in TRD generation would be similar between Alternative 2 and the No Action Alternative, with a maximum decrease of 5.2 GWh (0.6% change) in wet years and a maximum increase of 9.8 GWh (1.4% change) in below normal years.
Air Quality, Greenhouse Gas Emissions and Global Climate Change	
Average annual increase in GHG emissions of 6,720 MT CO_2e in comparison to the No Action Alternative.	Average annual increase in GHG emissions of 1,857 MT CO_2e in comparison to the No Action Alternative.
Agricultural Resources	
Agricultural resources would be similar to the No Action Alternative. Changes in irrigated acreage and agricultural production would be less than 1% for all year types in the Sacramento and San Joaquin Valleys.	Effects would be comparable to Alternative 1.
Socioeconomics	
Lower Klamath and Trinity Rivers	*Lower Klamath and Trinity Rivers*
Commercial, sport, and tribal fishing opportunities would be improved due to the reduced likelihood of an Ich outbreak and associated fish-die off.	Effects would be comparable to Alternative 1.
Recreational economic factors related to the use of Trinity Lake would be similar.	Effects would be comparable to Alternative 1.
Recreational economic factors would be similar downstream of Lewiston Dam on the Trinity River and lower Klamath River.	Effects would be comparable to Alternative 1.
Central Valley and Bay-Delta	*Central Valley and Bay-Delta*
Agricultural water-related employment would be similar.	Effects would be comparable to Alternative 1.
Recreational economic factors in the use of CVP reservoirs would be similar.	Effects would be comparable to Alternative 1.

Table ES-3. Comparison of Environmental Effects of Alternatives 1 and 2 (contd.)

Alternative 1 Compared to the No Action Alternative	Alternative 2 Compared to the No Action Alternative
Indian Trust Assets	
There are no substantial adverse effects to ITAs related to water, fisheries resources and terrestrial biological resources.	Effects would be comparable to Alternative 1.
Environmental Justice	
No disproportionately high and adverse effects on low-income or minority populations or Indian tribes.	Effects would be comparable to Alternative 1.

Key:
% = percent
CVP = Central Valley Project
CO_2e = carbon dioxide equivalent
Delta = Sacramento-San Joaquin River Delta
GHG = greenhouse gas emissions
GWh = gigawatt-hours
IOS = Interactive Object-Oriented Simulation
ITA = Indian Trust Asset
NCRWQCB = North Coast Regional Water Quality Control Board
MT = metric tons
OMR = Old and Middle River
ROD = Record of Decision
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet
TRD = Trinity River Division
TRRP = Trinity River Restoration Program

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Appendices

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Abbreviations and Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
AB	California Assembly Bill
ACID	Anderson-Cottonwood Irrigation District
ACS	American Community Survey
ARB	California Air Resource Board
Banks Pumping Plant	Harvey O. Banks Pumping Plant
BEA	U.S. Bureau of Economic Analysis
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BO	Biological Opinion
BSPP	Barker Slough Pumping Plant
CAAQS	California Ambient Air Quality Standards
CBOD	Carbonaceous Biochemical Oxygen Demand
CCF	Clifton Court Forebay
CCWD	Contra Costa Water District
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Coordinated Operation Agreement
Columnaris	*Flavobacter columnare*
CPUC	California Public Utilities Commission
CRPR	California Rare Plant Ranks
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
D-1641	Decision 1641
DAT	daily average temperatures

DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin River Delta
DFG	Department of Fish and Game
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DOI	U.S. Department of the Interior
DPS	distinct population segment
Draft LTP	Draft Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River
DWR	California Department of Water Resources
EA	Environmental Assessment
EC	electrical conductivity
EDD	California Employment and Development Department
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive Order
EOM	end-of-month
ESA	Federal Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FMWT	Fall Midwater Trawl Survey
FONSI	Finding of No Significant Impact
FR	Federal Register
FWCA	Fish and Wildlife Coordination Act
GCID	Glenn-Colusa Irrigation District
GHG	greenhouse gas
GPS	Global Positioning System
GSP	Groundwater Sustainability Plan
GWh	gigawatt-hours
HFC	hydrofluorocarbons
HWG	Hydropower Working Group
Ich	*Ichthyophthirius multifiliis*
IFIM	Instream Flow Incremental Methodology
IM 15	Interim Measure 15
IMPLAN	IMpact analysis for PLANning
IOS	Interactive Object-Oriented Simulation
IPCC	Intergovernmental Panel on Climate Change
ITA	Indian Trust Asset
Jones Pumping Plant	C.W. Jones Pumping Plant
KBAO	Klamath Basin Area Office
KFHAT	Klamath Fish Health Assessment Team

KRRC	Klamath River Renewal Corporation
LTP	Long-Term Plan to Protect Adult Salmon in the Lower Klamath River
M&I	municipal and industrial
MAF	million acre-feet
MMPA	Marine Mammal Protection Act
msl	mean sea level
MT	metric tons
MW	megawatts
MWh	megawatt-hours
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NASS	National Agricultural Statistics Service
NCAO	Northern California Area Office
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOD	North-of-Delta
NOI	Notice of Intent
NWR	National Wildlife Refuge
OCAP	Operations Criteria and Plan
OMR	Old and Middle River
PCE	primary constituent element
PFC	perfluorocarbons
PFMC	Pacific Fishery Management Council
PL	Public Law
RBPP	Red Bluff Pumping Plant
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	river mile
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RPS	California Renewables Portfolio Standard
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SF_6	sulfur hexafluoride
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis & Delta-Mendota Water Authority
SOD	South-of-Delta

SONCC	Southern Oregon/Northern California Coast
Subgroup	Lower Klamath River Flow Augmentation Subgroup
SWAP	Statewide Agriculture Production
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TCD	temperature control device
TDS	total dissolved solids
TEPA	Tribal Environmental Protection Agency
TMC	Trinity Management Council
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
TRD	Trinity River Division
TRFE	Trinity River Flow Evaluation
TRRP	Trinity River Restoration Program
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Western	Western Area Power Administration
WSEL	reservoir water surface elevation
WUA	Weighted Usable Area
YOY	young-of-the-year
YTFP	Yurok Tribal Fisheries Program

Chapter 1 Introduction

Background and History

In September 2002, an unforeseen and unprecedented fish die-off occurred during a two-week period in the lower Klamath River (Reclamation 2015a). A subsequent U.S. Fish and Wildlife Service (USFWS) report indicated that of the approximately 34,000 anadromous salmonids estimated to have perished during this event, nearly all (98.4 percent) were adult salmonids. Of this total, 97 percent (~33,000) were fall-run Chinook Salmon, 1.8 percent (~629) were steelhead, and 1.0 percent (344) were Coho Salmon. The two fish disease pathogens leading to the die-off were identified as *Ichthyophthirius multifiliis* (Ich) and *Flavobacter columnare* (Columnaris) (USFWS 2003).[1] High fish densities—due to the relatively large run size (approximately 170,000 adult Chinook Salmon), low flows, and relatively high water temperatures—were identified as causative factors for the rapid spread of disease. Although a larger number of Klamath River fall-run Chinook Salmon died, a greater proportion of the Trinity River run was lost because the die-off occurred during the peak migration of the Trinity River fish (DFG 2004). Since 2002 the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) has been working with local tribes, resource agencies, and the public to protect fall-run Chinook Salmon returning to the Klamath and Trinity Rivers.

In 2003 and 2004 the Klamath River Chinook Salmon run sizes varied significantly with post-return estimates of approximately 192,000 adults and just under 79,000 adults, respectively, as shown in Table 1-1. As shown in Figure 1-1, to avert another die-off, Reclamation made preventative releases from Trinity Reservoir, part of the Reclamation's Central Valley Project (CVP), in the late summer of both years, totaling 38,000 and 36,313 acre-feet, respectively, to improve fish habitat conditions in the lower Klamath River. The majority of that combined volume was acquired through an exchange with the Metropolitan Water District of Southern California.[2] There was no substantial disease outbreak noted by tribal, Federal, or State fishery resource agencies during these return periods.

[1] Both diseases are infectious and the pathogens are naturally present in low concentrations during much of the year in many rivers and streams. Historically, small numbers of fish are infected by one or both diseases during years with normal or above-normal hydrology. The free-swimming protozoan life stage of Ich is opportunistic, however, and spreads more rapidly among fish that are in close proximity in slow-moving water. In such instances, large numbers of protozoans attach to gill arches, inhibiting respiration, which can prove fatal.

[2] Though Metropolitan Water District of Southern California sought return of the exchange volume in years immediately after the 2003-2004 exchange, it was not until 2009 that the exchanged volume was fully repaid, delayed primarily by Delta conveyance constraints.

Table 1-1. Summary of Hydrologic and Biological Conditions in the Lower Klamath River for Years with Fish Die-Off or Flow Augmentation Releases

Year	Post Season Adult Fall-Run Chinook Salmon Run Size	Ich Counts	Average Flows at Klamath, California in August and September Excluding Flow Augmentation Releases (cfs)	Observed Fish Die-off	Flow Augmentation Action Implemented
2002	170,000	Not Available	2,160	Yes	No
2003	192,000	Counts > 50 observed	3,100	No	Yes
2004	79,000	0	2,670	No	Yes
2012	292,000	0	2,890	No	Yes
2013	165,100	0	2,890	No	Yes
2014	160,000	Counts > 600 observed	2,160	No	Yes
2015	83,800	Maximum counts > 600	2,200	No	Yes

Note:

[1] Counts are qualified by criteria where low-level infection (less than 30 Ich trophonts per gill arch) occur in the first two weeks of September on three adult salmon in one day.

Key:

cfs = cubic feet per second

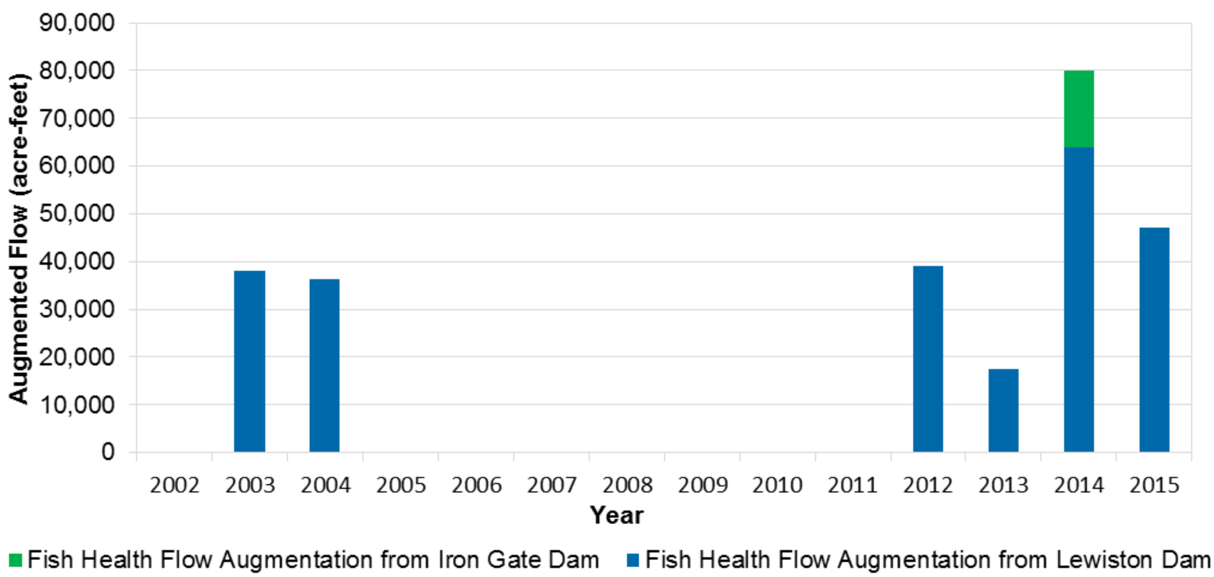

Figure 1-1. Flow Augmentation Releases Made by Reclamation and PacifiCorp from 2003 to 2015 to Reduce the Prevalence of Fish Disease in the Lower Klamath River

Predicted very dry hydrologic conditions in the Klamath River Basin in 2008 and 2009 again triggered concerns regarding adult fish health. Reclamation prepared to make augmentation releases and consulted with tribes and other Klamath and Trinity River Basin partners to develop biological and hydrologic criteria. Hydrologic conditions later improved to the extent that preventative actions were ultimately unnecessary. Adult fall-run Chinook Salmon post-return estimates during 2008 and 2009 totaled 70,698 and 100,644, respectively.

In March of 2012, the Pacific Fishery Management Council (PFMC) announced its in-river, run-size projection for Klamath River fall Chinook Salmon of 384,000 adults; the highest estimate, by a considerable margin, since recordkeeping began in 1978 (PFMC 2013).[3] Abnormally dry hydrologic conditions led to very low Klamath River accretion forecasts, prompting concerns of a disease outbreak. Tribes, sport-fishing groups, and other fishery advocates formally requested that Reclamation take action.

In response, Reclamation collaborated with tribes, regulatory agencies, and other basin partners to develop and refine monitoring and flow augmentation criteria. A Lower Klamath River Flow Augmentation Subgroup (Subgroup) of the Flow Workgroup, (affiliated with the Trinity River Restoration Program (TRRP) was established among the partners and met on many occasions. The Subgroup reviewed past analyses, researched contemporary disease propagation information, and studied hydrologic data. Ultimately, the Subgroup summarized their recommendations in a memorandum, 2012 *Fall Flow Release Recommendation*, to the Trinity Management Council (TMC)[4] Chair, dated May 31, 2012 (Trinity River Restoration Program 2012). Their primary recommendations were two-fold:

- As a preventative measure, they recommended that flows in the lower Klamath River be augmented to at least 3,200 cubic feet per second (cfs) beginning August 15, 2012, and continuing through September 21, 2012, at a minimum, or until river water temperatures were reduced to below 23 degrees Celsius (°C); and,

- They recommended enhanced monitoring of fish for indicators of disease, and as an emergency flow augmentation measure, if such indicators were above a predetermined threshold as documented by the Fish Health Center, that flows in the lower Klamath River be doubled to a maximum of 6,400 cfs for a period of 7 days.

Reclamation prepared an Environmental Assessment (EA) and on August 10, 2012, signed a Finding of No Significant Impact (FONSI) for the release of up to 44,800 acre-feet to augment flows in the lower Klamath River for preventative purposes, along with up to 48,000 acre-feet exclusively from Trinity Reservoir for emergency flow augmentation purposes if monitoring indicated that this was necessary. Klamath River Basin hydrologic conditions had deteriorated over the course of the analysis, precluding additional releases from the Klamath River Basin, whereas Trinity Reservoir storage in mid-summer was at 107 percent of the 15-year average.

In addition to collaborating with partners in formulating the action, Reclamation consulted with water user and power customer representatives prior to releasing the EA and again prior to executing the FONSI. Ultimately, 39,000 acre-feet was released for preventative purposes and no

[3] The highest previous run size during the period of record was 222,800 adults in 1995. The actual 2012 run size was 302,000 adults, and while it was 21 percent below the PFMC projection, it still represents a modern-day record.

[4] The TMC is prescribed by the ROD for the Trinity River Mainstem Fisheries Restoration EIS/EIR to guide overall implementation of the TRRP. Comprised of eight members representing two tribes, Trinity County, the State of California, and four Federal agencies, the TMC makes decisions by super majority, meaning that at least seven aye votes are required to pass a formal motion.

emergency releases were required. There was no substantial disease outbreak noted by tribes or fishery resource agencies during the return period. The fall-run Chinook Salmon return, post-season estimate was 292,000 adults.

From 2013 through 2015, the Klamath Basin experienced drought conditions. During this period, below-average precipitation was observed that affected both flows and river temperatures throughout the region. As shown in Table 1-1, without flow augmentation actions, drought conditions in 2014 and 2015 would have resulted in low flows during late summer months in the lower Klamath River, similar to those observed in 2002.

In March of 2013, the PFMC announced its in-river, run-size projection for Klamath River fall Chinook Salmon of 272,000 adults for that year, second only in number to the 2012 projection since recordkeeping began in 1978. Further, based on the prior-year analysis of age components, fisheries experts reported that the 2013 run would have an abnormally high proportion of age four fish, which are typically larger and more accurately modeled (estimated) than younger age classes. Many fishery interests suggested this as a possible indicator that the total bio-mass would be higher than typical. In May, the National Oceanic and Atmospheric Administration (NOAA) California-Nevada River Forecast Center's forecast model indicated that Klamath River flow accretions would be very low in August and September, in fact just 50 percent of the flow rates presented in their 2012 forecast. Tribes, sport-fishing groups, other fish advocates, and fishery resource agencies again formally requested that Reclamation augment flows. Many urged that the 2012 augmentation flow rate (3,200 cfs) be instituted again for the same calendar period.

After reviewing all written materials produced regarding the 2002 die-off and subsequent actions, Reclamation's Northern California Area Office (NCAO) developed two alternative augmentation regimes, to some extent mimicking past (2003-2004) augmentation protocols and designed to use less water from Trinity Reservoir as compared to the 2012 protocol.[5] The alternatives were presented to the TMC during meetings held on June 18 and June 26, 2013, where neither gained broad acceptance. After considerable discussion, a motion was introduced and seconded, recommending that flows be augmented to a rate of 2,800 cfs from August 15 through September 30, complemented by a focused water temperature and fish health monitoring effort. The motion failed, thus the TMC recommendation made in 2012 was, in effect, sustained into 2013. Through further government-to-government consultation and other forums, Reclamation obtained input from the Hoopa Valley Tribe, the Yurok Tribe, the USFWS, National Marine Fisheries Service (NMFS), and other basin partners. The parties discussed 2013 projected fishery conditions and reviewed the Fall Flow Subgroup's 2012 recommendations. Reclamation considered these and a variety of other factors—in addition to seeking responses from water users, power customers, and fishery interests similar to 2012—prior to making a decision on flow augmentation. Key contributing factors were the low Klamath River accretion forecast, along with the Trinity Reservoir storage level being considerably lower than the year prior. Reclamation also considered the potential of the proposed flow augmentation depleting Trinity Reservoir storage levels to the extent that the cold water pool would be reduced, hampering efforts to meet temperature targets in the Trinity River, either in the present or following year. Taking into account this concern, together with an earlier recommendation in a

[5] One alternative would use intermittent pulse flows released from Trinity Reservoir to flush the free-swimming Ich life stage and induce fish migration. The other would involve a more gradual ramp rate on the ascending and descending limbs. Both would emphasize in-season monitoring and quick response adaptive management of flows.

2010 study produced by Dr. Joshua Strange (Strange 2010), Reclamation determined that flows would be augmented to a rate of 2,800 cfs in the lower Klamath River from August 15 through September 21.

NCAO prepared an EA and on August 6, 2013, signed a FONSI for the release of up to 62,000 acre-feet to augment lower Klamath River flows to a rate of 2,800 cfs for preventative purposes. Citing sub-normal Klamath River Basin hydrology, the FONSI stated that augmentation would be provided exclusively from Trinity Reservoir.

Ultimately, as flows (at Klamath, California) during August and September were higher than initially anticipated, 17,500 acre-feet was released for preventative purposes in 2013, and no emergency releases were required. There was no substantial disease outbreak, though it was reported by the Yurok Tribe that several fish died from Columnaris. The post-season run size estimate was 165,100 adults.

NMFS and USFWS co-authored a memorandum dated August 12, 2013 (Joint Memorandum), which included a recommendation for monitoring fish health and conditions in the lower Klamath River along with augmentation flow thresholds (USFWS and NMFS 2013b). The Joint Memorandum included an extensive assessment of historical, biological and hydrologic factors. The key elements of their recommendation for actions to be undertaken, when conditions present a risk of Ich spreading throughout a large number of fish, are summarized below. It must be noted that the recommendations were based on hydrologic, fishery, and other conditions as specifically observed in 2013.

Preventative Flow Augmentation:

- Initiate preventative flow augmentation in the lower Klamath River to a minimum of 2,800 cfs when the cumulative harvest of Chinook Salmon in the Yurok Tribal fishery in the estuary area meets or exceeds 7,000 fish.[6]

- Initiate preventative flow augmentation by August 22 if the fish metric above is not triggered.

- Continue augmentation until September 21, unless the mean daily water temperature in the lower Klamath River is projected to be greater than or equal to 23°C, in which case continue until the daily water temperature is projected to be less than 23°C, or until the end of September when seasonal air temperatures typically cool.

- Implement real-time flow-temperature management using existing water temperature models and NOAA Weather Service weather projections.

- Implement fish pathology monitoring to determine the need for a fish pathology/ mortality emergency release.

[6] The partners' initial reaction to utilizing the fish presence metric to trigger flow augmentation was positive, but some indicated that more time for evaluation of the concept was necessary.

- Monitor conditions to inform need and timing of emergency flow releases based on real-time environmental conditions.

Emergency Flow Augmentation:

- If diagnosis of severe Ich infection of gills (30 or more parasites per gill arch) in 5 percent or greater of a desired sample of 60 adult salmonids, is confirmed by the USFWS Fish Health Center or;

- Observed mortality of greater than 50 dead adult salmonids in a 20 kilometer index reach in 24 hours combined with a confirmed presence of Ich by the USFWS Fish Health Center, then:

  – Immediately double pre-existing flows in the lower Klamath River for a period of 7 days.

In March 2014, the PFMC announced its in-river, run size projection for Klamath River fall Chinook Salmon of 92,800 adults. In May 2014, the NOAA California-Nevada River Forecast Center announced that its forecast model indicated Klamath River flow accretions would be very low in August and September (1,800 – 1,900 cfs or lower), perhaps the lowest for the period of record. On June 20, 2014, the Hoopa Valley Tribe issued a letter to the Secretary of the Interior urging that flows be augmented to a rate of no less than 2,500 cfs beginning in August and continuing through at least September 21, 2014. The Yurok Tribe, PFMC, and other entities later formally requested that Reclamation augment flows. Conversely, Reclamation received letters from CVP water and power users questioning the biological basis for releasing additional water and expressing concern about the impact to water supplies and power generation.

After reviewing the information and consulting with State and Federal fish agencies, tribes, and others, Reclamation announced on July 29, 2014, that it would not provide augmentation flows on a preventative basis, but rather would implement the fish pathology/mortality component of the emergency fall flow release recommendation as described in the 2013 Joint Memorandum.

Accordingly, Reclamation coordinated discussions among fish agencies, tribes, and its own fishery and operations experts to enhance the disease monitoring, reporting, public safety notification, and communication aspects of an emergency response.

During the first half of August 2014, both hydrologic conditions and observed fish health continued to worsen. It was reported that the adult return had begun much earlier than expected, and thousands of fish were stalled at the mouth of Blue Creek on the lower Klamath River mainstem. Other observations indicated fish were exhibiting lethargic behavior—in some cases to the degree that fish could be caught with bare hands. Water temperatures had risen above 23°C, a widely accepted thermal migration barrier mark[7], and water quality was generally poor. A meeting was convened by the Klamath Fish Health Assessment Team (KFHAT) on August 29, 2014, during which they reported that, in their opinion, a significant fish die-off was likely imminent. Attendees at this meeting included the California Department of Fish and Wildlife

[7] A wide array of factors influence fish migration, but it is generally accepted by fishery biologists that a water temperature of approximately 23°C or greater constitutes a thermal barrier to salmonid migration.

(CDFW), the North Coast Regional Water Board, Yurok Tribe, Karuk Tribe, Shasta Valley Resource Conservation District, USFWS, NMFS, Reclamation, and U.S. Forest Service.

After again consulting with fish agencies, Reclamation determined that an emergency release from Trinity Reservoir was necessary to avert a potentially significant fish loss. On August 22, 2014, Reclamation announced it would increase releases from Trinity Reservoir to achieve a flow rate of approximately 2,500 cfs in the lower Klamath River. The ramp-up began the following day, August 23, and the increased release rate continued through September 14, 2014. On September 15, scientists from the Fish Health Center confirmed the presence of Ich parasites on nine of 24 fish taken from the lower Klamath River, six of those sampled with concentrations high enough to constitute a severe infestation in accordance with the Joint Memorandum. Reclamation consulted briefly with Federal scientists before again increasing releases from Lewiston Dam to approximately 3,400 cfs so as to achieve a doubling (from the flow rate of 2,500 cfs maintained earlier to 5,000 cfs) in the lower Klamath River. Per the criteria, the doubling was maintained for one week. Though there were documented reports of severely infected fish present at several locations within the mainstem Klamath River, there was no significant die-off. Formal post-season fishery reviews are not yet available, but anecdotal reports indicated that fish health did not decline following the flow doubling. A total volume amount of 64,000 acre-feet was ultimately released. In addition, approximately 15,500 acre-feet was released from PacifiCorp’s Iron Gate Dam from October 4 to October 15, 2014.

The fall-run Chinook Salmon return post-season estimate was 160,000 adults. Reclamation was unable to complete its evaluation of this action under the National Environmental Policy Act (NEPA) as has occurred in past years, because the release was undertaken only after monitoring indicated there was an emergency need for flow augmentation. Due to the emergency nature of the releases, Reclamation consulted with the Council on Environmental Quality (CEQ) regarding alternative arrangements under NEPA as provided for in CEQ regulations.

Conditions in summer and fall 2015 reflected the continuation of drought in the area. Klamath River flows in 2015 were anticipated to be 2,000 cfs in late August, which was consistent with flows observed in 2002, the year of the large fish die-off. Due to the extended drought, there was little to no snow pack, and accretions were predicted to be minimal. Thus, lower Klamath River flows were anticipated to remain low, only getting lower as fall 2015 approached. Because of the 2014 Ich outbreak, it was anticipated that background levels of Ich could contribute to an outbreak in 2015.

The predicted fall run of Chinook Salmon was fairly large, with 119,000 expected to return to the lower Klamath River. While a predicted run of 119,000 was not as high as the fall run of 2002 (170,000), run-size predictions are difficult to make. It is not uncommon for run predictions to be off by 50,000 fish or more in either direction. Furthermore, and perhaps more importantly, in 2015 the USFWS identified “the pattern of upstream migration to be a more important factor in determining disease risk than run size alone” to suggest that run size should be de-emphasized as an indicator for disease risk (USFWS 2015).

Ich was already present in the river system. The Yurok Tribe captured six Chinook Salmon from Blue Creek, a tributary of the lower Klamath River, on July 22, 2015, and all tested positive for Ich infection. One of these fish had a severe infection, with more than 30 Ich spots per gill arch.

This disease occurrence was a month earlier than that discovered in 2014, when it was first observed on August 27. Such high levels of Ich present that early in the year indicated a significant risk for a large fish die-off in 2015. The warmer-than-normal water temperatures, low flows, and presence of Ich already in the system all pointed toward a risk of infection and fish die-off event in 2015.

Reclamation prepared an EA and on August 20, 2015, signed a FONSI for the release of up to 51,000 acre-feet to augment lower Klamath River flows to a rate of 2,800 cfs for preventative purposes. Approximately 48,000 acre-feet was released from Lewiston Dam to improve environmental conditions in the lower Klamath River. Although Ich was detected throughout the monitoring period, no fish die-off occurred. The post-season run size estimate was 83,800 adults (Trinity River Restoration Program 2016).

Hydrologic conditions in summer of 2016 reflected improved conditions, relative to previous years in the area. However, lower Klamath River flows were anticipated to be 2,400 to 2,500 cfs in August and September. Because of this predicted lower-than-median flow level of the lower Klamath River, there was a concern that this level of flow may not be adequate to prevent a disease outbreak. Reclamation prepared a Draft EA and provided it for public review and comment on August 2, 2016. Reclamation signed a FONSI on August 24, 2016, and initiated flow augmentation releases from Lewiston Reservoir on August 25, 2016.

Development of the Draft Long-Term Plan for Protecting Late-Summer Adult Salmon in the Lower Klamath River

In response to the need for augmentation flows in the past several years, the indication that such flows may be needed in future years, and competing environmental and water supply demands for Trinity River Division (TRD) of the CVP water supplies, Reclamation started developing the *Draft Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River* (Draft LTP) in 2013. An initial Draft LTP was provided to key stakeholders on December 31, 2014. Reclamation received comments from CDFW, California Water Impact Network, Hoopa Valley Tribe, Klamath Water Users Association, NMFS, San Luis & Delta-Mendota Water Agency and Westlands Water District, Stillwater Sciences, Yurok Tribe and Northern California Power Agency. The Draft LTP was released again to the public on April 17, 2015 (Reclamation 2015a). This Environmental Impact Statement (EIS) further refines the flow augmentation actions, processes, and monitoring that were identified in the Draft LTP.

Purpose and Need

The primary factors currently thought to contribute to infection dynamics and outbreaks of Ich disease in adult salmon returning to the Klamath River are anticipated to continue, including the presence of the Ich pathogen, high water temperatures in the lower Klamath River, low flow conditions in the lower Klamath River, and large run size of fall-run Chinook Salmon. The purpose of the Proposed Action is to reduce the likelihood, and potentially reduce the severity, of any Ich epizootic event that could lead to an associated fish die-off in future years. The need is based on the past extensive fish die-off in 2002, as described above in the *Background and History* section.

Regional Setting

Klamath River Basin

The upper watershed has four main lakes: Crater Lake, Upper Klamath Lake, Clear Lake, and Tule Lake. The lower watershed begins at Iron Gate Dam. Within the Klamath River Basin, the largest communities are Klamath Falls, Oregon, and Yreka, California (DOI and CDFW 2012).

The Klamath River, located in the Klamath River Basin, originates just downstream from Upper Klamath Lake in southern Oregon, and flows 253 miles southwest through northern California to the Pacific Ocean. Along this course, the Klamath River crosses the Cascade Mountains; the Klamath is one of the few rivers to do so. The Klamath River flows through mountainous terrain from the Oregon-California border to the Pacific Ocean. Unlike most river systems, the Klamath River is warmer and flatter in its headwaters, while downstream portions, beginning near Copco Dams 1 and 2, tend to be colder and steeper. The major tributaries entering the mainstem of the Klamath River include Shasta, Scott, Salmon, and Trinity Rivers (see Trinity River Subbasin discussion below), that join the Klamath River below Iron Gate Dam. Downstream from Iron Gate Dam, and for most of its length to the Pacific Ocean, the river maintains a relatively steep, high-energy gradient (National Research Council 2004). The stretch of the Klamath River below the Trinity River confluence is known as the “lower Klamath” (USFWS et al. 2000).

The Karuk Tribe occupies territory along the Klamath River downstream of Iron Gate Dam. A portion of the Hoopa Valley Indian Reservation includes about a quarter mile reach of the Klamath River called Saints Rest Bar upriver from Weitchpec, California (e.g., upriver of the confluence with the Trinity River). The Yurok Tribe Reservation surrounds the lower Klamath River for one mile on either side of the river, stretching roughly from the Pacific Ocean to the confluence with the Trinity River.

Klamath Project

The Secretary of the Interior authorized development of Reclamation’s Klamath Project on May 15, 1905, under provision of the Reclamation Act of 1902 (32 Stat. 388), and construction began in 1906. The Klamath Project consists of three storage facilities and four diversion dams, including the associated canals, drains, pumping plants, two tunnels, and the Lost River Diversion Channel. Storage facilities include Gerber Reservoir on Miller Creek, Clear Lake Reservoir on the Lost River, and Upper Klamath Lake (formed by Link River Dam) at the head of the Klamath River. The Klamath Project provides water to approximately 200,000 to 240,000 acres of agricultural land, with primary crops including onions, potatoes, mint, alfalfa and grass hay, horseradish, and several varieties of cereal grains. Water supplies to the Klamath Project are managed in accordance with the *Biological Opinions on the Effects of Proposed Klamath Project Operations from May 31, 2013 through March 31, 2023, on Five Federally Listed Threatened and Endangered Species,* issued May 31, 2013, by NMFS and USFWS.

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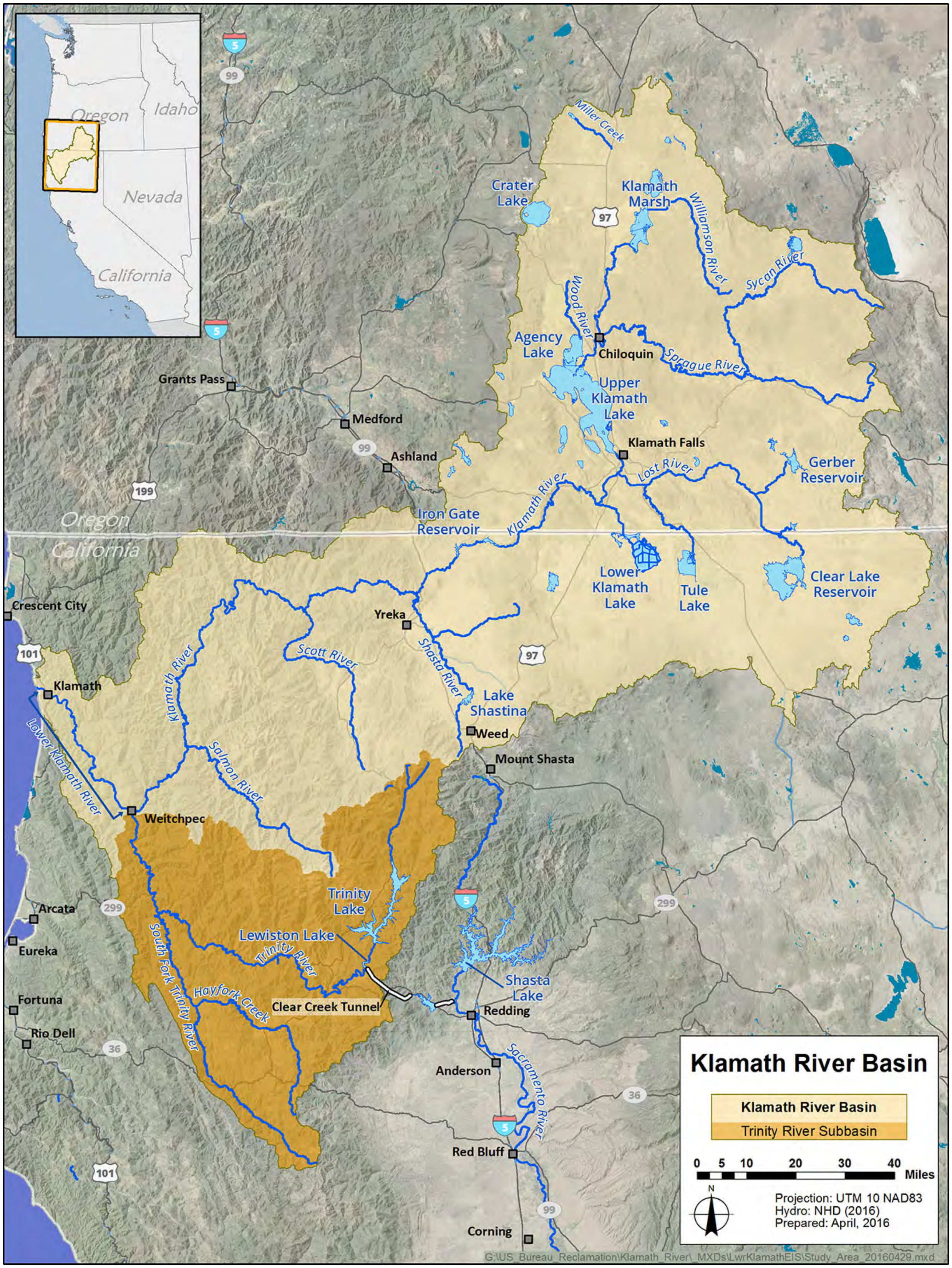

2 Figure 1-2. Klamath River Basin Including Trinity River Subbasin

PacifiCorp Klamath Hydroelectric Project

Built between 1903 and 1962, PacifiCorp's Klamath Hydroelectric Project consists of seven hydroelectric developments and one non-generating dam. Reclamation owns Link River Dam which PacifiCorp operates in coordination with the company's hydroelectric projects. The Link River Dam, located upstream from PacifiCorp's projects, controls storage within, and releases from, Upper Klamath Lake. Upper Klamath Lake water releases (through Link River Dam) are directed by Reclamation to fulfill the primary objectives of regulating Klamath River flows to benefit fish and wildlife, including providing refuge supplies and meeting irrigation demands. In addition, PacifiCorp manages Upper Klamath Lake for flood control objectives. Diversions for hydroelectric purposes occur after these objectives are attained (PacifiCorp 2016).

On April 6, 2016, the U.S. Department of the Interior (DOI), U.S. Department of Commerce, PacifiCorp, and the States of Oregon and California, signed an agreement that, following a process administered by the Federal Energy Regulatory Commission (FERC), is expected to remove four dams (JC Boyle, Copco 1 and 2, and Iron Gate) on the Klamath River by 2020 (Reclamation 2016). The amended dam removal agreement, which uses existing non-Federal funding and follows the same timeline as the original 2010 Klamath Hydroelectric Settlement Agreement, will be filed with FERC for consideration under their established processes. Under the agreement, dam owner PacifiCorp will transfer its license to operate the Klamath River dams to a private company known as the Klamath River Renewal Corporation. This company will oversee the dam removal in 2020. PacifiCorp will continue to operate the dams until they are decommissioned.

State and Federal officials also signed a separate agreement with irrigation interests and other parties known as the 2016 Klamath Power and Facilities Agreement (KPFA). This agreement is intended to help Klamath Basin irrigators avoid potentially adverse financial and regulatory impacts associated with the return of fish runs to the Upper Klamath Basin, which are anticipated after the dams are removed.

Trinity River Subbasin

The Trinity River Subbasin, part of the Klamath River Basin, originates in the Klamath and Coast Ranges and covers over 2,000 square miles. From its headwaters, the Trinity River flows 172 miles south and west through Trinity County, then north through Humboldt County and the Hoopa Valley and Yurok Indian Reservations. It is the largest tributary to the Klamath River, with their confluence lying at Weitchpec, approximately 44 miles upstream from the mouth of the Klamath River (North Coast Regional Water Quality Control Board 2005). The confluence is just north of the Hoopa Valley Indian Reservation and within the boundary of the adjoining Yurok Indian Reservation.

Trinity River Division Trinity Reservoir is the primary water storage facility in the TRD of the CVP. At capacity, it stores approximately 2.4 million acre-feet (MAF), and receives an average annual inflow of approximately 1.2 MAF. Water released from Trinity Reservoir flows to Lewiston Reservoir, a re-regulating reservoir formed by Lewiston Dam. From Lewiston Reservoir, water can be diverted for use in the Sacramento River Basin via the 10.7-mile Clear Creek Tunnel, or it can pass through Lewiston Dam to flow 112 miles before entering the Klamath River at Weitchpec. The Trinity River Hatchery, located at the base of Lewiston Dam, also diverts a small quantity of water from Lewiston Reservoir in support of fish hatchery operations (Reclamation 2015b).

Trinity Reservoir storage is used to meet the needs of the cold-water fish resources in the Trinity River and those areas within the Sacramento River Basin, including Clear Creek that is fed from Whiskeytown Reservoir and the Sacramento River.

Water from the Trinity Reservoir, by way of Lewiston Reservoir, is released to the Trinity River year-round as prescribed by the Trinity River Mainstem Fisheries Restoration EIS/ Environmental Impact Report (EIR) Record of Decision (ROD), as part of the requirements of the TRRP (DOI and Hoopa Valley Tribe 2000).

Central Valley Project Facilities and Service Areas

The CVP is composed of 20 reservoirs with a combined storage capacity that exceeds 11 MAF, more than 10 hydroelectric power plants, and more than 500 miles of major canals and aqueducts. The major on-stream CVP reservoirs in the Central Valley include Shasta Lake on the Sacramento River, Folsom Lake on the American River, New Melones Reservoir on the Stanislaus River, and Millerton Lake on the San Joaquin River. As described in Chapter 4, "Surface Water Supply and Management," the action alternatives will have no impact on Friant or New Melones Reservoir operations or San Joaquin River flows. Therefore, Friant and New Melones Reservoirs, and downstream rivers' segments above the Sacramento-San Joaquin River Delta (Delta), are not included in the study area for this EIS.

As described above, the CVP also diverts water from Trinity Lake via Lewiston Reservoir (on the Trinity River) to the Sacramento River system (see Figure 1-3). CVP pumping plants and canals include the Red Bluff Pumping Plant, which diverts water from the Sacramento River into the CVP Tehama-Colusa Canal; Folsom South Canal, which conveys water from Folsom Lake to southeastern Sacramento County; Contra Costa Canal Pumping Plant, which diverts water from Rock Slough in the Delta into the CVP Contra Costa Canal; and C.W. Jones Pumping Plant, which diverts water from the south Delta into the CVP Delta-Mendota Canal (Reclamation 2015c).

The CVP and State Water Project (SWP) operate in a coordinated manner in accordance with Public Law (PL) 99-546 (October 27, 1986), directing the Secretary of the Interior to execute the Coordinated Operations Agreement (COA) and State Water Resources Control Board decisions and water rights orders related to the CVP's and SWP's water rights permits and licenses to appropriate water by diverting to storage, by directly diverting to use, or by re-diverting releases from storage later in the year or in subsequent years.

Managed by the California Department of Water Resources (DWR), the SWP is the largest state-owned, multi-purpose, water storage and delivery system in the United States. The multi-purpose SWP facilities deliver water through contracts between DWR and 29 public water agencies throughout California.

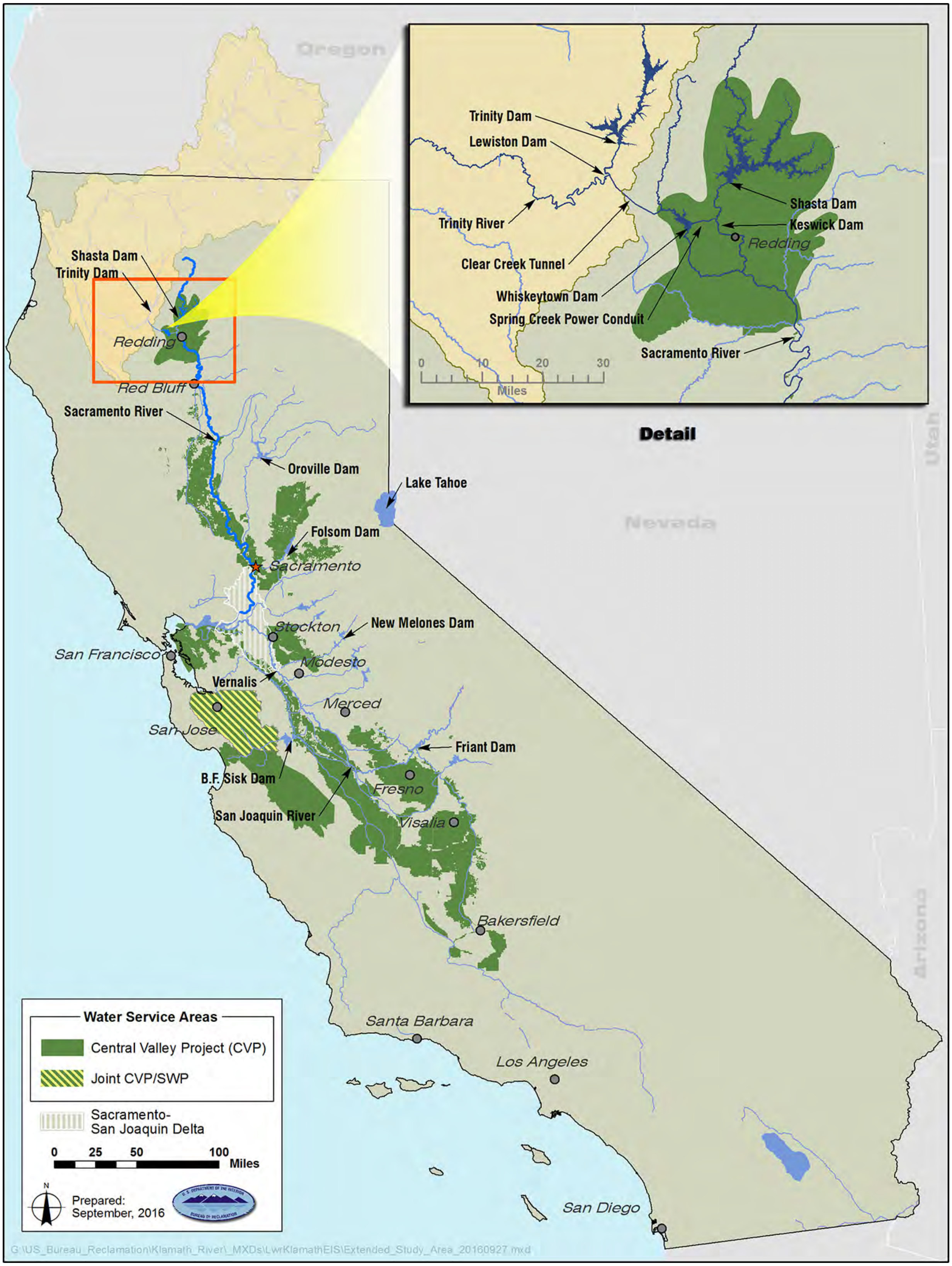

Figure 1-3. CVP Facilities and Water Service Areas

Sacramento River Basin

The Sacramento River is the largest river and watershed system in California. This 27,000–square mile basin drains the eastern slopes of the Coast Range, Mount Shasta, the western slopes of the southernmost region of the Cascades, and the northern portion of the Sierra Nevada. The Sacramento, McCloud and Pit Rivers flow into Lake Shasta, a 4.5 MAF reservoir formed by Shasta Dam. From this dam, the Sacramento River winds approximately 30 miles south through the foothills between Redding and Red Bluff. Many small and moderate-sized tributaries join the river, from both east and west, including Clear, Cottonwood, Cow, and Battle Creeks. At Red Bluff, a large portion of its flow is diverted into canals delivering irrigation water to agriculture south in the Sacramento Valley. The Sacramento River is joined by its largest tributary, the Feather River, at Verona. About 10 miles downstream, the Sacramento River flows through the City of Sacramento and receives the American River, its second largest tributary. The mouth of the Sacramento River is at Suisun Bay near Antioch, where it combines with the San Joaquin River. The Sacramento River, now nearly a mile wide at its mouth, flows into San Francisco Bay and joins the Pacific Ocean under the Golden Gate Bridge in San Francisco (Sacramento River Watershed Program 2016).

Delta

The Delta is formed by the confluence of the Sacramento and San Joaquin Rivers, and is composed of an extensive tidally-influenced network of interconnecting channels surrounding Delta islands or bordering adjacent uplands. The specifically defined “Legal Delta” covers 738,000 acres, of which about 8.3 percent is water. Much of the land is located in islands or tracts that sit below sea level, and are collectively protected by over a thousand miles of levees. Channel flow in the Delta is influenced by inflow from upstream rivers, tidal flows, diversion for in-Delta uses, and exports at the CVP and SWP facilities. Water quality is influenced by upstream water development, including reservoir storage, flood control, diversion and water transfers; return flows from upstream and in-Delta agriculture and municipal and industrial wastewater releases. The Delta is often referred to as the upper estuary associated with the San Francisco Bay, and is connected through the San Pablo Bay, Carquinez Straits, and Suisun and Honker Bays. The western edge of the Delta is about 53 miles from the Golden Gate Bridge. The Delta also serves as a key resource for water management activities in the state (Reclamation 2009).

As described in Chapter 2, “Description of Alternatives,” augmentation flows under the action alternatives are released from Lewiston Dam, and affect resources in and along the Trinity River and lower Klamath River. Accordingly, within the Klamath River Basin, the study area for most resource areas focuses on TRD facilities, in and along the Trinity River downstream of Lewiston Reservoir, and in and along the Klamath River downstream from the confluence with the Trinity River (i.e., lower Klamath River). In addition, due to exports from the TRD to the Sacramento River Basin, the study area for most resource areas also includes CVP facilities, in and along rivers and waterways downstream from CVP facilities (including the Delta), and CVP service areas. Due to the coordinated operation with the SWP, the study area for most resource areas also includes SWP facilities (i.e., Oroville Dam and Reservoir), and in and along rivers and waterways downstream from SWP facilities (i.e., Feather River). For analysis purposes for most resource areas, the study area was divided into two regions, the Lower Klamath and Trinity River Region, and the Central Valley and Bay-Delta Region.

Statutory Authority

The Trinity River Division Central Valley Project Act of 1955 (PL84-386) provides the principal authorization for implementing the action alternatives. Specifically, Section 2 of the 1955 Act limits the integration of the TRD with the rest of the CVP and gives precedence to in-basin needs including that “the Secretary is authorized and directed to adopt appropriate measures to insure preservation and propagation of fish and wildlife…" (Proviso 1) and “that not less than 50,000 acre-feet shall be released annually from the Trinity Reservoir and made available to Humboldt County and downstream users." (Proviso 2)[8] The following are also authorities for the Proposed Action: the Trinity River Basin Fish & Wildlife Management Act of 1984 (Act of October 24, 1984 (PL 98-541); as amended by the Act of October 2, 1992 (PL 102-377); Act of November 13, 1995 (PL 104-46); Act of May 15, 1996 (PL 104-143)) (that directs the Secretary to restore the fish populations impacted by the TRD facilities); the Fish and Wildlife Coordination Act (FWCA) (16 USC 661) and section 3406(b)(1) of the Central Valley Project Improvement Act (CVPIA). In addition, the Proposed Action is also consistent with Reclamation’s obligation to preserve tribal trust resources. Additional information on these statutory authorities is provided in the Statutory Authority Appendix.

Study Period of Analysis

In 2008 and 2009 the USFWS and NMFS, respectively, issued biological opinions (BOs) for the Coordinated Long-Term Operation of the CVP and SWP (USFWS 2008, NMFS 2009). In these BOs, Reclamation analyzed its operations through the year 2030. Because the TRD is a component of the CVP, and Reclamation would need to revisit effects to Federal Endangered Species Act (ESA) listed species from operation of the CVP in 2030, Reclamation has chosen to analyze effects from the proposed action through the same time period, to be consistent with its BOs to operate the CVP.

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[8] For the actions implemented in 2012, 2013 and 2014, Reclamation relied primarily on the provision in Section 2 of the Trinity River Division Authorization 1955 Act that authorizes and directs the Secretary to insure “the preservation and propagation of fish and wildlife” downstream of the TRD facilities. On October 1, 2014, the U.S. District Court for the Eastern District of California found that this provision of Section 2 of the 1955 Act did not provide authority for the 2013 augmentation releases. A notice of appeal has been filed regarding this decision. In 2015, Reclamation added an explanation concerning the use of Proviso 2 of the 1955 Act, in addition to Proviso 1.

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Chapter 2
Description of Alternatives

Alternatives Development and Screening

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) developed the Proposed Action to meet the Purpose and Need, while including input received during preparation of the *Draft Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River* (Draft LTP) (Reclamation 2015a) and input received during the public scoping process (Reclamation 2015b). In determining alternatives to the Proposed Action, Reclamation developed four criteria to effectively address the Purpose and Need statement to screen potential alternatives:

- **Effective:** Addresses more than one of the significant contributing factors to *Ichthyophthirius multifiliis* (Ich) epizootic events: (1) crowded holding conditions for pre-spawn adults, (2) warm water temperatures, and (3) presence of disease pathogens.
- **Substantial Risk Reduction:** Capability of meaningfully and substantially reducing the likelihood, and potentially reducing the severity of any Ich epizootic event that could lead to an associated fish die-off.
- **Immediate Implementability:** Actions may be needed as early as August 2017, therefore alternatives need to be able to be implemented immediately. Further, the term proposed for this Environmental Impact Statement (EIS) is 2017 through 2030. This period is relatively short, and measures need to be able to provide measurable benefit within this time period.
- **Consistent with Laws and Regulations:** Consistent with Federal Reclamation law; other Federal laws; State of California and Oregon laws, water rights, permits, and licenses.

Reclamation also considered the environmental effects of potential alternatives in the development and screening of alternatives.

Alternatives Retained for Detailed Analysis

No Action Alternative

The No Action Alternative represents future conditions without implementation of the proposed action, and the resulting environmental effects from taking no action. Under the No Action Alternative, Reclamation would not implement flow augmentation actions to supplement flows in the lower Klamath River.

The No Action Alternative assumes continued implementation of existing projects, plans, ecosystem restoration projects (e.g., Trinity River Restoration Program), land or resource management plans, water supply management and wastewater facilities, flood management facilities, and recreational facilities. The No Action Alternative assumes future conditions such as climate change and sea-level rise, development of lands in accordance with general plans in areas served by Central Valley Project (CVP) water supplies, and continued operation of the CVP to the year 2030.

Concerning the PacifiCorp Hydroelectric facilities, the U.S. Department of the Interior (DOI), U.S. Department of Commerce, PacifiCorp, and the States of Oregon and California, signed an agreement that, following a process administered by Federal Energy Regulatory Commission (FERC), to remove four dams (JC Boyle, Copco No. 1 and Copco No. 2, and Iron Gate) on the Klamath River. The amended dam removal agreement, which uses existing non-Federal funding, and follows the same timeline as the original 2010 Klamath Hydroelectric Settlement Agreement, will be filed with FERC for consideration under their established processes. Under the agreement, dam owner PacifiCorp will transfer its license to operate the Klamath River dams to a private company known as the Klamath River Renewal Corporation (KRRC). The KRRC will oversee the dam removal work.

The Klamath Facilities Removal Final EIS/Environmental Impact Report (EIR) was completed in 2012 (DOI and DFG 2012); however, a Record of Decision (ROD) for the dam removal was not issued. On June 16, 2016, FERC approved a temporary suspension of the relicensing process in order for PacifiCorp and the KRRC to develop two additional applications for FERC review, including an application to transfer the four dams/facilities to the KRRC; and an application by the KRRC to surrender and remove the four dams. As these applications are pending, FERC has not approved the removal of the four dams. Therefore, for the purposes of this EIS, the No Action Alternative includes PacifiCorp operating under the current annual license with the dams remaining in place. The California Department of Fish and Wildlife (CDFW), funded by PacifiCorp, would continue to operate the Iron Gate Hatchery under its current operations. Flows downstream of Iron Gate Dam would remain similar to current flows, which are released consistent with the 2013 Klamath Biological Opinion (BO) for Reclamation’s Klamath Project.

Proposed Action (Alternative 1)

The Proposed Action (Alternative 1) includes supplemental flows from Lewiston Dam to prevent a disease outbreak in the lower Klamath River in years when the flow in the lower Klamath River is projected to be less than 2,800 cubic feet per second (cfs). The water for these supplemental flows would come from water stored in Trinity Reservoir, to support “appropriate measures for the preservation and propagation of fish and wildlife” (Proviso 1) and releases of “not less than 50,000 acre-feet” for Humboldt County and downstream water users (Proviso 2), as provided in the 1955 Trinity River Division Act.

Flow Augmentation Components

The Proposed Action is comprised of three different flow augmentation components to be implemented as needed in a phased approach, based on environmental (e.g., flow) and biological conditions. The three components include: (1) a preventive base-flow release that targets increasing the base flow of the lower Klamath River to 2,800 cfs from mid-August to late September, to improve environmental conditions; (2) a preventive pulse flow to be used as a secondary measure to alleviate continued poor environmental conditions and signs of Ich infection in the lower Klamath River; and (3) a contingency volume, to be used on an emergency basis as a tertiary treatment to avoid a significant die-off of adult salmon when the first two components of the Proposed Action are not successful at meeting their intended objectives. Reclamation would implement these flow augmentation components in coordination with Federal, State, and tribal resource specialists, including fisheries biologists or pathologists (i.e., Long-Term Plan to Protect Adult Salmon in the Lower Klamath River [LTP] Technical Team).

Details of implementing each flow component of the Proposed Action (Alternative 1) are described below.

Preventive Base Flow Augmentation Initiate preventive base-flow augmentation from Lewiston Dam when one or more of the following conditions occur:

- Flow in the lower Klamath River is projected to be less than 2,800 cfs at the Klamath, California gage (gage # 11530500) in August and September (USFWS 2015).
- Ich infection of adult salmon or steelhead is identified in July and early August, suggesting a low-level infection is present that could worsen with poor environmental conditions.
- Thermal regime of the lower Klamath River is inhibitory to the upstream migration of infected adult salmon.
- High densities of adult fall-run Chinook Salmon and steelhead are holding in the lower Klamath River.

In coordination with the LTP Technical Team, Reclamation will initiate preventive base-flow augmentation releases by August 22 to meet the target flow (2,800 cfs) in the lower Klamath River, if the fish harvest metric above is not met. This date was selected based on historical harvest information for the estuary and the middle Klamath River area (as summarized in USFWS and NMFS 2013). Reclamation will continue flow augmentation to target a flow of 2,800 cfs in the lower Klamath River, as measured at the Klamath, California gage through September 21. The LTP Technical Team would continue to implement fish-pathology monitoring to determine the potential need for the secondary flow augmentation action (Preventive Pulse Flow).

Preventive Pulse Flow During the preventive base flow period, a preventive pulse flow targeting a rate of 5,000 cfs for one 24-hour period at the Klamath, California gage would occur when the peak fall-run migration (typically the first or second week of September) is identified in the lower Klamath River, as indicated by fish density. This flow level, based on 2015 experience, intends to use a small volume of water to provide a change to the environmental conditions of the lower Klamath River; further reducing the Ich infection risk that could result in a disease outbreak (Reclamation 2015c). Specifically, the anticipated benefit of the pulse flow is to enhance flushing and dilution of parasites in the river when the bulk of fall-run Chinook Salmon adults are likely to be in the lower river; while also improving water quality/quantity to facilitate movement of adult salmon, eliminating the potential for crowding. Conditional release of this pulse flow requires low-level infections of Ich (less than 30 Ich per gill arch), confirmed on three fall-run adult salmon (of a maximum sample size of 60 fish), captured in the lower Klamath River in one day during this time of typical peak migration, subject to LTP Technical Team review. Disease sampling and confirmation of disease findings would follow the methods as described by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in the 2013 Fall Flow Release Recommendation (2013).

Emergency Pulse Flow Augmentation Initiate an emergency flow release to target a flow of 5,000 cfs in the lower Klamath River for up to five days in August or September, if these emergency conditions exist as identified by USFWS and NMFS (2013):

- Diagnosis of severe Ich infection of gills (30 or more parasites on a gill arch) in 5 percent, or greater, of a desired sample of 60 adult salmonids confirmed by the USFWS' California-Nevada (CA-NV) Fish Health Center, or

- Observed mortality of greater than 50 dead adult salmonids in a 20 kilometer reach in 24 hours, coupled with the confirmed presence of Ich by the USFWS CA-NV Fish Health Center.

The protocol for sharing and confirming information would be used on a real-time basis to determine if and when the emergency flows would be implemented. The LTP Technical Team and agency managers would be on high alert during the flow augmentation action and would be getting timely on-the-ground monitoring results. The USFWS CA-NV Fish Health Center would provide a pathology report documenting the findings of its diagnostics survey to Federal, State, and tribal fish biologists and pathologists, and the Klamath Fish Health Assessment Team (KFHAT). An emergency release would be considered by Reclamation on receipt of a positive pathology report.

The need for emergency flow augmentation is expected to be low considering its infrequent use in the past (only once in 6 years of implementing an action since 2002), and the knowledge gained from previous years regarding the dynamics of Ich infection and environmental variables including flow. Since the 2002 fish die-off, additional emergency releases were only required during 2014 when preventive base flows were 2,500 cfs (i.e., 300 cfs lower than the Proposed Action) in the lower Klamath River. Accordingly, the Proposed Action (Alternative 1) was developed to minimize, to the extent possible, the use of these emergency flows.

Annual Implementation Process

The annual implementation process, beginning in late March, outlines a month-by-month process to determine: whether augmentation flows are required in a given year; which water source(s) would be used for augmentation flows; and, to finalize and implement augmentation flows. Table 2-1 presents the process by month that Reclamation would follow.

Table 2-1. Annual Implementation Schedule for the Proposed Action (Alternative 1)

Timeframe	Actions
March through May	1. Reclamation obtains Klamath Basin accretion forecasts from the NOAA California Nevada River Forecast Center 2. Reclamation develops projections for lower Klamath River flows through September, based on: the NOAA accretion forecast; 2013 USFWS and NMFS Klamath Project Biological Opinion release requirements from Iron Gate Dam; tribal boat dance flows (even years in the Klamath River, and odd years in the Trinity River); and the Trinity River ROD flows from Lewiston Dam 3. Reclamation assesses environmental conditions and the applicability of augmentation criteria in collaboration with tribes and resource agencies 4. Reclamation assesses hydrologic conditions (current and projected) and water supply allocations in the CVP 5. Reclamation coordinates with the USFWS, CDFW and NMFS
May through July	1. Reclamation collaborates with tribes, CVP water and power users, regulatory agencies, and other key stakeholders for additional input 2. The LTP Technical Team continues to assess environmental conditions and the need for augmentation flows 3. Reclamation refines the augmentation flow regime, if applicable 4. Reclamation coordinates with Humboldt County on potential use of their Contractual Right for preventive and emergency flow actions
August through September	1. Preventive flow augmentation is implemented, if needed 2. The LTP Technical Team conducts monitoring, evaluates data and conditions, and determines the need for supplemental actions; including preventive pulse flow and emergency pulse flow augmentation
October through December	1. The LTP Technical Team convenes to review and document outcomes from the year's activities

Note:
The LTP Technical Team would consist of Federal, State, and tribal resource specialists, including fisheries biologists or pathologists.
Key:
CDFW = California Department of Fish and Wildlife
CVP = Central Valley Project
NMFS = National Marine Fisheries Service
NOAA = National Oceanic and Atmospheric Administration
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
ROD = Record of Decision
LTP = Long-Term Plan to Protect Adult Salmon in the Lower Klamath River
USFWS= U.S. Fish and Wildlife Service

Monitoring and Research

Monitoring and research efforts will include both essential monitoring actions (e.g., monitoring required to measure the flow augmentation component triggers, such as Ich infestation level) as well as additional monitoring and research actions, to inform potential refinement of flow augmentation trigger criteria.

Essential Monitoring Actions The following required essential monitoring actions evaluate if the specific criteria have been triggered for the three flow augmentation components. These essential monitoring actions would be performed annually.

Flow and Water Temperature Real-time flow and water temperature data would be obtained from existing U.S. Geological Survey (USGS) stream gages along the Klamath and Trinity Rivers. Preventive and emergency flow augmentation criteria and actions are based upon the Klamath, California gage (gage # 11530500).

Fish Density, Including Estuary Counts The Yurok Tribe would collect harvest and catch effort data for the estuary. Estimates of fall-run Chinook Salmon adult abundance in the estuary will be made based on weekly or more frequent harvest quantity data and the fishing efforts of the Yurok Tribe. A key assumption is that the number of Chinook Salmon that escape estuary harvest is positively associated with the number of fish that are harvested. In addition, other methods for determining fish densities will be developed through the research and monitoring actions, such as in-river sonar.

Fish Health Monitoring (Ich) Monitoring and assessment of salmon and steelhead for the presence of Ich would be conducted along the lower Klamath River during the late-summer and fall months (July through October) by the Yurok, Hoopa and Karuk Tribes, or resource agencies. Fish will be collected using gill nets, dip nets, spears, and hook-and-line. During monitoring activities, the first gill arch on each side of the fish will be removed and examined in the field for Ich with a dissecting microscope, and slides will be prepared for archiving. Samples will be provided to the USFWS CA-NV Fish Health Center for examination with more powerful microscopes. Individual Ich organisms on the gill arches would be counted as soon as possible. Additional information, including fish length and potential presence of a coded-wire tag will be recorded. If the fish is missing its adipose fin (indicative of coded-wire tagging), the head will be collected and frozen for later retrieval of the coded-wire tag. All results would be presented to the LTP Technical Team and KFHAT.

For emergency flow augmentation criteria related to observed mortality, Reclamation will utilize information from KFHAT and other sources, as available. The KFHAT requests that public individuals provide notification if large numbers of dead or dying fish are observed in the lower Klamath River. This information, in conjunction with observations made by the Yurok and Karuk Tribes during their fish health monitoring, and by the USFWS and CDFW, would be utilized for identifying the emergency flow augmentation trigger of 50 or more freshly dead salmon in a 20 kilometer (12.43 mile) reach.

Potential Additional Monitoring and Research Actions and Flow Component Trigger Criteria Refinement As part of the Proposed Action (Alternative 1), additional monitoring and research actions would be conducted to further scientific understanding of causative factors of Ich infection and outbreak in the lower Klamath River. Based on the concept of adaptive management, and utilizing additional scientific information on the causative factors, Reclamation may refine trigger criteria of the three flow components (e.g., preventive base flow augmentation, preventive pulse flows, and emergency pulse flow augmentation) to further reduce the likelihood—and potentially the severity—of any Ich epizootic event. The process for potential refinement of flow component trigger criteria will be based on adaptive management principles, as follows:

- Develop hypotheses and conceptual models to identify potential causative factors (e.g., identification of relationships between salmon and environmental conditions—including pathogens—to ecological processes and potential management actions).

- Develop and refine performance measures related to reducing the likelihood of Ich epizootic events and associated fish die-offs.

- Collect and evaluate relevant data and other information pertaining to physical and biotic components of the Klamath River system, salmon performance, pathogen presence, and Ich infestation.
- Propose modifications to flow augmentation trigger criteria that would decrease the likelihood—and potentially the severity—of Ich epizootic outbreaks.
- Recommend implementation of additional monitoring and research programs to examine how selected management actions meet performance measures.

Table 2-2 identifies additional monitoring and forecasting actions that may be conducted as part of the Proposed Action to inform refinement of flow augmentation trigger criteria. Table 2-3 identifies potential key scientific questions and related research and monitoring efforts to support hypothesis and conceptual model development. It is recognized that the identified actions in Tables 2-2 and 2-3 are not all-inclusive. Reclamation anticipates that new developments or studies may be identified and conducted that could influence future monitoring and research efforts.

This monitoring process would be administered by Reclamation with input from the LTP Technical Team. Participants would typically convene several times a year; including late-fall, to review outcomes from the previous year's activities; and spring to make recommendations concerning the coming year's preventive base flow augmentation, preventive pulse flow and emergency flow augmentation actions, and related monitoring. Refinement of the trigger criteria for the flow components could result in minor modifications to preventive base flow augmentation, preventive pulse flow, and emergency flow augmentation actions described in this EIS.

The purpose of adaptive management is to allow for mid-course corrections that can be employed to better manage flow as new information becomes available. For example, the flow target of 2,800 cfs could be modified through an adaptive management approach, as could the frequency of flow augmentation actions. While it is likely that adjustments in flow may lead to using less water as causative factors become better understood, it is also possible that additional flow may be necessary. Reclamation would prepare supplemental environmental documentation, as necessary, as changes to the flow augmentation actions are contemplated based on new information gained through adaptive management.

Table 2-2. Potential Additional Monitoring and Forecasting Actions to Inform Flow Augmentation Trigger Criteria for Alternatives 1 and 2

Monitoring/Forecasting Actions	**Data Type**
Adult Salmon Abundance in Estuary/Lower Klamath River	
Yurok Tribal fishery landings	- Index of abundance/density
CDFW sport creel census	- Index of abundance/density
Summer snorkel surveys at thermal refugia	- Index of density
CDFW upriver weir counts	- Index of ultimate abundance
PSMFC pre-season run-size projections	- Index of abundance planning
Migration run timing in river and at hatchery	- Index of run composition and response to flow augmentation
Willow Creek weir counts (late August, removed at 2400 cfs)	- Index of run composition and response to flow augmentation
Karuk Tribal fishery and health monitoring/mouth of salmon	- Index of run composition and response to flow augmentation - Index of infectivity
Adult Salmon Pathology	
Adult salmon samples (lower Klamath River)	- Index of infectivity
External parasite/bacterial examination	- Index of infectivity
USFWS histology/pathology	- Index of infectivity/pathogenicity
Mortality/pre-spawning mortality	- Index of pathogenicity
Hatchery sampling	- Index of infectivity
Water Temperature and Flow	
USGS Gage No. 11530500	- River discharge
Yurok Tribe Environmental Program monitoring	- Water temperature
Annual hydrologic February – April forecasts	- Planning – river discharge
River water temperature forecasting models	- Planning – water temperature
Meteorology forecasting	- Planning – water temperature and river discharge

Key:
CDFW = California Department of Fish and Wildlife
PSMFC = Pacific States Marine Fisheries Commission
USFWS = U.S. Fish and Wildlife Service
USGS = U.S. Geological Service

1 Table 2-3. Potential Scientific Questions and Research and Monitoring Efforts to Support
2 Hypothesis and Conceptual Model Development for Alternatives 1 and 2

Scientific Questions	Research and Monitoring Efforts
How well do Yurok Tribal fishery metrics and other fish density estimates reflect salmon abundance and densities in the lower Klamath River?	- Net harvest index of immigrating salmon abundance - Extent and persistence of thermal refugia use - Underwater observations of atypical salmon behaviors - Migration/movement responses to flow and temperature cues - Fishery independent measures of abundance - Test ARIS camera technology for measuring salmon abundance and densities - Efficacy of flow augmentation criteria for protecting late-running spring Chinook Salmon
What are the key dynamics and metrics for determining Ich (and other pathogens) infectivity and pathogenicity?	- Ich infectivity and relationships to adult salmon spatiotemporal dynamics - Triggers for Ich infectivity and pathogenicity - Relationship of Ich infectivity to gill hyperplasia and pathogenicity - Spatiotemporal and interannual dynamics of Ich infection - "Hangover Effect" (e.g., latent carry-over of pathogens to successive years) - Synergism of Ich infectivity with other pathogens (i.e., Columnaris) - Interaction of resident fish as a reservoir of Ich - Synergism of Ich infectivity with other stressors (water quality, microcystin) - Sentinel fish monitoring for presence or virulence of pathogens - Identification of controlling factors and thresholds for Ich infectivity
What potential techniques are available, and can effective monitoring and assessment techniques for Ich be used as part of annual management?	- Non-lethal histologic sampling techniques - Controlled experiments on Ich-infected adult salmon - Infective-stage parasite (theront) density in water samples - eDNA techniques to measure Ich presence and density - Use of sentinel fish histopathology monitoring - ARIS technology - Evaluate pathogenicity of different genotypes of Ich/genotype(s) in Klamath River
How have hatchery operations and in-river harvest affected run timing, and does current management accommodate or provide for manipulation of run-timing?	- Has selection of run-timing been significant in Klamath Basin stocks? - Would manipulation of broodstock selection be of value to reduce vulnerability?
How much influence does upstream reservoir management/operation have on lower Klamath River water temperatures?	- Water temperature monitoring at key measurement nodes - Improve/update calibration of water temperature models
What are the potential inadvertent or unanticipated adverse effects of late-summer flow augmentation that may require monitoring and mitigation?	- Asynchronous cue attracting a pre-mature entry of fall run from ocean - Effects to resident fish, herpetofauna, and invertebrates, especially in upstream reaches - Advance immigration of fall run to upper Trinity River increasing potential of spawning overlap with spring run - Depending on source of late-summer flow, impair or delay immigration of spring run (i.e., reduction in spring Trinity River ROD releases) - Impacts to Hoopa Tribal fishery (net-fouling) - Impacts to hatchery operations by prematurely queuing immigration/arrival - Impacts to thermal refugia
What are salmon responses to late-summer flow augmentation?	- Employ field and analytic techniques to monitor and measure salmon response to flow and temperature management - Migration initiation, rates, and behavioral responses - Flow, temperature relationships with infectivity and pathogenicity of Ich

3
Key:
ARIS = Adaptive Resolution Imaging Sonar
ROD = Record of Decision
eDNA = Environmental DNA

Trinity River Record of Decision Flow Rescheduling Alternative (Alternative 2)

The Trinity River ROD provides for annual instream flows below Lewiston Dam according to the recommendations provided in the Trinity River Mainstem Fishery Restoration Final EIS/EIR (DOI and Hoopa Valley Tribe 2000; USFWS et al. 2000). Under the Trinity River ROD, the total volume of water released from the Trinity River Division (TRD) to the Trinity River will range from approximately 369,000 acre-feet to 815,000 acre-feet, depending on the annual hydrology (water-year type) determined as of April 1 of each year. For the Trinity River mainstem, the recommended flow regimes link two essential purposes deemed necessary to restore and maintain the Trinity River's fishery resources: 1) flows to provide physical fish habitat (i.e., appropriate depths and velocities, and suitable temperature regimes for anadromous salmonids), and 2) flows to restore the riverine processes that create and maintain the structural integrity and spatial complexity of the fish habitats.

The Trinity River ROD Flow Rescheduling Alternative (Alternative 2) includes supplemental flows from Lewiston Dam to prevent a disease outbreak in the lower Klamath River in years when the river's flow is projected to be less than 2,800 cfs. Supplemental flows would come sequentially from water stored in Trinity Reservoir, primarily through modifying the pattern of releases (i.e., rescheduling) for Trinity River ROD flows. If rescheduling of ROD flows is insufficient to meet flow augmentation requirements, water would be released pursuant to authorities provided in the 1955 Trinity River Division Act, including Provisos 1 and 2. The supplemental flows would be comprised of the same three components described for the Proposed Action (Alternative 1), including preventive base flow augmentation, preventive pulse flow, and emergency pulse flow augmentation.

Under Alternative 2, Trinity River ROD flow releases would be reduced in earlier months to reserve a portion of the total release volume, to meet the estimated need for supplemental flows later in the season. Table 2-4 identifies the volume of water, based on Trinity River ROD year type, to be rescheduled for release in August and September for flow augmentation. Figure 2-1 shows how the pattern of Trinity River ROD flows would be rescheduled during each year type, by reducing the flows early in the year to provide a reserve for release in August and September for flow augmentation. For extremely wet, wet, normal, and dry year types, the ramping rate would be accelerated following the peak spring flows (e.g., rate of flow curtailment on falling limb would be accelerated). For these four year types, the duration of spring peak flows and the magnitude of the spring peak flows would be maintained. For critically dry years, the duration of the peak spring flows would be reduced as shown in Figure 2-1. For critically dry years, the magnitude of the spring peak flows and ramping rates would be maintained. The Trinity Management Council will continue to guide the Adaptive Environmental Assessment and Management Program and will recommend possible adjustments to the annual flow schedule (within the designated flow volumes provided in Table 2-4) to ensure that the restoration and maintenance of the Trinity River anadromous fishery continues, based on the best available scientific information and analysis.

Table 2-4. Trinity River ROD Flow Volumes by Water Year Type

Water Year Classification	Total Trinity Reservoir Inflow for Water Year Classification[1] (acre-feet)	Total Volume of Trinity River ROD Flows[1] (acre-feet)	Volume Rescheduled for Alternative 2[2] (acre-feet)
Extremely Wet	>=2,000,000	815,000	3,228
Wet	1,350,000-1,999,999	701,000	7,593
Normal	1,025,000-1,349,999	647,000	10,536
Dry	650,000-1,024,999	453,000	23,476
Critically Dry	<650,000	369,000	33,261

Notes:
[1] As described in the Final Trinity Mainstem Fishery Restoration Environmental Impact Statement/Report (USFWS et al. 2000)
[2] Volumes reflect average estimated preventive base flow augmentation by year type based upon CalSim inputs
Key:
ROD = Record of Decision

The annual implementation schedule for Alternative 2 would be the same as described for the Proposed Action (Alternative 1). Monitoring and research actions would be the same as those described for the Proposed Action (Alternative 1).

Alternatives Eliminated from Detailed Evaluation

During the alternatives development and screening process, a number of project alternatives were considered but eliminated from further consideration. These alternatives and the rationale for their removal from further consideration are described briefly below.

Structural Flow Augmentation Measures

Several alternatives were identified to provide additional flow, or improve the quality of flow, through construction of various facilities. These included construction of water treatment facilities for augmentation flow sources, additional or new storage in the Klamath River basin, or additional storage in the Trinity River basin. These alternatives included such elements as: constructing desalination plants for ocean water, and associated pipelines and storage facilities; constructing water treatments plants above the confluence of the Trinity River, and associated storage facilities; constructing new or expanded storage in the Klamath River basin (including dams and reservoirs on the Shasta and Scott Rivers); and, constructing new or expanded storage in the Trinity River Basin. None of these measures would be implementable in 2017, and would take several years or more to plan, design, and construct. While additional storage in the Trinity River Basin could alleviate some of the impacts associated with the proposed action, environmental effects related to construction would likely be substantial.

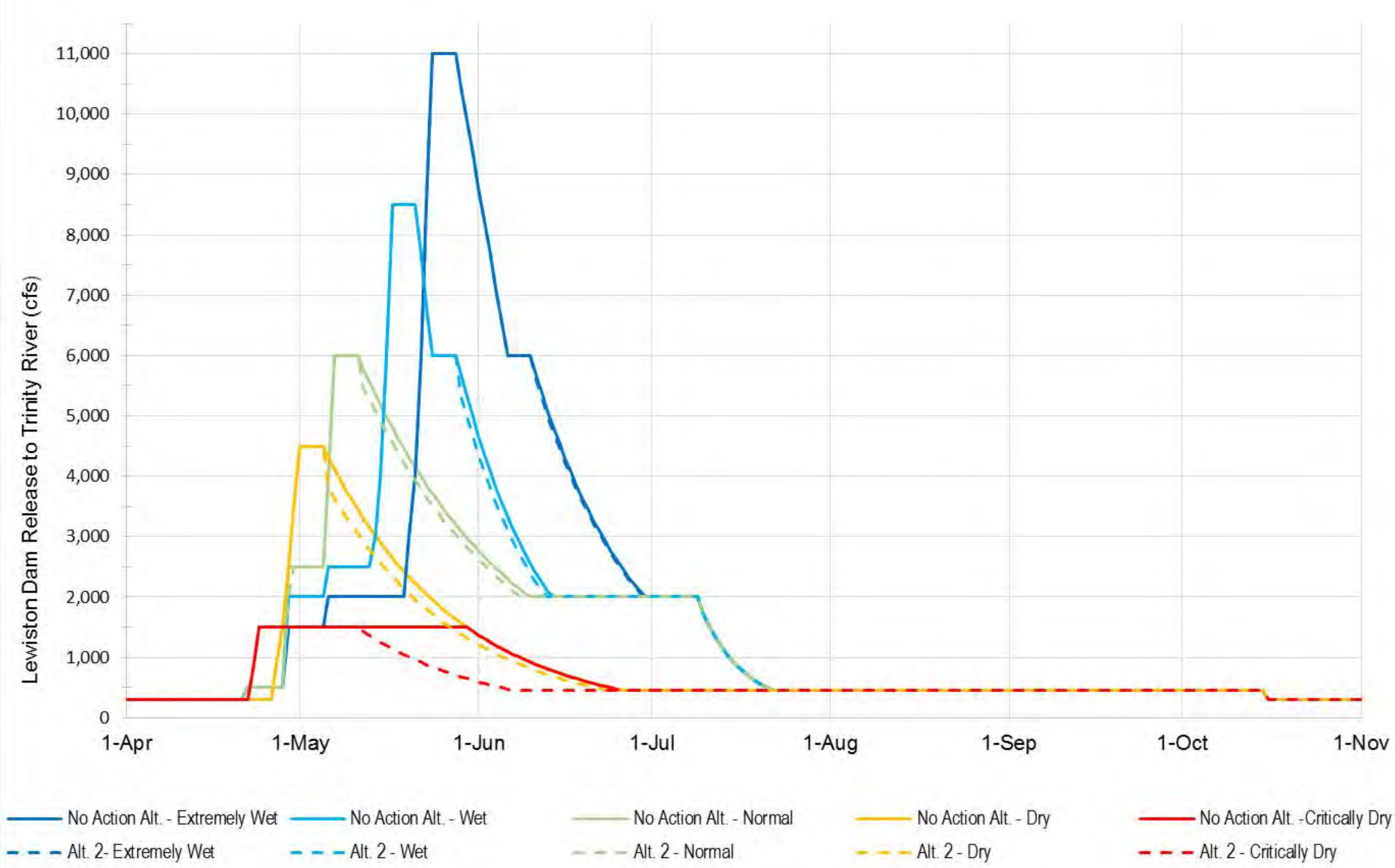

Figure 2-1. Rescheduling of Trinity River ROD Flow Release Pattern for All Year Types Under Alternative 2

Non-Structural Flow Augmentation Measures

Several non-structural alternatives were identified to provide additional flow through reoperating existing facilities or modifying regulatory requirements in the Klamath River Basin. In the Klamath River Basin upstream of the confluence with the Trinity River, these included: reoperating the Klamath Project through prioritizing fishery flows, acquiring water from willing sellers, or providing replacement water supplies; reoperating the Klamath Hydroelectric Project; reoperation of Klamath River tributary facilities; and altering flow requirements under the 2013 Klamath Project BO. Evaluations indicated that increased releases from Klamath River Basin sources would provide limited to no reduction in temperature in the lower Klamath River compared to increased releases from Trinity Reservoir. Since temperature is a significant contributing factor to Ich epizootic events, flow augmentation from Klamath River Basin sources would not be as effective as releases from the Trinity River Subbasin and would not address more than one of the contributing factors to an Ich epizootic event. Further, for the Trinity River Subbasin, non-structural flow augmentation measures that were not carried forward and incorporated into alternatives include: reoperation of storage in Trinity Reservoir based on acquiring water from willing sellers, providing replacement water supplies, modifying Reclamation's Safety of Dams storage restrictions for Trinity Dam, increasing wet year carryover storage in Trinity Reservoir, or carryover storage of Proviso 2 water up to 150 thousand acre-feet. As acquisition of water supplies from willing sellers and providing replacement water supplies from other sources to water users would not reliably provide needed water supplies, these measures would not be able to reliably reduce crowded holding conditions for pre-spawn adults nor reduce warm water temperatures in the lower Klamath River. Modifying Reclamation's Safety of Dams storage restrictions for Trinity Dam would result in unacceptable risks to human health and safety and associated potential for significant impacts due to dam failure. Increasing carryover storage in Trinity Reservoir, either through increasing carryover in wet years or accumulating unused portions of the Humboldt County contract water, would increase operational spills (such releases may not be considered a beneficial use). Additionally, carryover storage of Proviso 2 water implicates CVP system-wide operational criteria and plan that may require modification and a greater scale of analysis to determine potential impacts to the CVP from the potential change in operational criteria and plan. Because of the need for this additional analysis, this proposed alternative is not immediately implementable by August 2017 and as a result, would not meet the purpose and need.

Non-Flow Related Measures

Additional alternatives were identified that consisted of such elements as fisheries management actions, improvement in water quality or temperature, and other measures. These included: reducing hatchery production targets within the Klamath River Basin, including the Trinity River Hatchery; restricting commercial and recreational fishing for Klamath Basin Chinook Salmon and Coho Salmon; removing restrictions to tribal, commercial, and recreational fishing for Klamath Basin Chinook Salmon and Coho Salmon; implement fish passage improvement in the lower Klamath River; implementing a truck-and-transport operation on the lower Klamath River; reducing lower Klamath River flows during the early migration period; directly treating the lower Klamath River for the prominent fish disease (most likely Ich) using chemicals such as chloramine-T, formalin, potassium permanganate, copper sulfate, or sodium chloride; implementing stream habitat enhancement and restoration to reduce water temperature in the lower Klamath River; reconstructing facilities at Lewiston Dam and Reservoir to improve water temperatures; implementing additional water quality standards for agricultural return flow in the

Klamath River Basin to improve water quality to better meet fish needs; and, physically removing all or part of Iron Gate Dam, Copco No. 1 Dam, Copco No. 2 Dam, and JC Boyle Dam, and appurtenant works currently licensed to PacifiCorp. Other non-flow related measures consisted of implementing additional habitat improvement or water quality improvement projects.

Reclamation reviewed each of these concepts, and determined that many of them would not meet the purpose and need for the project, nor did they alleviate one or more of the significant impacts that might be associated with the Proposed Action. Further, none of these concepts would meaningfully and substantially reduce the likelihood, and potentially reduce the severity of Ich epizootic events. Some of these concepts, such as removal of the PacifiCorp dams and reconstructing facilities at Lewiston Dam and Reservoir would not be implementable in 2017. Several of these concepts are already being pursued in different venues, and while they cannot provide a solution on their own, they're part of the larger comprehensive management of the Klamath River system. Many of these elements—such as improving temperature management at Trinity Reservoir—will continue to be pursued in those venues, and Reclamation will support those efforts to the extent practicable.

References

DOI (U.S. Department of the Interior) and Hoopa Valley Tribe. 2000. Record of Decision – Trinity River Mainstem Fishery Restoration. December.

DOI and DFG (U.S. Department of the Interior and California Department of Fish and Game). 2012. Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report. December.

Reclamation (U.S. Department of the Interior, Bureau of Reclamation). 2015a. Draft Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River. April.

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____. 2015c. Lower Klamath River Late-Summer Flow Augmentation from Lewiston Dam Environmental Assessment. August.

USFWS (U.S. Department of the Interior, U.S. Fish and Wildlife Service). 2015. Response to Request for Technical Assistance Regarding 2015 Fall Flow Releases. Memorandum. August 10.

USFWS (U.S. Department of the Interior, U.S. Fish and Wildlife Service), Reclamation (U.S. Department of the Interior, Bureau of Reclamation), Hoopa Valley Tribe, and Trinity County). 2000. Trinity River Mainstem Fishery Restoration Environmental Impact Statement/Report. October.

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Chapter 3 Considerations for Describing Affected Environment and Environmental Consequences

Basis of Environmental Analysis

This Environmental Impact Statement (EIS) addresses effects that would result from the implementation of the action alternatives as compared to the No Action Alternative. The document addresses changes in operations of the Trinity River Division (TRD), and other Central Valley Project (CVP) and State Water Project (SWP) facilities, that could occur between now and 2030 (as described in Chapter 1, "Introduction") if implementing the action alternatives. Implementation of the action alternatives do not include any additional construction or expansion of facilities, therefore there are no construction-related impacts discussed in this EIS.

Resources Considered for Environmental Analysis

Each resource chapter (Chapters 4 through 14) describes the affected environment and the associated direct, indirect, and cumulative impact with implementation of the No Action Alternative and the action alternatives. Potential cumulative effects that would occur with implementation of the alternatives are described in each resource chapter. Potential mitigation measures to avoid, reduce, or otherwise minimize potential adverse impacts to the environment due to implementation of the proposed action and action alternatives are also discussed within each resource area.

The resources included in Chapters 4 through 14 were identified during the scoping process and as described in the 2015 *Scoping Report Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River* (Reclamation 2015). The following resources are described and analyzed in this EIS' chapters:

- Chapter 4 "Surface Water Supply and Management"
- Chapter 5 "Surface Water Quality"
- Chapter 6 "Groundwater Resources/Groundwater Quality"
- Chapter 7 "Biological Resources – Fisheries"
- Chapter 8 "Biological Resources – Terrestrial"

- Chapter 9 "Hydropower Generation"
- Chapter 10 "Air Quality, Greenhouse Gas Emissions, and Global Climate Change"
- Chapter 11 "Agricultural Resources"
- Chapter 12 "Socioeconomics"
- Chapter 13 "Indian Trust Assets"
- Chapter 14 "Environmental Justice"

Because the action alternatives would use existing facilities and conveyances, and flow release augmentations would remain within the range of historical releases, there are no obligations under Section 106 of the National Historic Preservation Act as the undertaking does not have the potential to effect historic properties, pursuant to 36 CFR § 800.3(a)(1). As a result, there would be no substantial impacts to historic properties from the action alternatives. Therefore, cultural resources received no further impact analysis under the National Environmental Policy Act.

Scoping comments questioned potential impacts to geology, soils and mineral resources, due to soil subsidence and greater deposits of salts, that negatively affect soil quality by relying more heavily on lower-quality groundwater resources. Both of these potential impacts are addressed in Chapter 6, "Groundwater Resources/Groundwater Quality."

Regulatory Environment and Compliance Requirements

Federal or State regulations relevant to implementation of the alternatives evaluated in this EIS are described in the *Regulatory Environment and Compliance Requirements* portions of Chapters 4 through 14, as appropriate.

Affected Environment

The *Affected Environment* portions of Chapters 4 through 14 provide an adequate level of detail for the quantitative and qualitative impact analyses presented in this EIS.

Implementation of the action alternatives could result in changes to:

- Flow rates and water quality in the lower Klamath River and Trinity River, and associated use of the rivers to support fishery and terrestrial resources and socioeconomics (e.g., commercial and tribal fishing, recreation).
- Flow rates and water quality in rivers downstream of other CVP and SWP reservoirs, and associated use of the rivers to support biological resources.
- Water elevations in TRD reservoirs, and other CVP and SWP reservoirs that store water supplies, and associated use of the reservoir or surrounding areas to support biological resources.

- Flows and water quality in the Sacramento-San Joaquin River Delta (Delta), including Delta outflow and reverse flows, and associated use of the rivers to support beneficial uses.
- CVP deliveries, including associated changes in agricultural production, groundwater use and socioeconomics.
- CVP and SWP energy generation and use, including associated changes in greenhouse gas emissions.

Impact Analysis

The *Impact Analysis* sections in each resource chapter (Chapters 4 through 14) address direct, indirect, and cumulative effects of the alternatives and potential mitigation measures (if necessary and available). The impact analysis includes quantitative and qualitative analyses depending upon the availability of acceptable numerical analytical tools and available information. The quantitative analyses include numerous analytical tools, as summarized in Figure 3-1.

References

Reclamation (U.S. Department of the Interior, Bureau of Reclamation). 2015. Scoping Report Long-Term Plan for Protecting Late Summer Adult Salmon in the Lower Klamath River. Humboldt County, California. November.

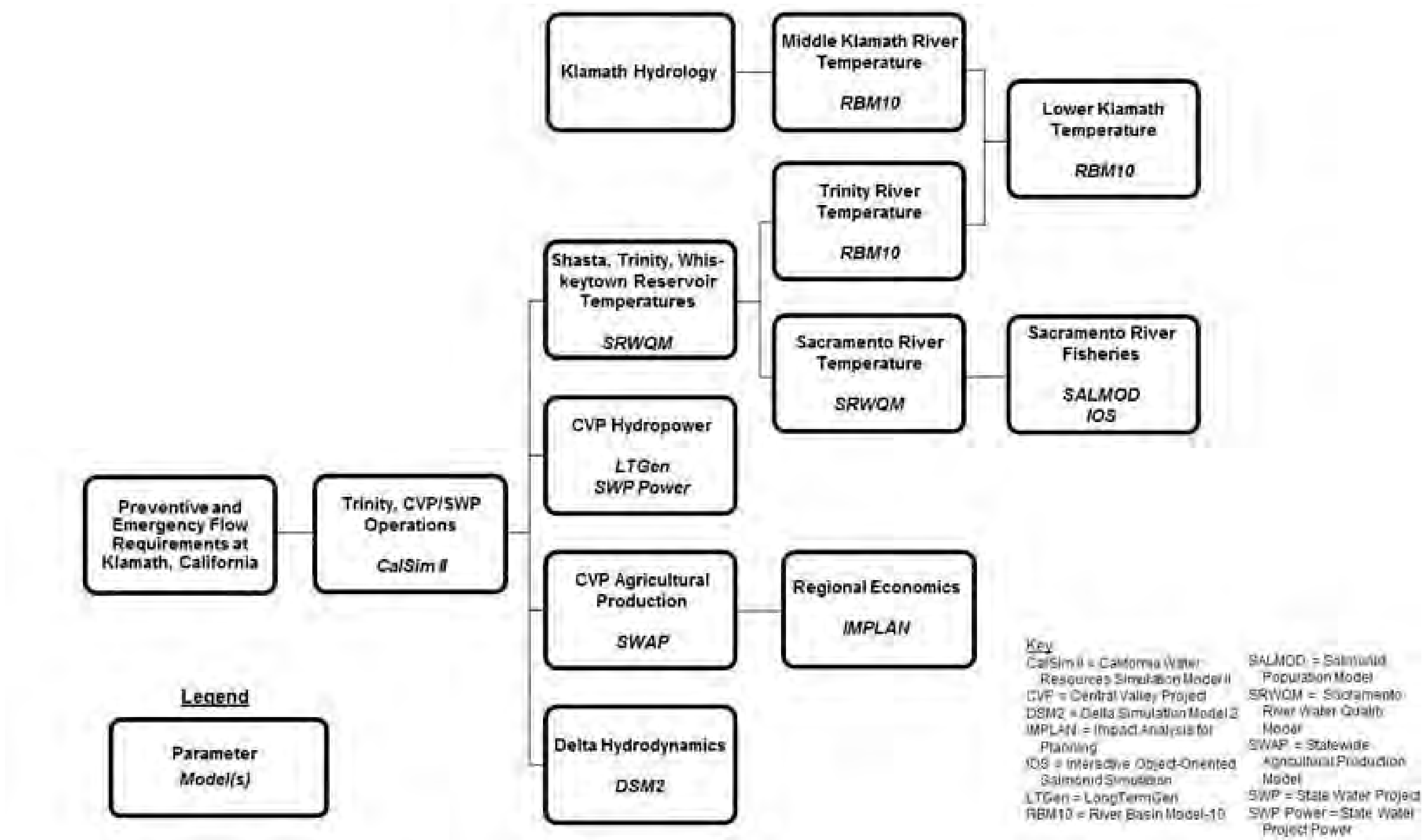


Figure 3-1. Analytical Framework Used to Evaluate Impacts of the Alternatives

Chapter 4 Surface Water Supply and Management

Introduction

This chapter describes the surface water resources and water supplies in the study area and potential changes that could occur as a result of implementing the alternatives evaluated in this Environmental Impact Statement (EIS). Implementation of the alternatives could affect these resources through potential changes in operation of the Central Valley Project (CVP), including the Trinity River Division (TRD), and the State Water Project (SWP), as a result of augmenting flows in the lower Klamath River.

Regulatory Environment and Compliance Requirements

The CVP, including the TRD (e.g., Trinity and Lewiston Dams), and SWP are operated in a coordinated manner in accordance with Public Law 99-546 (October 27, 1986), directing the Secretary to execute the Coordinated Operating Agreement (COA). The COA is an agreement between the Federal government and the State of California for the coordinated operation of the CVP and SWP.

The CVP and SWP are also operated under the State Water Resources Control Board (SWRCB) decisions and water right orders related to Reclamation's CVP and California Department of Water Resources' (DWR) SWP water right permits and licenses to appropriate water by diverting to storage, by directly diverting to use, or by re-diverting releases from storage later in the year or in subsequent years. The CVP and SWP have built water storage and water delivery facilities in the Central Valley to deliver water supplies to CVP and SWP contractors, including senior water users.

Reclamation and DWR water rights are conditioned by SWRCB to protect the beneficial uses of water within the CVP and SWP and jointly for the protection of beneficial uses in the Sacramento Valley and the Sacramento–San Joaquin Delta Estuary. Reclamation and DWR coordinate and operate the CVP and SWP to meet water right and contract obligations upstream of the Sacramento-San Joaquin River Delta (Delta), Delta water quality objectives, and CVP and SWP water right and contract obligations that depend upon diversions from the Delta.

The Porter-Cologne Water Quality Control Act provides for the development and periodic review of water quality control plans that designate beneficial uses of California's major rivers and groundwater basins and establish narrative and numerical water quality objectives for those waters. SWRCB adopted the *1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*, which was implemented, in part, through the SWRCB Decision 1641 (D-1641). SWRCB D-1641 amends certain terms and conditions of the

SWP and CVP water rights to impose flow and water quality objectives to assure protection of beneficial uses in the Delta and Suisun Marsh. SWRCB also grants conditional changes to points of diversion for each project with SWRCB D-1641.

The CVP and SWP are also operated consistent with the U.S. Fish and Wildlife Service (USFWS) *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project and State Water Project* (2008 USFWS BO) (USFWS 2008) and the National Marine Fisheries Service (NMFS) 2009 *Biological Opinion and Conference Opinion on the Long- Term Operations of the CVP and SWP* (2009 NMFS BO) (NMFS 2009). The 2008 USFWS BO and the 2009 National Marine Fisheries Service (NMFS) BO each included a Reasonable and Prudent Alternative (RPA) to avoid jeopardy to fish species. These RPAs included conditions for revised water operations of the CVP and SWP, habitat restoration and enhancement actions, and fish passage actions.

In addition, Reclamation's Klamath Project is operated consistent the terms and conditions of the UUSFWS and NMFS *Biological Opinion on the Effects of Klamath Project Operations from May 31, 2013, through March 31, 2023, on Five Federally Listed Threatened and Endangered Species* (2013 Klamath BO) (USFWS and NMFS 2013). The 2013 Klamath BO identifies flow and volume targets for Iron Gate Dam releases which affect conditions in the lower Klamath River. Reclamation coordinates closely with PacifiCorp on the releases from Iron Gate Dam.

Affected Environment

This section describes the surface water resources and water supplies that could be potentially affected by the implementation of the alternatives considered in this EIS, including:

- **Surface Water Hydrology –** Storage in Trinity Reservoir and flows in the Trinity River and the lower Klamath River will be directly influenced by the additional augmentation flows released to the Trinity River at Lewiston Reservoir. These additional releases may also change operations at other CVP and SWP facilities due to changes in exports from the TRD to the Sacramento River basin.

- **Deliveries to CVP and SWP Water users –** CVP water delivery may be directly affected by the potential changes in TRD export of water from the Trinity River basin. The changed CVP operations, through changes in Sacramento River flows into the Delta may also affect SWP water operations through the joint operation of CVP and SWP export facilities under the COA.

Additional detailed information on the facilities, current operations, and service areas of the CVP and SWP is provided in the *Coordinated Long-Term Operation of the Central Valley Project and State Water Project EIS* (Reclamation 2015b).

Mean monthly historical data on CVP and SWP operations is presented for the period 2009 to 2016 within the *Affected Environment* section in this chapter. The RPAs in the 2008 USFWS BO and 2009 NMFS BO changed CVP and SWP operations and historical data before that period may not be representative of current operations. The data is shown as mean monthly values for compatibility with the mean monthly simulated CalSim II data used in the analysis.

Overview of CVP and SWP Water Supply and Water Management Facilities

Overview of the Central Valley Project

With the passage of the Rivers and Harbors Act of 1935, Congress appropriated funds and authorized construction of the CVP by the U.S. Army Corps of Engineers (USACE) (Reclamation 1997, 2011a). When the Rivers and Harbors Act was reauthorized in 1937, the construction and operation of the CVP was assigned to the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and the CVP became subject to Reclamation Law (as defined in the Reclamation Act of 1902 and subsequent legislation).

The CVP facilities were initiated in the late 1930s (Reclamation 1997, 2011a). The major CVP facilities include:

- Trinity and Lewiston dams on the Trinity River
- Shasta and Keswick dams on the Sacramento River
- Red Bluff Pumping Plant on the Sacramento River to deliver water into the Tehama-Colusa Canal and the Corning Canal
- Folsom and Nimbus dams on the American River and the Folsom-South Canal
- Delta Cross Channel in the Delta
- Rock Slough Intake to deliver water into the Contra Costa Canal, Contra Costa Pumping Plant, and Contra Loma Reservoir
- Friant Dam along the San Joaquin River to deliver water into the Friant-Kern and Madera canals
- C.W. Jones Pumping Plant (Jones Pumping Plant) (previously known as the Tracy Pumping Plant) in the south Delta to deliver water into the Delta-Mendota Canal (DMC) and Mendota Pool
- DMC/California Aqueduct Intertie downstream from the CVP Jones Pumping Plant and the SWP Harvey O. Banks Pumping Plant (Banks Pumping Plant)
- San Luis Reservoir-related facilities include O'Neill Forebay, Pumping Plant, and Canal; Coalinga Canal; Pleasant Valley Pumping Plant; San Luis Drain; B.F. Sisk Dam (the major dam that forms San Luis Reservoir); San Luis Canal; Los Banos and Little Panoche dams; and associated pumping plants. The O'Neill Forebay, B.F. Sisk Dam, San Luis Canal, Los Banos and Little Panoche dams, and associated pumping plants are operated in coordination with the SWP.

- Pacheco Tunnel and Conduit to deliver water from the San Luis Reservoir into the San Justo Dam and Reservoir, Hollister Conduit, and Santa Clara Tunnel and Conduit
- New Melones Dam along the Stanislaus River

Overview of the State Water Project

As the CVP facilities were being constructed after World War II, the State began investigations to meet additional water needs through development of the California Water Plan. In 1957, DWR published Bulletin Number 3 that identified new facilities to provide flood control in northern California and water supplies to the San Francisco Bay Area, San Joaquin Valley, San Luis Obispo and Santa Barbara counties, and southern California (DWR 1957, 2012, Reclamation 2011a). In 1960, California voters authorized the Burns-Porter Act to construct the initial SWP facilities.

The major SWP facilities include:

- Oroville Dam and Thermalito Diversion Dam on the Feather River
- Barker Slough Pumping Plant (BSPP) in the north Delta which delivers water to the North Bay Aqueduct
- Clifton Court Forebay (CCF) and Banks Pumping Plant in the south Delta, which delivers water into the Bethany Forebay and California Aqueduct
- South Bay Pumping Plant to deliver water from Bethany Forebay to the South Bay Aqueduct and Lake Del Valle
- San Luis Reservoir-related facilities, operated in coordination with the CVP, include O'Neill Forebay, B.F. Sisk Dam, San Luis Canal, Los Banos and Little Panoche dams, and associated pumping plants
- California Aqueduct to deliver water to the San Joaquin Valley, Central Coast, and southern California. The California Aqueduct extends from the Banks Pumping Plant to San Luis Reservoir and continues to Lake Perris in Riverside County

Lower Klamath and Trinity River Region

The Lower Klamath and Trinity River Region includes the Trinity River from Trinity Lake to the confluence with the Klamath River and the Klamath River from the confluence with the Trinity River to the Pacific Ocean.

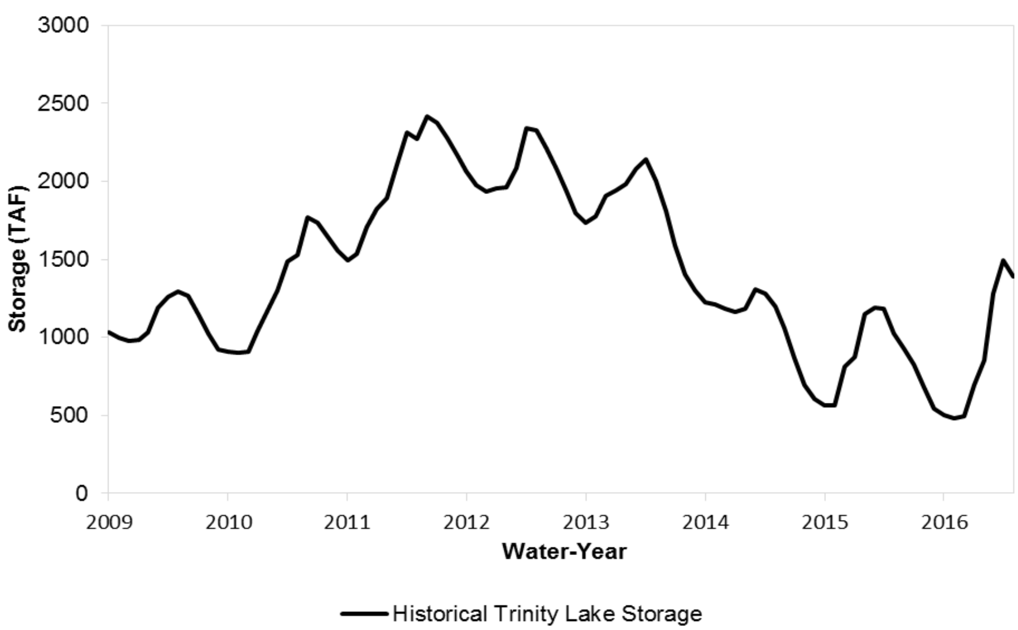
Trinity River

The Trinity River subbasin, part of the Klamath River basin, extends over approximately 1,897,600 acres and ranges in elevation from over 9,000 feet above sea level in the headwaters area to less than 300 feet at the confluence of the Trinity River with the Klamath River (NCRWQCB et al. 2009; USFWS et al. 2000). Average precipitation in the Trinity River subbasin ranges from 30 to 70 inches per year, with a long-term average of approximately 62 inches per year. Over 90 percent of the precipitation has historically occurred between October and April. Precipitation ranges from mostly snow at higher elevations to mostly rain near the confluence with the Klamath River.

The Trinity River includes the mainstem, North Fork Trinity River, South Fork Trinity River, New River, and numerous smaller streams (NCRWQCB et al. 2009; USFWS et al. 1999). The mainstem of the Trinity River flows 170 miles to the west from the headwaters to the confluence with the Klamath River. The CVP Trinity and Lewiston dams are located at approximately River Miles 105 and 112, respectively; and upstream from the confluences of the Trinity River and the North Fork, South Fork, and New River. Flows on the North Fork, South Fork, and New River are not affected by CVP facilities. The Trinity River flows approximately 112 miles from Lewiston Dam to the Klamath River through Trinity and Humboldt counties and the Hoopa Indian Reservation within Humboldt County.

Trinity Lake, a CVP facility on the Trinity River formed by the Trinity Dam, was completed in 1962. The 2.4 million acre-feet (MAF) reservoir is located approximately 50 miles northwest of Redding (USFWS et al. 1999). Lewiston Reservoir, a CVP facility on the Trinity River formed by Lewiston Dam, was completed in 1963 and is located 7 miles downstream from the Trinity Dam. Lewiston Reservoir is used as a regulating reservoir for downstream releases to the Trinity River and to Whiskeytown Lake, located in the adjacent Clear Creek watershed, via Clear Creek Tunnel. Water is diverted from the lower outlets in Trinity Lake to Lewiston Reservoir to provide cold water to Trinity River. There are no other major dams in the Trinity River watershed.

Historical storages in Trinity Reservoir from 2009 to 2016 are presented in Figure 4-1. Trinity Lake storage varies in accordance with upstream hydrology and downstream water demands and instream flow requirements.



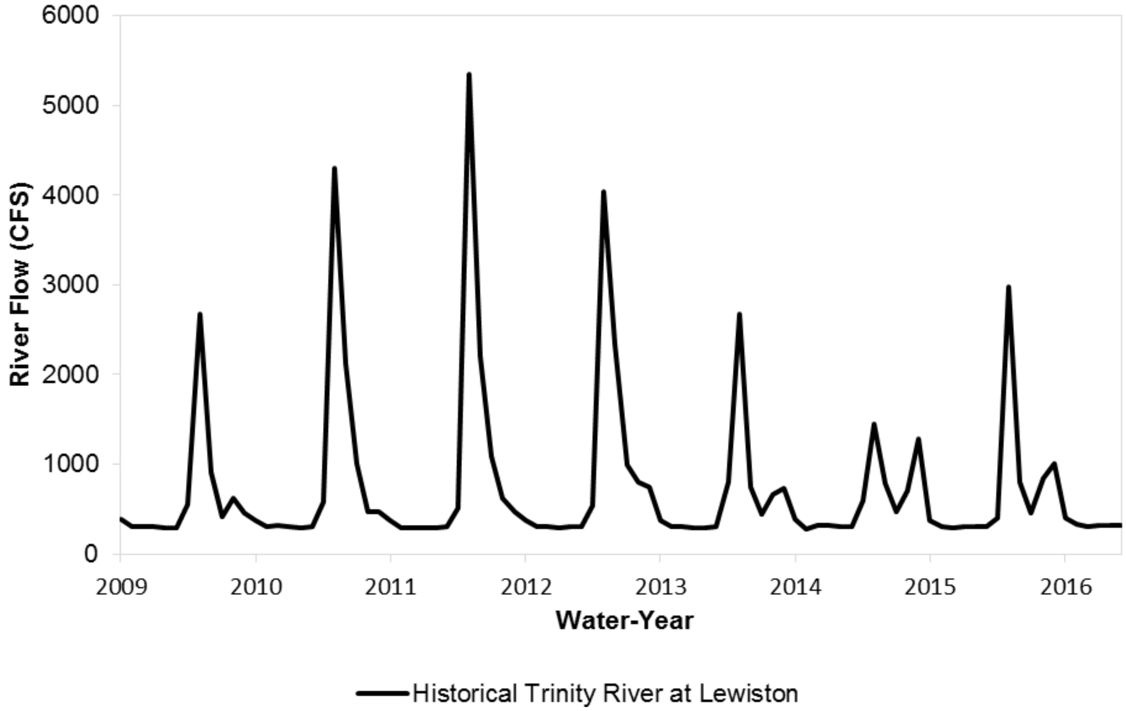
Source: DWR 2016b
Key: TAF = thousand acre-feet

Figure 4-1. Historical Trinity Lake Storage from 2009 to 2016

Prior to completion of Trinity and Lewiston dams, flows in the Trinity River were highly variable and could range from over 100,000 cubic feet per second (cfs) in the winter and spring to 25 cfs in the summer and fall (USFWS et al. 1999). Total annual flow volume at Lewiston (immediately downstream from the current location of Lewiston Dam) ranged from 0.27 to 2.7 MAF with a long-term average of 1.2 MAF.

A large portion of the Trinity River flows upstream from Trinity Lake and Lewiston Dam is exported to the Sacramento River watershed through CVP facilities. The reduction in flows in the Trinity River initially caused substantial reductions in the Trinity River fish populations (USFWS et al. 2000). In response to the reductions in fish populations, Congress enacted legislation and directed that recommendations be developed for the restoration and maintenance of Trinity River fishery. In December 2000, DOI and Hoopa Valley Tribe adopted the *Trinity River Mainstem Fishery Restoration Final EIS/Environmental Impact Report Record of Decision* (ROD), referred to as the Trinity River ROD, for the purpose of restoring Trinity River flow and habitat to produce a healthy, functioning alluvial river system (DOI and Hoopa Valley Tribe 2000). The Trinity River ROD included physical channel rehabilitation; sediment management; watershed restoration; and variable annual instream flow releases from Lewiston Dam based on forecasted hydrology for the Trinity River Basin as of April 1st each year that range from 368,600 acre-feet/year in critically dry years to 815,000 acre-feet/year in extremely wet years. The Trinity River ROD was challenged in United States District Court for the Eastern District of California (District Court); and the changes in operations related to flow were not allowed to proceed while supplemental environmental documentation was prepared and reviewed (NCRWQCB et al. 2009). In 2004, the United States Court of Appeals for the Ninth Circuit entered an opinion that reversed the District Court order; and all actions in the Trinity River ROD were mandated. The flow actions were not completely implemented until several infrastructure projects in the Trinity River channel were completed to protect areas from flood damage. Historical flow in the Trinity River at Lewiston from 2009 through 2016 is presented in Figure 4-2. Historical flow in the Trinity River at Hoopa for 2009 through 2016 is presented in Figure 4-3.

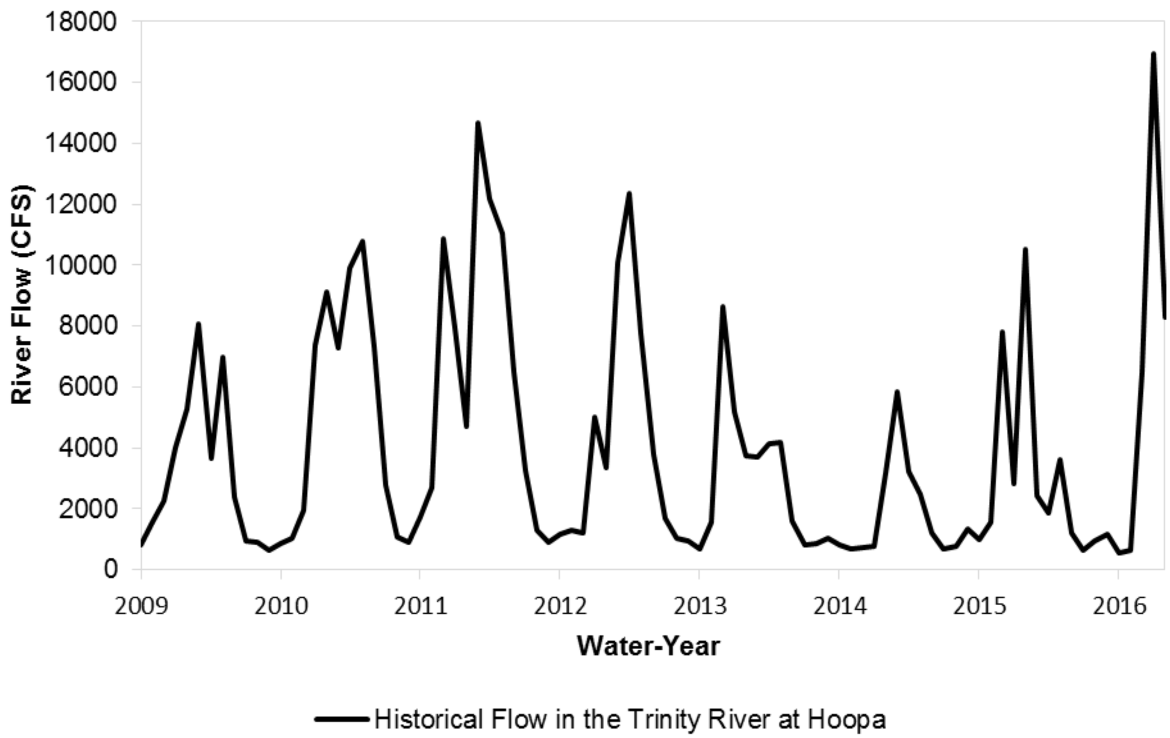
Additional water releases periodically occur into the Trinity River as part of flood control operations and to provide other flow releases (NCRWQCB et al. 2009; Reclamation 2011a). Although flood control is not an authorized purpose of the TRD, flood control benefits are provided through normal operations. The Reclamation Safety of Dams release criteria generally provide for maximum storage in Trinity Lake of 2.1 MAF between November and March. Initial flood releases are discharged from Trinity Lake into Lewiston Reservoir, and then, through the powerplant and into Whiskeytown Lake in the Clear Creek watershed. To reduce the potential for flooding on the Trinity River, releases into Trinity River generally are less than 11,000 cfs from Lewiston Dam (under Safety of Dams criteria) due to local high water concerns in the floodplain and local bridge flow capacities.



Source: USGS 2016b
Key: CFS = cubic feet per second

Figure 4-2. Historical Flow in the Trinity River at Lewiston from 2009 to 2016

Temperature objectives for cold-water fisheries for the Trinity River are set forth in SWRCB Water Rights Order 90-5. These objectives vary by reach and by season. Between Lewiston Dam and Douglas City Bridge, the daily average temperature should not exceed 60 degrees Fahrenheit (°F) from July 1 to September 14, and 56°F from September 15 to September 30. From October 1 to December 31, the daily average temperature should not exceed 56°F between Lewiston Dam and the confluence of the North Fork Trinity River.



Source: USGS 2016g
Key: CFS = cubic feet per second

Figure 4-3. Historical Flow in the Trinity River at Hoopa from 2009 to 2016

Lower Klamath River from Trinity River Confluence to the Pacific Ocean

The Klamath River watershed extends over 15,600 square miles from southern Oregon to northern California, and ranges in elevation from over 9,500 feet above sea level near the headwaters to sea level at the Pacific Ocean (USFWS et al. 1999). The upper Klamath River basin extends over 60 miles from the headwaters to Iron Gate Dam (DOI and DFG 2012). The lower Klamath River basin extends 190 miles from Iron Gate Dam to the Pacific Ocean. Four major tributaries flow into the lower Klamath River, including Shasta, Scott, Salmon, and Trinity Rivers.

As shown in Figure 4-4, the lower Klamath River flows 43.5 miles from the confluence with the Trinity River to the Pacific Ocean (USFWS et al. 1999). Downstream from the Trinity River confluence, the Klamath River flows through Humboldt and Del Norte counties and through the Hoopa Valley Indian Reservation, Yurok Indian Reservation, and Resighini Indian Reservation within Humboldt and Del Norte counties (DOI and DFG 2012). Historical flow in the Klamath River at Orleans from 2009 through 2016 is presented in Figure 4-5.

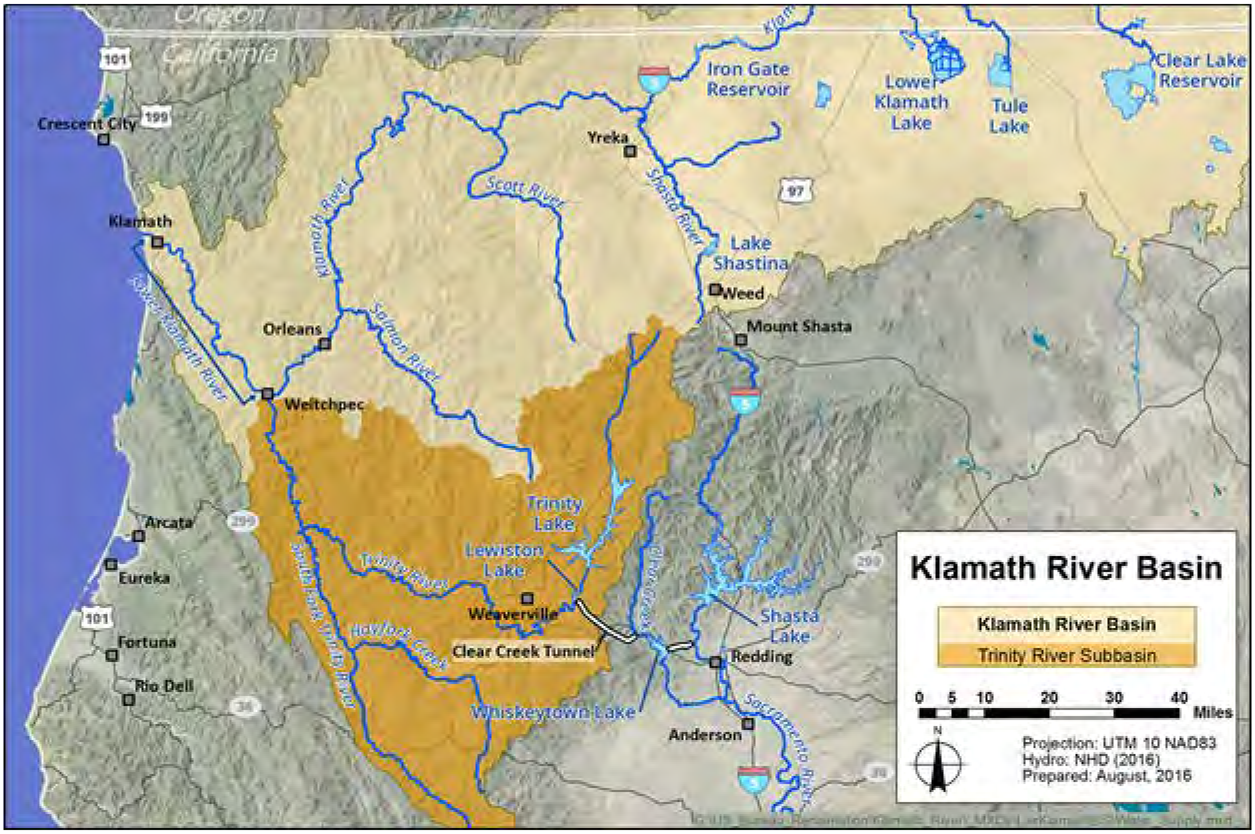
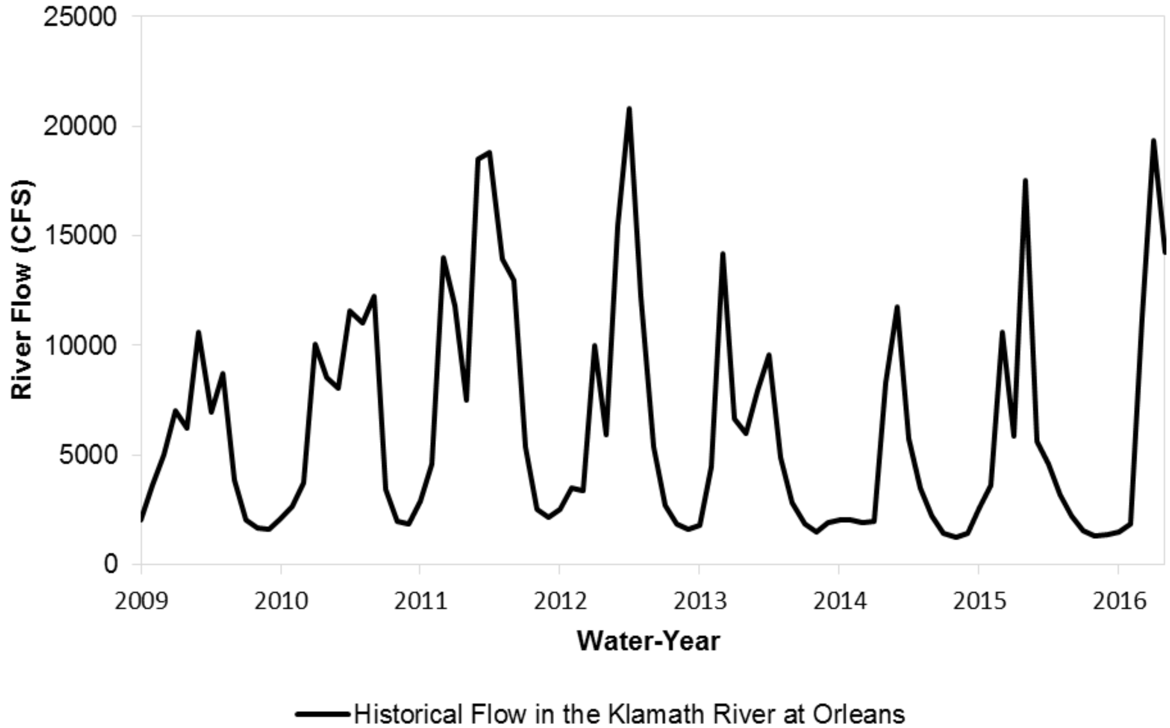


Figure 4-4. Lower Klamath and Trinity Rivers

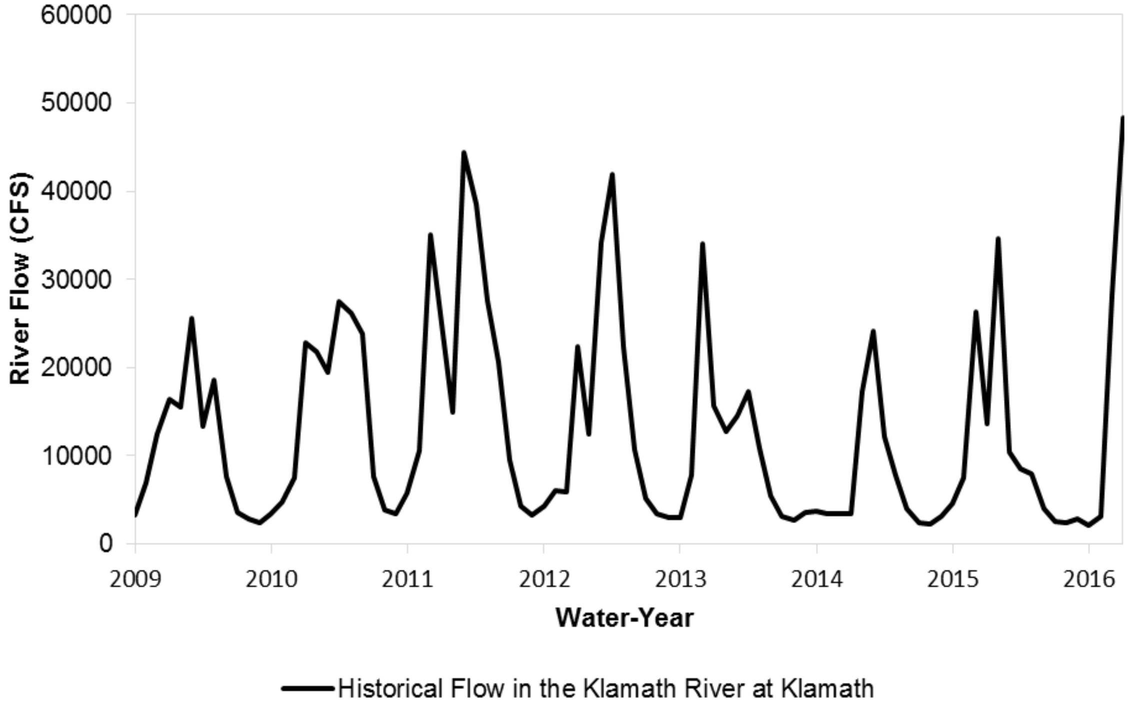


Source: USGS 2016h
Key: CFS = cubic feet per second

Figure 4-5. Historical Flow in the Klamath River at Orleans for Years 2009 to 2016

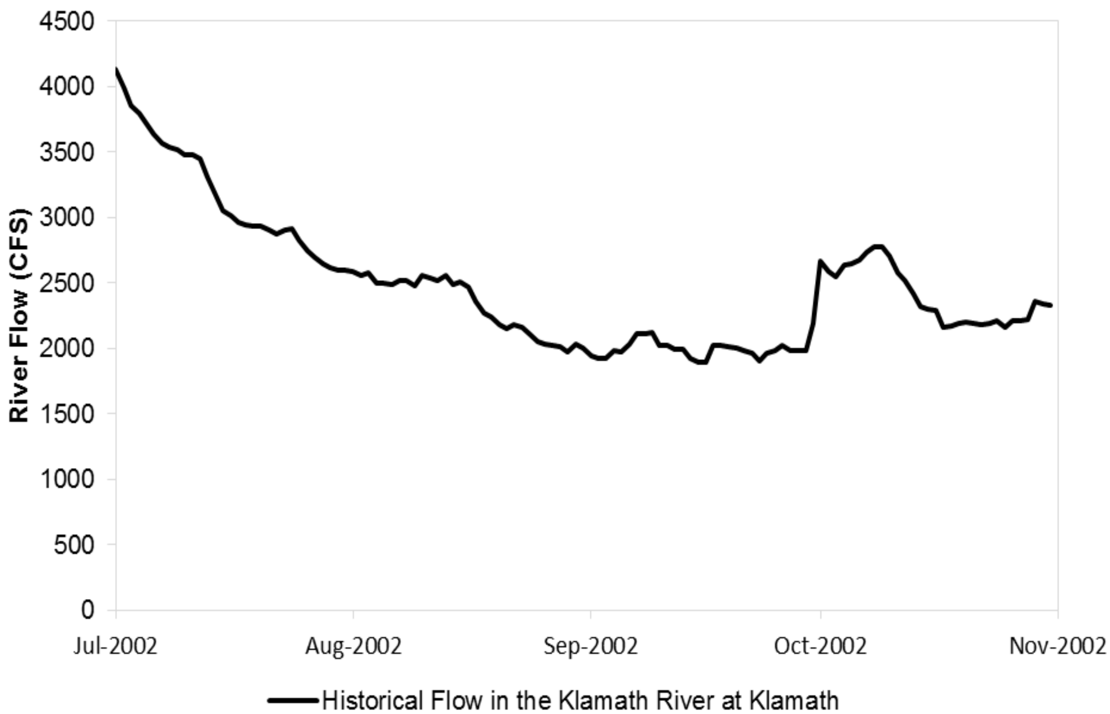
The Trinity River is the largest tributary to the Klamath River (DOI and DFG 2012). There are no dams located in the Klamath River watershed downstream from the confluence with the Trinity River. The western portion of the Klamath River watershed receives substantial rainfall during the winter months. Average precipitation in the western portion of the watershed ranges from 60 to 125 inches per year (Reclamation 2015b; DWR 2013a). Due to the heavy precipitation and the upstream water supply projects in the Klamath River, approximately 85 percent of the flows in the lower Klamath River occur due to runoff in the lower watershed during the winter months (DOI and DFG 2012).

The Klamath River estuary extends for approximately 5 miles upstream from the Pacific Ocean (DOI and DFG 2012). This area is generally under tidal effects and salt water can occur up to 4 miles from the coastline during high tides in summer and fall when Klamath River flows are low. Historical flows in the Klamath River at Klamath from 2009 through 2016 are presented in Figure 4-6. As described in Chapter 1, “Introduction,” Reclamation has periodically released water from Lewiston Dam into the Trinity River to improve late summer flow conditions to avoid fish die-offs in the lower Klamath River or for tribal requirements along the Trinity River (Reclamation 2015a; DOI 2014; TRRP 2014). Figure 4-7 presents historical flows in the Klamath River at Klamath for July through October of 2002, corresponding to the 2002 fish die-off.



Source: USGS 2016i
Key: CFS = cubic feet per second

Figure 4-6. Historical Flow in the Klamath River at Klamath for Years 2009 to 2016



Source: USGS 2016j
Key: CFS = cubic feet per second

Figure 4-7. Historical Flow of the Klamath River at Klamath from July Through October 2002

Central Valley and Bay-Delta Region

The Central Valley and Bay-Delta Region includes the major rivers and waterways downstream from CVP and SWP dams and reservoirs. Major CVP and SWP reservoirs, downstream waterways, and related conveyance facilities (e.g., pump stations and canals) discussed in this section are shown Figure 4-8.

Figure 4-8. Major CVP and SWP Reservoirs, Downstream Rivers, and Conveyance Facilities

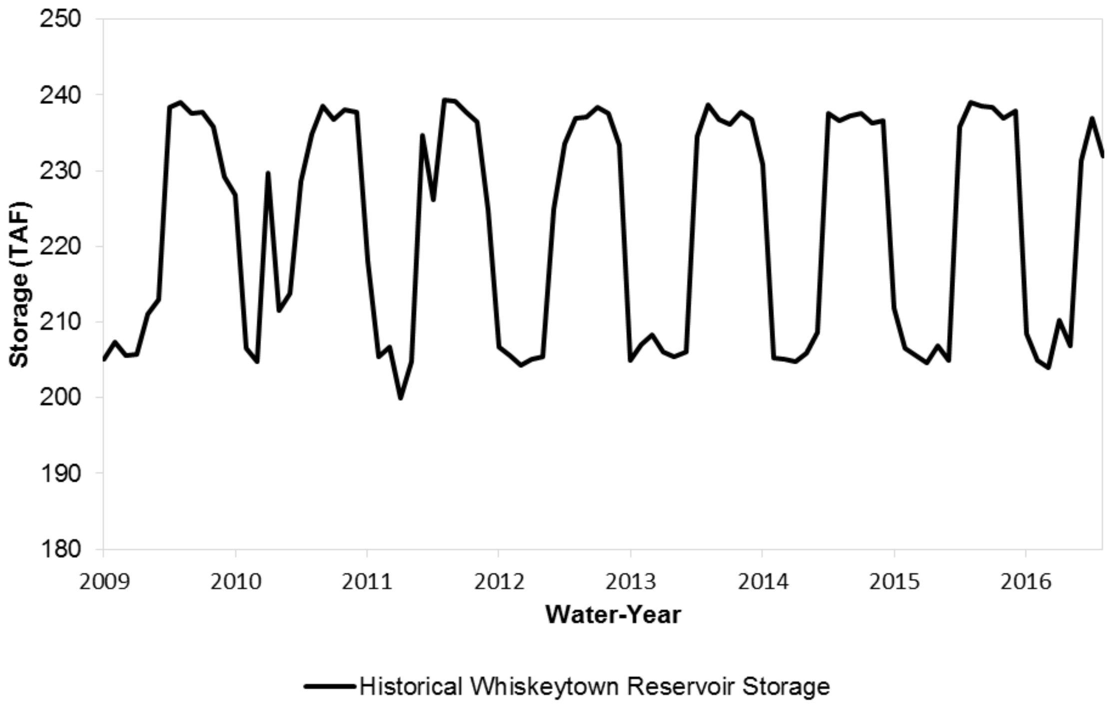
Sacramento Valley

The Sacramento River watershed encompasses an area over 15,360,000 acres in the northern portion of the Central Valley; extending from the foothills of the Coast Ranges and Klamath Mountains on the west to the foothills of the Sierra Nevada and Cascade Range on the east; and extending through the Delta on the south (Reclamation 2013).

The Sacramento River flows approximately 351 miles from the north near Mount Shasta to the confluence with the San Joaquin River at Collinsville in the western Delta (Reclamation 2013). The Sacramento River receives contributing flows from numerous major and minor streams and rivers that drain the east and west sides of the basin. The volume of flow increases as the river progresses southward, and is increased considerably by the contribution of flows from the Feather River and the American River. The Sacramento River also receives imported flows from the Trinity River watershed, as discussed above.

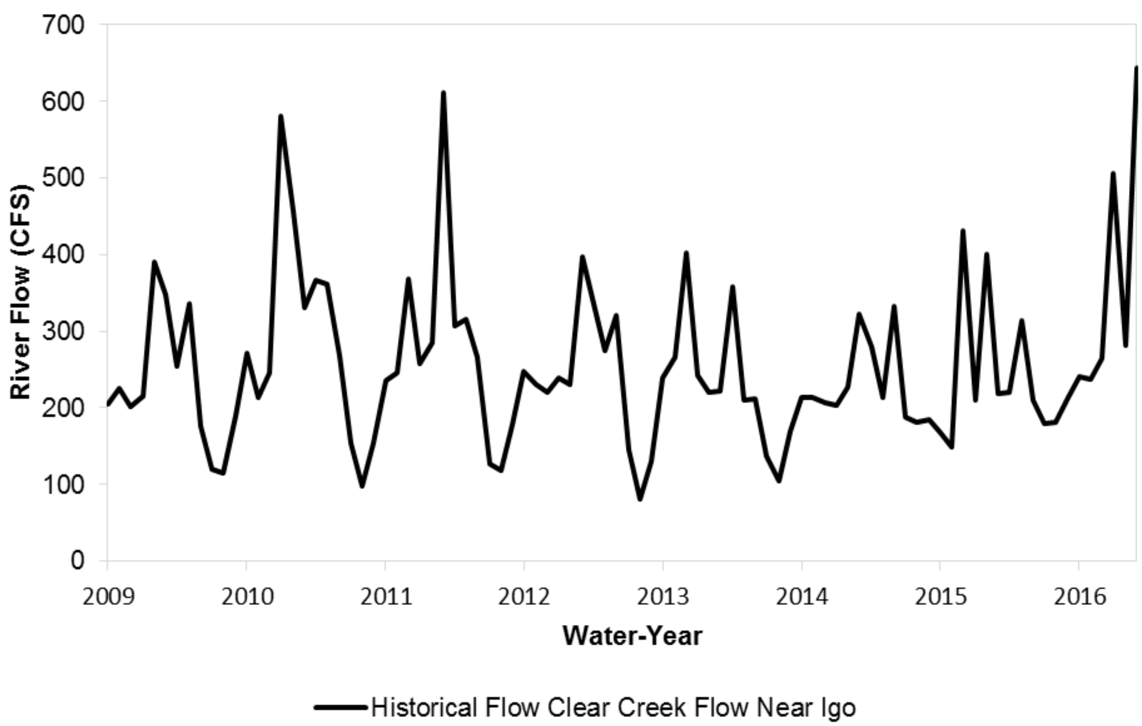
Whiskeytown Dam and Clear Creek Whiskeytown Dam, a CVP facility completed in 1963, is the only dam on Clear Creek and is located approximately 16.5 miles downstream from the headwaters (Reclamation 1997). Whiskeytown Lake, which is formed by the dam, has a storage capacity of 0.241 MAF; and regulates runoff from Clear Creek and diversions from the Trinity River watershed. Flows from Lewiston Reservoir in the Trinity River watershed are diverted to Whiskeytown Lake through the Clear Creek Tunnel. Currently, the Clear Creek Tunnel between Lewiston Reservoir and Whiskeytown Lake has a capacity of 3,200 cfs (Reclamation 2011b). Historical storage in Whiskeytown Reservoir from 2009 through 2016 is presented in Figure 4-9.

Water from Whiskeytown Lake is released to the Sacramento River through the Spring Creek Tunnel which conveys water to the Spring Creek Conduit, and then to Keswick Reservoir. Water from Whiskeytown Lake also is released into Clear Creek directly from Whiskeytown Lake; or during high flow conditions (e.g., flood flows), from a Glory Hole within Whiskeytown Lake through a conduit into Clear Creek. Most of the flows are released through the Spring Creek Tunnel and Powerplant to Keswick Reservoir. These flows into Keswick Reservoir provide cold water flows that reduce temperatures in the upper Sacramento River, especially during the fall months. Water also is discharged from Whiskeytown Lake to Clear Creek to provide for instream flows and water for users located in the CVP Clear Creek South Unit within, or adjacent to, the Clear Creek watershed. In accordance with the 2009 NMFS BO RPA, Reclamation is required to manage Whiskeytown Lake releases to meet daily water temperatures in Clear Creek at Igo. Historical flow in Clear Creek near Igo from 2009 to 2016 is presented in Figure 4-10.



Source: DWR 2016c
Key: TAF = thousand acre-feet

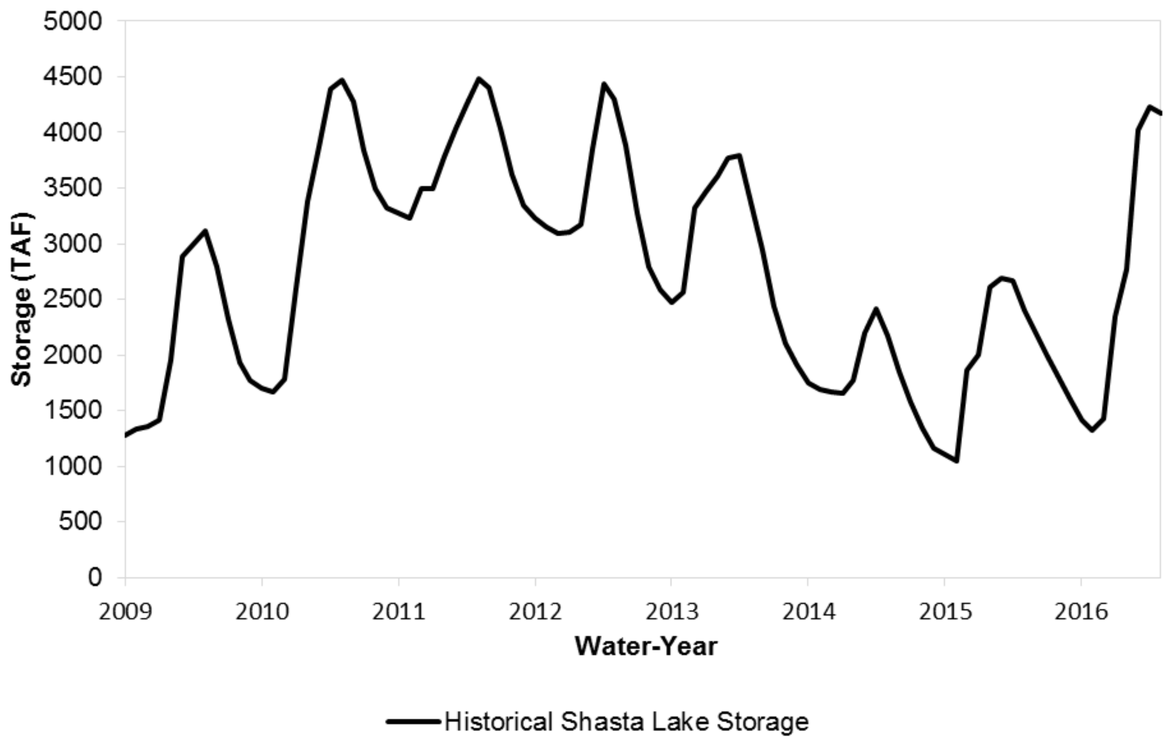
Figure 4-9. Historical Whiskeytown Reservoir Storage from 2009 to 2016



Source: USGS 2016c
Key: CFS = cubic feet per second

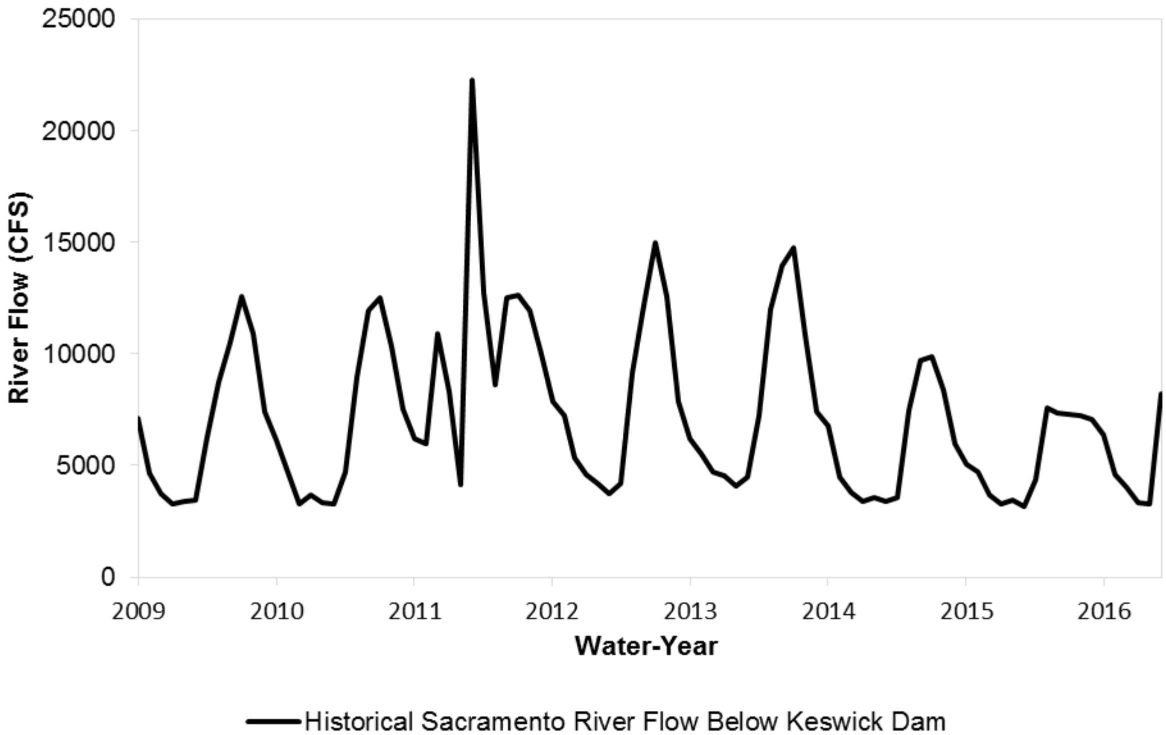
Figure 4-10. Historical Flow in Clear Creek near Igo from 2009 to 2016

Shasta Dam, Keswick Dam and the Sacramento River from Keswick to Red Bluff Shasta Lake, a CVP facility on the Sacramento River formed by Shasta Dam, is located near Redding. Construction on the 4.552 MAF reservoir was completed in 1945. Water flows from Shasta Lake along the Sacramento River into the 0.0238 MAF Keswick Reservoir, a CVP facility, which operates as an afterbay, or regulating reservoir, for Shasta Lake hydropower operations. Construction on Keswick Reservoir was completed in 1950. A temperature control device at Shasta Dam was constructed between 1996 and 1998 to provide cold water without power bypass to the Sacramento River downstream from Keswick Reservoir. Historical storage in Shasta Lake from 2009 to 2016 is presented in Figure 4-11. Historical Sacramento River flows below Keswick Dam from 2009 to 2016 are presented in Figure 4-12.



Source: DWR 2016a
Key: TAF = thousand acre-feet

Figure 4-11. Historical Shasta Lake Storage from 2009 to 2016



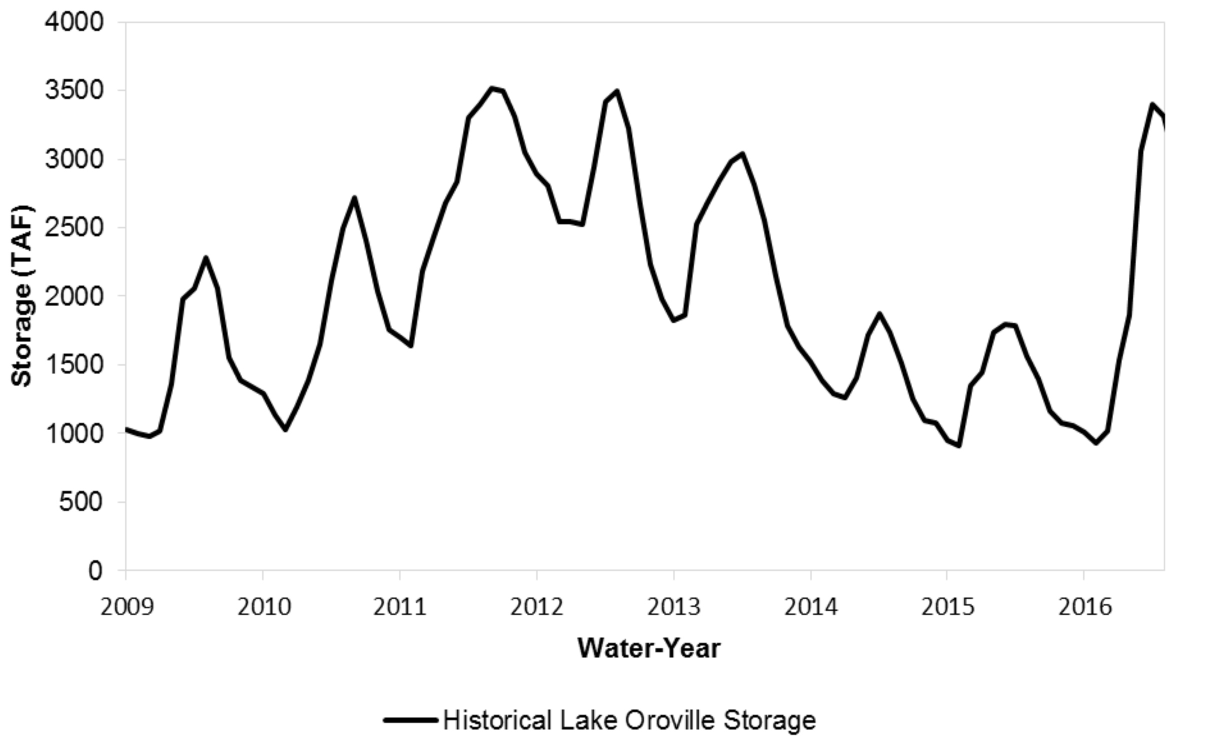
Source: USGS 2016a
Key: CFS = cubic feet per second

Figure 4-12. Historical Sacramento River Flow Below Keswick Dam for Water Years 2009 to 2016

Sacramento River from Keswick Dam to the Delta Water released from Shasta Dam travels approximately 245 miles over three to four days to the northern Delta boundary near Freeport (Reclamation 2013). The upper reach of the Sacramento River flows for approximately 60 miles from Keswick Dam to Red Bluff; and the middle reach of the Sacramento River flows approximately 160 miles from Red Bluff to the confluence with the Feather River. The lower reach of the Sacramento River flows for approximately 20 river miles between the confluence with the Feather River and Freeport, immediately downstream from the confluence with the American River.

Major diversions in this reach of the Sacramento River include the CVP Red Bluff Pumping Plant, Glenn-Colusa Irrigation District (GCID) intake, and individual diversions for the CVP Sacramento River Settlement Contractors. The Red Bluff Pumping Plant was completed in August 2012 to improve fish passage conditions on the Sacramento River by removing the Red Bluff Diversion Dam, and to continue to divert water from the Sacramento River into the Tehama-Colusa and Corning canals. The GCID Main Pump Station is located near Hamilton City to divert water into the GCID Canal that conveys water to over 130,000 acres, including the USFWS Sacramento National Wildlife Refuge; and terminates at the Colusa Basin Drain near Williams. In 2001, the GCID Fish Screen was completed in addition to several canal improvements to allow year-round water deliveries.

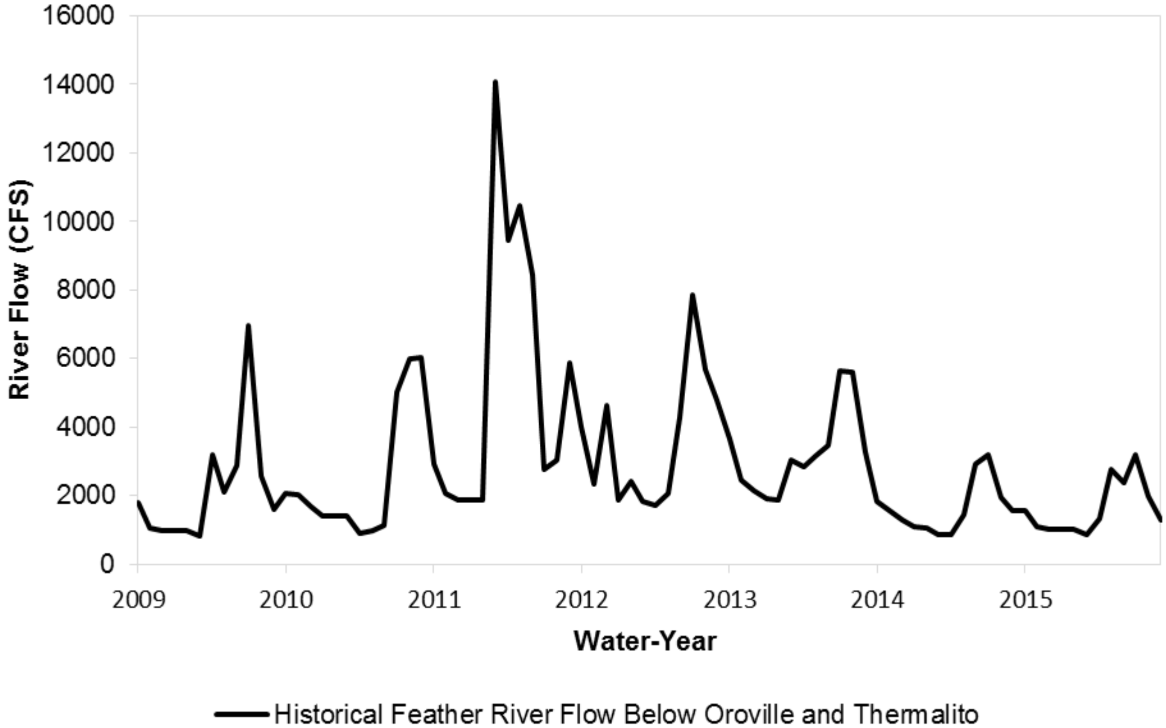
Oroville Dam, Thermalito Afterbay and the Feather River The major SWP facility on the Feather River is the 3,500 thousand acre-feet (TAF) Lake Oroville, which is formed by Oroville Dam located at the confluence of the North, Middle, and South forks of the Feather River. Lake Oroville stores winter and spring runoff, which is released into the Feather River to meet SWP water demands; provide pumpback capability to allow for on-peak electrical generation; provide 750 TAF of flood control storage, recreation, and freshwater releases to control salinity intrusion in the Delta; and for fish and wildlife protection. Oroville Dam was completed in 1967. Historical storage in Lake Oroville from 2009 to 2016 is presented in Figure 4-13.



Source: DWR 2016d
Key: TAF = thousand acre-feet

Figure 4-13. Historical Storage in Lake Oroville from 2009 to 2016

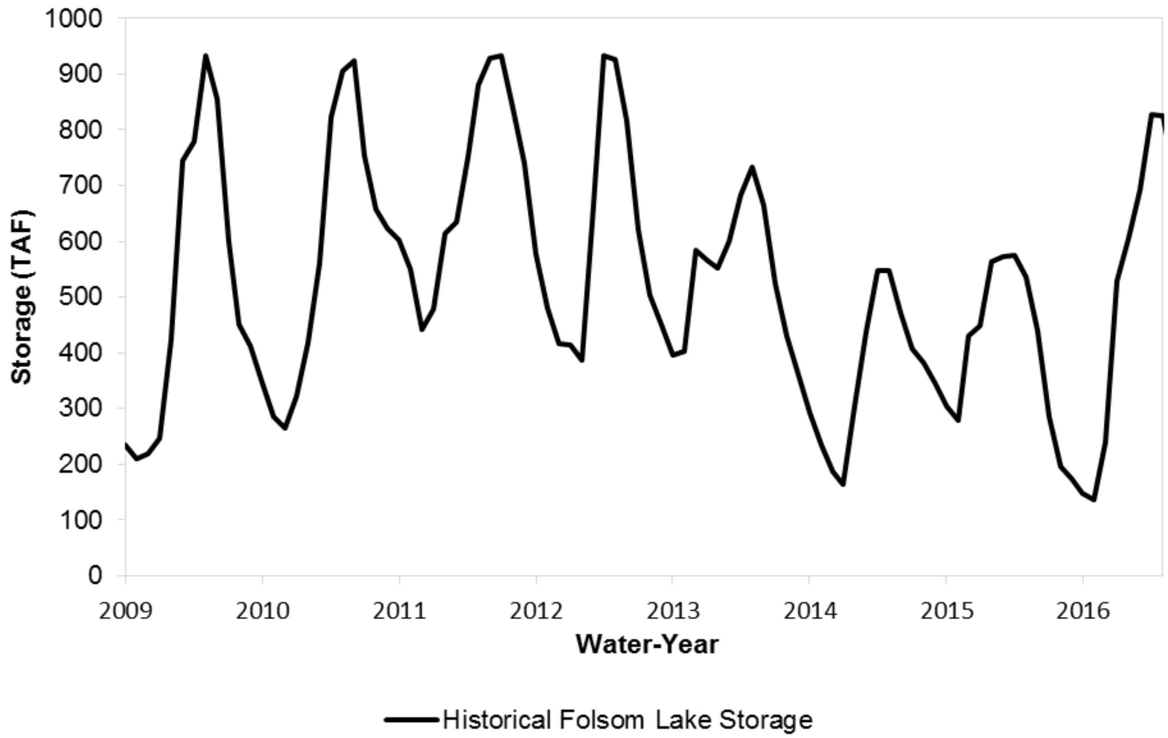
Water is released from Lake Oroville through the Edward Hyatt Powerplant into the Thermalito Diversion Pool. The Thermalito Diversion Pool releases water through the Feather River Fish Hatchery which returns water to the Feather River. Additional water is released from the Thermalito Diversion Pool into the Feather River, forming a low flow channel with a relatively constant flow rate for several miles in the Feather River to the confluence with Thermalito Afterbay release. Lake Oroville power releases above the release to the low flow channel are diverted from the Thermalito Diversion Pool into the Thermalito Forebay through a power canal. Water is released from the Thermalito Forebay through the Thermalito Powerplant into the Thermalito Afterbay and then returned to the Feather River at the downstream end of the low flow channel. Water can be pumped back through the Thermalito Powerplant and the Edward Hyatt Powerplant into Lake Oroville when energy prices are low and re-released through the powerplants to generate when energy prices are high. Local agricultural districts also divert water from the Thermalito Afterbay. Flood releases above the Thermalito Powerplant capacity are made from the Thermalito Diversion Dam into the low flow channel. Historical flows in the Feather River below Oroville Lake and Thermalito Afterbay from 2009 to 2015 are presented in Figure 4-14.



Sources: USGS 2016e, 2016f
Key: CFS = cubic feet per second

Figure 4-14. Historical Feather River Flow below Oroville Lake and Thermalito Afterbay from 2009 to 2015

Folsom Dam, Nimbus Dam, and the American River Folsom Lake and Lake Natoma on the American River are located within portions of the American River watershed that could be affected by changes in CVP and SWP operations. Folsom Lake is a CVP facility formed by Folsom Dam 7 miles upstream from the CVP Nimbus Dam (Reclamation et al. 2006). Folsom, Lake is the largest reservoir in the American River watershed, and has a capacity of 967 TAF. Historical storage levels in Folsom Lake from 2009 to 2016 are presented in Figure 4-15.

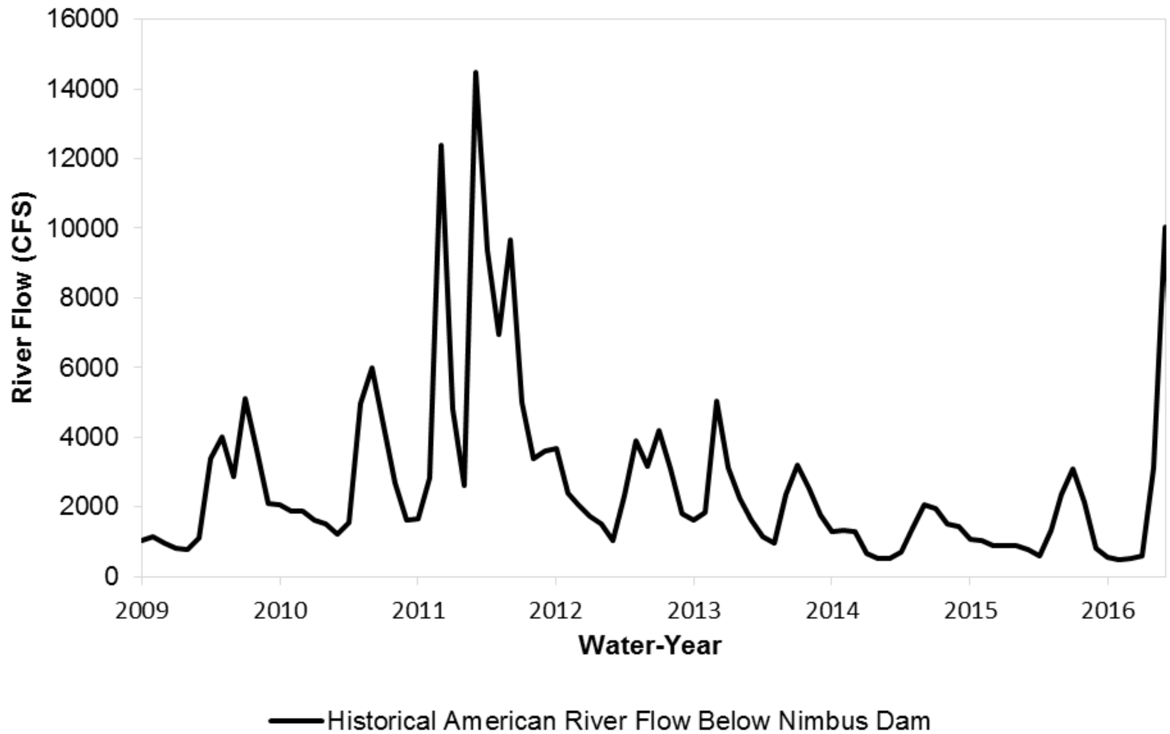


Source: DWR 2016e
Key: TAF = thousand acre-feet

Figure 4-15. Historical Storage in Folsom Lake from 2009 to 2016

Numerous smaller reservoirs in the upper basin provide hydroelectric generation and water supply and are not owned or operated by Reclamation or DWR. The total upstream reservoir storage above Folsom Lake is approximately 820 TAF. Ninety percent of this upstream storage is provided by five reservoirs: French Meadows (136 TAF); Hell Hole (208 TAF); Loon Lake (76 TAF); Union Valley (271 TAF); and Ice House (46 TAF). No impacts are expected to these upper basin facilities.

Nimbus Dam creates Lake Natoma, a forebay built to re-regulate releases from Folsom Lake to smooth flows to the American River and to direct water into the CVP Folsom South Canal. Releases from Nimbus Dam to the American River pass through the Nimbus Powerplant when releases are less than 5,000 cfs or the spillway gates for higher flows. The American River flows 23 miles between Nimbus Dam and the confluence with the Sacramento River. Historical flows in the American River below Nimbus Dam from 2009 to 2016 are presented in Figure 4-16.



Source: USGS 2016d
Key: CFS = cubic feet per second

Figure 4-16. Historical Flows in the American River Below Nimbus Dam from 2009 to 2016

Yolo Bypass Flows from the Sacramento River, Feather River, Sutter Bypass, and Natomas Cross Canal join upstream from Verona on the Sacramento River. When the Sacramento River flows exceed 62,000 cfs, flows spill over the Fremont Weir into the Yolo Bypass. The Yolo Basin was a natural overflow area located to the west of the Sacramento River. The Sacramento River Flood Control Project modified the basin by confining the extent of overflow through a leveed bypass and allowing flood flows to enter the Yolo Bypass from the Sacramento River over the Fremont and Sacramento weirs. The Yolo Bypass conveys floodwaters around the Sacramento metropolitan area and reconnects to the Sacramento River at Rio Vista (DWR 2013b). Tributaries within the Yolo Bypass include the Cache Creek Detention Basin, Willow Slough, and Putah Creek.

Flows also enter the Yolo Bypass from the Colusa Basin, including from the Colusa Basin Drain through the Knights Landing Ridge Cut. In 2011 and 2012, construction at the outfall gates required water from the Colusa Basin Drain to be diverted into the Yolo Bypass. These events temporarily resulted in a fall pulse flow during late August through early October in the Yolo Bypass that increased the volume of flow (e.g., acre-feet) by more than 300 to 900 percent (Frantzich 2014).

San Joaquin Valley

The San Joaquin Valley is divided into two major drainage basins. The northern drainage basin extends from the San Joaquin River along the southern boundary of the Delta and along the lands adjacent to the San Joaquin River from the northern drainage of the San Joaquin River in Madera County to the southern drainage in Fresno County (DWR 2013a). The northern drainage basin includes the San Joaquin River; five major tributaries that flow westward from the Sierra Nevada, including Fresno, Chowchilla, Tuolumne, Merced, Stanislaus, and Calaveras Rivers; and three major creeks that flow eastward from the Coast Range, including Del Puerto, Orestimba, and Panoche Creek. All flows in the San Joaquin River flow northward to the Delta.

The southern drainage basin (also known as the Tulare Lake Basin) extends into the southern San Joaquin Valley between the Sierra Nevada on the east, Tehachapi Mountains on the south, and the Coast Range on the west (DWR 2013a). The southern basin includes four major tributaries, including Kings, Kaweah, Tule, and Kern Rivers, which drain towards three ancient lakes on the valley floor, including the Tulare, Buena Vista, and Goose lakes. Flows into these lakes have declined as water supply projects and agricultural development has occurred. The northern and southern drainage basins are generally hydrologically separated by a low, broad ridge that extends across the San Joaquin Valley between the San Joaquin and Kings Rivers. However, in flood years, water flows from the Kings River through the James Bypass and Fresno Slough into the San Joaquin River near Mendota; therefore, the basins become hydrologically connected.

Flows from Fresno, Chowchilla, Tuolumne, Merced, Calaveras, Kings, Kaweah, Tule, and Kern rivers contribute substantial flows into the San Joaquin Valley and affect operations of CVP and SWP water users and operations. However, the operations of reservoirs on these rivers are not modified within the alternatives evaluated in this EIS. Therefore, these rivers are not discussed in this chapter. This chapter will focus on the flows in the San Joaquin and Stanislaus rivers that are affected by changes in CVP and SWP operations considered in the alternatives evaluated in this EIS.

Stanislaus River The Stanislaus River originates in the western slopes of the Sierra Nevada and drains a watershed of approximately 900 square miles. The median annual unimpaired runoff in the basin is approximately 1.08 MAF per year (SWRCB 2012). Snowmelt from March through early July contributes the largest portion of the flows in the Stanislaus River, with the highest runoff occurring in the months of April, May, and June.

The North, Middle, and South forks of the Stanislaus River converge upstream from the CVP New Melones Reservoir. The 2.4 MAF New Melones Reservoir is located approximately 60 miles upstream from the confluence of the Stanislaus River and the San Joaquin River. Water from New Melones Reservoir flows into Tulloch Reservoir (Reclamation 2010). Tulloch Reservoir is owned and operated by the Tri-Dams Project for recreation, power, and flow re-regulation of New Melones Reservoir releases. Water released by Tulloch Reservoir and Powerplant flows downstream to Goodwin Reservoir where water is either diverted to canals to serve Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District; or released from Goodwin Reservoir to the lower Stanislaus River (SWRCB 2012).

San Joaquin River Upstream from Stanislaus River Operations of Millerton Lake and the CVP Friant Division will not be modified by changes in CVP and SWP operations under the alternatives considered in this EIS because it is disconnected from the Delta under current conditions. By 2030 the San Joaquin River Restoration Program will be making full releases from Millerton Lake and will be connected to the Delta; however, Millerton Lake will not be operated to meet any Delta conditions and its operations will not be modified by changes in CVP and SWP operations under the alternatives considered in this EIS.

The CVP Westside contractors can exercise legacy water rights to San Joaquin River water if their CVP allocation is low enough and thereby impact Friant Division allocation. The CalSim II modeling performed in support of this EIS does not include this operation rule so it cannot be evaluated in the context of the analysis. Therefore, Millerton Lake and Friant Division are not analyzed in this EIS.

Delta

The Delta constitutes a natural floodplain that covers 1,315 square miles and drains approximately 40 percent of the State (DWR 2013a). The Delta has a complex web of channels and islands and is located at the confluence of the Sacramento and San Joaquin Rivers.

Historically, the natural Delta system was formed by water inflows from upstream tributaries in the Delta watershed and outflow to Suisun Bay and San Francisco Bay. In the late 1800s, local land reclamation efforts in the Delta resulted in the construction of channels and levees that began altering the Delta’s surface water flows. Over time, the natural pattern of water flows continued to change as the result of upper watershed diversions and the construction of facilities to divert and export water through the Delta to areas where supplemental water supplies are needed, including densely populated areas such as San Francisco and Southern California and agricultural regions such as the San Joaquin Valley and Tulare Lake. The SWP and CVP use the Delta as the hub of their conveyance systems to deliver water to large pumps located in the southern Delta.

Inflows to the Delta occur primarily from the Sacramento River system and Yolo Bypass, the San Joaquin River, and other eastside tributaries such as the Mokelumne, Calaveras, and Cosumnes Rivers. In general, in any given year, approximately 77 percent of water enters the Delta from the Sacramento River, approximately 15 percent enters from the San Joaquin River, and approximately 8 percent enters from the eastside tributaries (DWR 1994). The Delta is tidally influenced; rise and fall varies from less than 1 foot in the eastern Delta to more than 5 feet in the western Delta (DWR 2013a). The flows in the western Delta are tidally influenced, with channel flows both towards and away from the ocean during a tidal cycle and the net flow towards the ocean. Reverse flows are assumed to occur when the net flow in the Old and Middle Rivers (OMR) is away from the ocean.

Hydrological conditions in the Delta are substantially affected by structures that route water through the Delta towards the major Delta water diversions in the south Delta, including the CVP Jones Pumping Plant, the SWP Banks Pumping Plant, the CVP Contra Costa Canal Pumping Plant at Rock Slough, and the Contra Costa Water District (CCWD) intakes on Old and Middle Rivers. These structures are operated to protect Delta water quality for these intakes, the SWP BSPP in the north Delta and over 1,800 municipal and agricultural in-Delta diversions (DWR 2010). These structures include the Delta Cross Channel and temporary barriers in the south Delta. Diversion patterns for the major facilities also are regulated to maintain Delta water quality and to protect fish and wildlife that are listed as threatened or endangered species under the Federal Endangered Species Act in accordance with the SWRCB D-1641, 2008 USFWS BO, and the 2009 NMFS BO.

CVP Jones Pumping Plant The CVP Jones Pumping Plant, located about 5 miles north of Tracy, has a permitted diversion capacity of 4,600 cfs and sits at the end of a 2.5-mile long earth-lined intake channel that extends to Old River. Water diverted at the Jones Pumping Plant is discharged to the CVP DMC.

SWP Clifton Court and Banks Pumping Plant The SWP facilities in the southern Delta include the 31 TAF CCF, located about 10 miles northwest of the city of Tracy, and the Banks Pumping Plant. Water is diverted from Old River into CCF that provides storage for off-peak pumping, moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels, and collects sediment upstream from the Banks Pumping Plant and the California Aqueduct. Water flows from CCF to Banks Pumping Plant which discharges into the California Aqueduct.

The nominal capacity of the Banks Pumping Plant is 10,300 cfs. Permits issued by the USACE regulate the rate of diversion of water into CCF. This diversion rate is normally restricted to 6,680 cfs as a three-day average inflow to CCF and 6,993 cfs as a one-day average inflow to CCF. CCF diversions may be greater than these rates between December 15 and March 15, when the inflow into CCF may be augmented by one-third of the San Joaquin River flow at Vernalis when those flows are equal to or greater than 1,000 cfs.

SWP Barker Slough Pumping Plant The SWP BSPP diverts water from Barker Slough into the SWP North Bay Aqueduct for delivery to the Solano County Water Agency and the Napa County Flood Control and Water Conservation District The current 162.5 cfs North Bay Aqueduct intake with a positive barrier fish screen is located approximately 10 miles from the Sacramento River at the end of Barker Slough.

Contra Costa Water District Intakes The CCWD diverts approximately 127 TAF per year, including approximately 110 TAF under the CVP water service contract. The CCWD diverts water at the CVP Rock Slough Intake, and at the CCWD Mallard Slough, Old River, and Middle River (on Victoria Canal) intakes. All four intakes have positive barrier fish screens. Water from the Old River and Middle River intakes can be diverted to the 160-TAF Los Vaqueros Reservoir when Delta salinity is low. When Delta salinity is high, typically in the fall months, CCWD blends low salinity water from Los Vaqueros Reservoir with water from the Delta to meet CCWD water quality goals. Water from Los Vaqueros Reservoir is also used by CCWD when Delta diversions are restricted.

South of Delta CVP/SWP Distribution System

Upstream from San Luis Reservoir

The California Aqueduct transports water from the Banks Pumping Plant to O'Neill Forebay, from which water can be released to the San Luis Canal, a portion of the California Aqueduct jointly owned by the SWP and CVP; or pumped into San Luis Reservoir at the Gianelli Pumping Plant.

The DMC transports water from the Jones Pumping Plant to a location near the San Luis Reservoir where it can be pumped into the O'Neill Forebay, which can then be and then pumped into San Luis Reservoir by the Gianelli Pumping-Generating Plant, or continue down the DMC.

The DMC/California Aqueduct Intertie between the DMC and the California Aqueduct allows water to flow in both directions between the CVP and SWP conveyance facilities. The DMC/California Aqueduct Intertie achieves multiple benefits, including meeting current water supply demands, allowing for the maintenance and repair of the CVP Delta export and conveyance facilities, and providing operational flexibility to respond to emergencies.

San Luis Reservoir

The 2.027 MAF San Luis Reservoir, formed by Sisk Dam, is jointly operated by Reclamation and DWR, with approximately 0.965 MAF used by the CVP and 1.062 MAF used by the SWP. Water generally is diverted into San Luis Reservoir during late fall through early spring when irrigation water demands of CVP and SWP water users are low and are being met by Delta exports. The CVP diverts water from San Luis Reservoir by the Pacheco Pumping Plant through the Pacheco Tunnel and Pacheco Conduit that conveys water to CVP water service contractors in Santa Clara and San Benito counties.

Downstream from San Luis Reservoir

CVP water from the San Luis Reservoir can be released into the DMC which extends to Mendota Pool on the San Joaquin River. Both CVP and SWP water from the San Luis Reservoir can be released into the first reach of the California Aqueduct, the San Luis Canal that is jointly owned by the SWP and CVP and extends from San Luis Reservoir to Kettleman City. This reach includes Dos Amigos, Buena Vista, Teerink, and Chrisman pumping plants.

The California Aqueduct then continues to convey SWP water into southern California through the Edmonston Pumping Plant, located at the foot of the Tehachapi Mountains, that raises the water 1,926 feet into approximately 8 miles of tunnels and siphons that convey water into Antelope Valley. At that location, the California Aqueduct divides into two branches; the East Branch and the West Branch for conveyance to final delivery locations.

Impact Analysis

Potential Mechanisms for Change in Surface Water Resources and Analytical Methods

The environmental consequences assessment considers changes in surface water resource conditions related to the implementation of the action alternatives as compared to the No Action Alternative.

Changes in CVP and SWP Reservoir Storage, Elevation and Downstream River Flows

Changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative would result in changes to reservoir storage volumes (and elevations) and flow patterns in the downstream rivers. Numerical models are available to quantitatively analyze the changes in CVP and SWP reservoirs and pumping plants in the Central Valley, affected surface water bodies, and deliveries of CVP and SWP water.

Use of CalSim II Model CalSim II is a reservoir-river basin planning model developed by DWR and Reclamation to simulate the operation of the CVP and SWP over a range of hydrologic conditions. For the two action alternatives, the No Action CalSim II simulation was modified to reflect the required releases for flow augmentation from Lewiston Reservoir to the Trinity River. The potential augmentation flows were computed based on an analysis of daily historical flows, modified to incorporate climate change, in the lower Klamath River to identify potential low flow periods that would require augmentation under the action alternatives. The resulting daily augmentation flows were then summed to get a monthly volume that could be input into the CalSim II model to simulate the action alternatives. Figure 4-17 presents the estimated flow augmentation volumes for the action alternatives for the CalSim period of analysis. In Alternative 2, additional modifications were made to reflect rescheduling of a portion of the Trinity River ROD spring flows based on Trinity year type. Details on the procedure to determine the potential augmentation flows and modified ROD flows are included in the Analytical Tools Technical Appendix.

CalSim II model monthly simulation of an actual daily (or even hourly) operation of the CVP and SWP results in several limitations in use of the model results. The model results must be used in a comparative manner to reduce the effects of use of monthly assumptions and other assumptions that are indicative of real-time operations, but do not specifically match real-time operations.

The CalSim II model output is based upon a monthly time step. The results are presented in tables of the mean values for individual months presented as averages by water year type to allow comparisons under the range of hydrologic conditions in the CalSim II simulation period. Water year types are used to classify years with similar hydrologic conditions into groups for historical, planning and operational analysis. Because of differences in the hydrologic conditions between watersheds the water year type definition between the Trinity/Klamath watershed and the Sacramento watershed there are unique water year type classifications for each. The Trinity water year classification system is used for tables of reservoir storage, elevation and downstream river flows for locations in the Lower Klamath and Trinity River Region (based on Trinity River ROD year types). Locations in the Central Valley and Bay-Delta Region use the Sacramento water year classification system (e.g., Sacramento River Index). The water year classification system used for each table is identified in the table title.

The CalSim II model output includes minor fluctuations of up to 5 percent due to model assumptions and approaches. Therefore, if the quantitative changes between a specific alternative and the No Action Alternative are 5 percent or less, the conditions under the specific alternative would be considered to be “similar” to conditions under the No Action Alternative.

Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for the continuation of the simulation. It is recognized that these operating rules are a simplified version of the very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions. As an example, CalSim II model results show simulated occurrences of extremely low storage conditions at CVP and SWP reservoirs during critical drought periods when storage is at dead pool levels at or below the elevation of the lowest level outlet. Simulated occurrences of reservoir storage conditions at dead pool levels may occur coincidentally with simulated impacts that are determined to be potentially significant. When reservoir storage is at dead pool levels, there may be instances in which flow conditions fall short of minimum flow criteria, salinity conditions may exceed salinity standards, diversion conditions fall short of allocated diversion amounts, and operating agreements are not met.

The Analytical Tools Technical Appendix includes additional detail on the CalSim II model, including incorporation of climate change and sea-level rise.

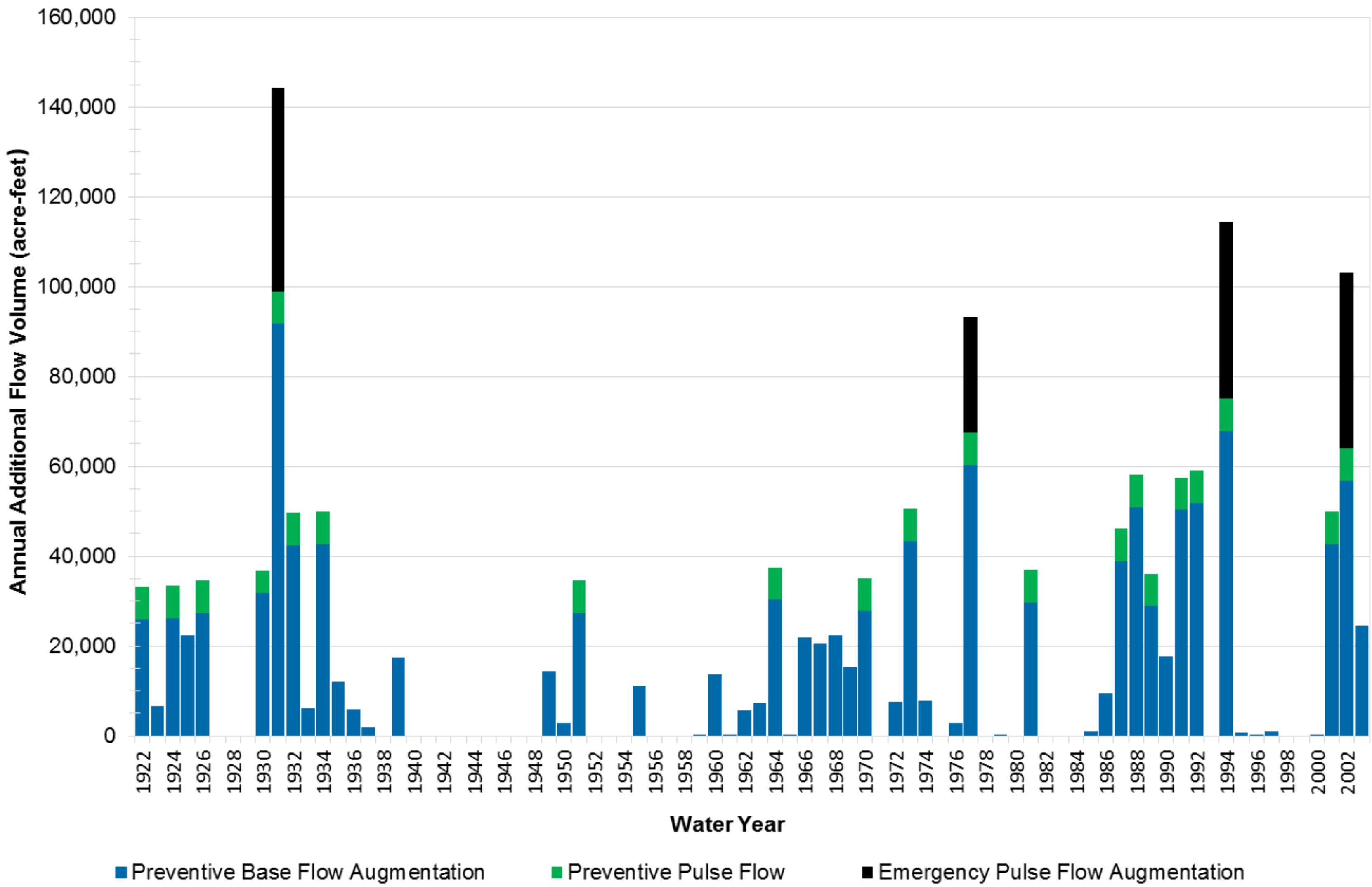


Figure 4-17. Estimated Flow Augmentation Volumes of Action Alternatives for the CalSim Period of Analysis

Analysis of Changes in Reservoir Storage and Downstream River Flows CalSim II outputs for the alternatives are compared to the CalSim II outputs for the No Action Alternative to evaluate changes in reservoir storages at Trinity Lake, Shasta Lake, Lake Oroville, Folsom Lake, New Melones Reservoir, and San Luis Reservoir; flows downstream from CVP and SWP reservoirs in Trinity, Sacramento, Feather, American, Stanislaus Rivers and Clear Creek.

Changes in Delta Conditions

Changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative would change the Delta inflows from the tributary watersheds, Delta outflow, positive and negative flows in OMR(as indicated by OMR flows), and CVP and SWP Delta exports.

Analysis of Changes in Delta Conditions CalSim II output for the alternatives are compared to the CalSim II output for the No Action Alternative to evaluate changes in Delta inflow and outflow, OMR flows and CVP and SWP Delta exports. For details on the CalSim II model and its application see section *Use of CalSim II Model* under section *Changes in CVP and SWP Reservoir Storage and Downstream River Flows* above.

Changes in CVP and SWP Deliveries

Changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative would change CVP and SWP deliveries.

Analysis of Changes in CVP and SWP Deliveries CalSim II output for the alternatives are compared to the CalSim II output for the No Action Alternative to evaluate changes in CVP and SWP Deliveries. For details on the CalSim II model and its application see section *Use of CalSim II Model* under section *Changes in CVP and SWP Reservoir Storage and Downstream River Flows* above.

It should be noted that deliveries to CVP and SWP water users located to the south of the Delta are not necessarily the same volume as the Delta export patterns because a portion of the exported water is stored in San Luis Reservoir and released on a different pattern than Delta exports.

It also should be noted that the monthly CalSim II model results do not represent daily water operations decisions, especially for extreme conditions. For example, in very dry years, the model simulates minimum reservoir volumes (also known as “dead pool conditions”) that appear to prevent Reclamation and DWR from meeting their contractual obligations, including water deliveries to CVP Sacramento River Settlement Contractors, CVP San Joaquin River Exchange Contractors, SWP Feather River Service Area Contractors, and Level II refuge water supplies. Such model results are anomalies that reflect the inability of the monthly model to make real-time policy decisions under extreme circumstances. Projected reservoir storage conditions near dead pool conditions should only be considered as an indicator of stressed water supply conditions, and not necessarily reflective of actual CVP and SWP operations in the future.

Evaluation of Alternatives

The impact analysis in this EIS is based upon the comparison of the action alternatives to the No Action Alternative in the year 2030.

No Action Alternative

Under the No Action Alternative, surface water resources would be comparable to the conditions described in the *Affected Environment* section of this chapter. Conditions in 2030 would be different than existing conditions primarily due to climate change and sea-level rise, general plan development throughout California, and implementation of reasonable and foreseeable water resource management projects to provide water supplies (see Analytical Tools Technical Appendix for additional information).

For the Klamath River Basin, temperatures and precipitation are both anticipated to increase. Climate change may also cause changes in stream flows in the Klamath Basin. Projected warming is anticipated to change runoff timing, with more rainfall runoff during the winter and less runoff during the late spring and summer.

For the Central Valley, it is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. For regulated rivers, reservoirs would be full more frequently by the end of April or May by 2030 than in recent historical conditions. However, as the water is released in the spring, there would be less snowpack to refill the reservoirs. This condition would reduce reservoir storage and available water supplies to downstream uses in the summer. The reduced end-of-September storage also would reduce the ability to release stored water to downstream regional reservoirs. These conditions would occur for all reservoirs in the California foothills and mountains, including non-CVP and SWP reservoirs.

Sea-level rise also would result in reduced CVP and SWP reservoir storage. As sea-level rise occurs, the location of the salt water-freshwater zone moves further inland. However, the CVP and SWP must continue to meet salinity criteria to protect Delta water users and Delta aquatic resources, including the SWRCB D-1641 and other salinity criteria to protect Delta water users. To meet these criteria, the amount of water released from CVP and SWP reservoirs must be increased as compared to recent historical conditions.

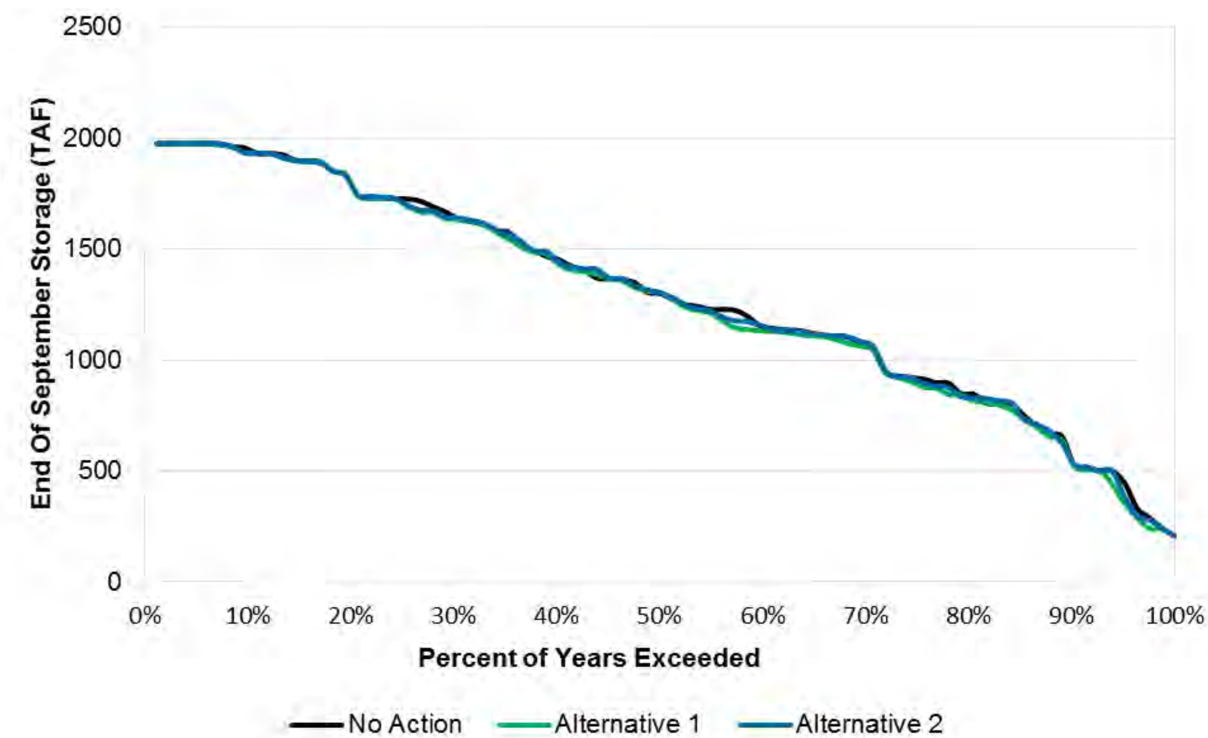
Climate change also would cause changes in stream flows in the Central Valley. During the storm events, the flows would be higher than in recent historical conditions because a larger portion of the precipitation would occur as rainfall instead of snowfall. Flows would increase in the spring as more water is released from CVP and SWP reservoirs to meet Delta salinity criteria. In the summer and fall months, flows could be lower due to reduced amounts of water remaining in reservoir storage.

Proposed Action (Alternative 1)

Lower Klamath and Trinity River Region

Changes in CVP and SWP Reservoir Storage, Elevation and Downstream River Flows The Lower Klamath and Trinity River Region is divided into two sub-regions for this analysis, including the Trinity River from Trinity Lake downstream to the confluence with the Klamath River, and the lower Klamath River from the Trinity River confluence to the Pacific Ocean.

Trinity River Changes in the release to the Trinity River from Lewiston Dam would result in changes to Trinity Lake operations and the exports into the Sacramento River basin via Clear Creek Tunnel. Trinity Lake storage and elevation is summarized in Tables 4-1 and 4-2, and releases from Lewiston Dam to the Trinity River is summarized in Table 4-3. Changes in Trinity River Diversion to Sacramento Basin at Lewiston Reservoir are summarized in Table 4-4. Figure 4-18 is an exceedance curve of Trinity Lake end of September carryover storage.



Key: TAF = thousand acre-feet

Figure 4-18. Trinity Lake End of September Carryover Storage

Trinity Lake storage under Alternative 1 is similar to under the No Action Alternative. Changes in Trinity Lake storage under Alternative 1 have less than a 1 percent decrease except in September of critically dry years where it is a 4 percent decrease.

Trinity Lake elevation under Alternative 1 is similar to under the No Action Alternative with less than 1 percent change in all months of all year types.

Lewiston Dam releases to the Trinity River would increase in August and September in all year types, ranging from 12 percent in August of extremely wet years to 115 percent in September of critically dry years under Alternative 1 as compared to the No Action Alternative. Lewiston Dam releases to the Trinity River would decrease 10 percent in November of extremely wet years, 7 percent in February of Normal years and 10 percent in Octobers of critical dry years under Alternative 1 as compared to the No Action Alternative. The decrease in extremely wet years and in normal years are both driven by a single month in 1974 and 1968 respectively. In these months the release is reduced because storage was lower at the start of the month and water was captured and stored, resulting in the same end of month storage in each case. In both cases these are unique conditions that did not result in substantial changes in subsequent operations and did not violate any operational constraints, including downstream release requirements. The decrease in critical dry years was reduced because the start of month storage in October 1934, at the end of a major drought, was already at the minimum pool level of 240 TAF which was maintained for the month. This is an example of the extreme conditions where there is not enough water supply to meet all requirements and CalSim II utilizes a series of operating rules to reach a solution to allow for the continuation of the simulation and may not be representative of real time operations under these unique extreme conditions. Releases from Lewiston Dam would be generally similar, less than 5 percent change, under Alternative 1 compared to the No Action Alternative during all other months and year types. The flow increases in August and September are due to release of preventive and emergency flow augmentation releases.

Changes under Alternative 1 as compared to the No Action Alternative in Trinity River Diversions to Sacramento River basin vary by year type and month, ranging from a decrease of 16 percent in July of critically dry years to an increase of 13 percent in March of critically dry years under Alternative 1 as compared to the No Action Alternative. The change in March in critical dry years was due to a change in a single year 1924 and is not expected to occur on a regular basis. The long term changes range from decreases of 7 percent in October to increases of 3 percent in February. These changes do not follow the same pattern as the changes in Lewiston release to the Trinity River because they are dependent both on Trinity Lake conditions and operations and Sacramento Basin operations.

1 Table 4-1. Changes in Trinity Lake Storage Under Alternative 1 as Compared to the No Action
2 Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Extremely Wet	1,197	1,258	1,399	1,618	1,839	1,998	2,208	2,300	2,236	2,105	1,993	1,850
Wet	1,373	1,393	1,507	1,621	1,806	1,952	2,114	2,090	2,018	1,896	1,752	1,606
Normal	1,322	1,324	1,346	1,415	1,529	1,669	1,843	1,773	1,689	1,534	1,386	1,276
Dry	1,096	1,089	1,113	1,127	1,189	1,292	1,403	1,361	1,302	1,159	1,005	901
Critically Dry	1,051	1,016	1,014	988	1,012	1,068	1,087	1,048	985	836	676	598
Average All Years	1,233	1,242	1,306	1,385	1,511	1,637	1,779	1,755	1,686	1,548	1,403	1,283
Alternative 1 (TAF)												
Extremely Wet	1,170	1,236	1,377	1,597	1,821	1,981	2,191	2,285	2,221	2,090	1,979	1,839
Wet	1,362	1,382	1,497	1,613	1,798	1,946	2,107	2,083	2,011	1,890	1,743	1,595
Normal	1,319	1,321	1,343	1,415	1,528	1,669	1,842	1,772	1,689	1,536	1,387	1,266
Dry	1,092	1,085	1,109	1,123	1,184	1,288	1,399	1,357	1,298	1,148	992	881
Critically Dry	1,044	1,007	1,005	979	1,004	1,058	1,078	1,039	976	848	677	576
Average All Years	1,224	1,233	1,298	1,377	1,504	1,631	1,772	1,749	1,680	1,544	1,396	1,269
No Action compared to Alternative 1 (TAF)												
Extremely Wet	-27	-22	-22	-21	-17	-17	-17	-15	-15	-15	-15	-11
Wet	-11	-11	-10	-9	-8	-7	-7	-7	-6	-6	-8	-11
Normal	-3	-2	-3	0	0	0	0	0	0	3	1	-10
Dry	-4	-4	-4	-4	-4	-4	-4	-4	-4	-11	-13	-20
Critically Dry	-7	-9	-9	-9	-8	-9	-9	-9	-9	11	1	-22
Average All Years	-9	-9	-9	-8	-7	-6	-6	-6	-6	-5	-8	-14
No Action compared to Alternative 1 (%)												
Extremely Wet	-2%	-2%	-2%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%
Wet	-1%	-1%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%	-1%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	-2%
Critically Dry	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	1%	0%	-4%
Average All Years	-1%	-1%	-1%	-1%	0%	0%	0%	0%	0%	0%	-1%	-1%

3

Key:
TAF = thousand acre-feet

Table 4-2. Changes in Trinity Lake Elevation Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Extremely Wet	2,268	2,275	2,289	2,311	2,328	2,340	2,355	2,360	2,356	2,347	2,340	2,330
Wet	2,286	2,289	2,299	2,309	2,325	2,336	2,348	2,346	2,341	2,332	2,322	2,310
Normal	2,283	2,283	2,285	2,292	2,302	2,314	2,328	2,323	2,316	2,303	2,291	2,281
Dry	2,254	2,253	2,256	2,258	2,265	2,278	2,290	2,286	2,281	2,268	2,251	2,238
Critically Dry	2,251	2,248	2,248	2,247	2,250	2,257	2,260	2,255	2,249	2,231	2,206	2,194
Average All Years	2,271	2,272	2,278	2,286	2,297	2,309	2,320	2,318	2,313	2,301	2,287	2,276
Alternative 1 (feet)												
Extremely Wet	2,265	2,271	2,287	2,309	2,327	2,339	2,353	2,359	2,355	2,346	2,339	2,329
Wet	2,285	2,287	2,297	2,307	2,324	2,336	2,347	2,346	2,341	2,332	2,321	2,309
Normal	2,282	2,283	2,285	2,292	2,302	2,314	2,328	2,322	2,316	2,304	2,291	2,280
Dry	2,253	2,253	2,256	2,258	2,265	2,277	2,289	2,286	2,281	2,266	2,249	2,235
Critically Dry	2,250	2,247	2,247	2,246	2,249	2,256	2,259	2,254	2,248	2,232	2,206	2,190
Average All Years	2,270	2,271	2,277	2,285	2,297	2,308	2,320	2,318	2,312	2,301	2,286	2,274
No Action compared to Alternative 1 (feet)												
Extremely Wet	-4	-3	-3	-2	-2	-1	-1	-1	-1	-1	-1	-1
Wet	-1	-2	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
Normal	0	0	0	0	0	0	0	0	0	0	0	-1
Dry	-1	-1	-1	-1	-1	0	0	0	0	-1	-2	-3
Critically Dry	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	0	-4
Average All Years	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-2
No Action compared to Alternative 1 (%)[1]												
Extremely Wet	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.

Key:
% = percent

Table 4-3. Changes in Trinity River Flow Below Lewiston Dam Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	373	796	930	1,264	1,525	2,458	1,042	4,570	4,626	1,241	450	450
Wet	373	300	1,023	1,175	915	510	481	4,687	2,862	1,102	450	450
Normal	373	300	300	300	385	302	477	4,189	2,120	1,102	450	450
Dry	337	286	300	300	300	300	543	2,848	847	481	450	450
Critically Dry	368	267	300	300	300	300	600	1,498	783	450	450	400
Average All Years	363	359	605	696	668	654	584	3,753	2,210	890	450	445
Alternative 1 (cfs)												
Extremely Wet	373	719	930	1,248	1,455	2,458	1,042	4,570	4,626	1,241	460	477
Wet	373	300	1,024	1,151	910	505	481	4,687	2,862	1,102	503	533
Normal	373	300	300	300	358	302	477	4,189	2,120	1,102	508	632
Dry	337	286	300	300	300	300	543	2,848	847	481	574	725
Critically Dry	332	267	300	300	300	300	600	1,498	783	450	699	861
Average All Years	359	349	605	687	652	652	584	3,753	2,210	890	538	630
No Action compared to Alternative 1 (cfs)												
Extremely Wet	0	-77	0	-16	-69	0	0	0	0	0	10	27
Wet	0	0	1	-24	-5	-5	0	0	0	0	53	83
Normal	0	0	0	0	-27	0	0	0	0	0	58	182
Dry	0	0	0	0	0	0	0	0	0	0	124	275
Critically Dry	-37	0	0	0	0	0	0	0	0	0	249	461
Average All Years	-4	-10	0	-9	-16	-2	0	0	0	0	88	185
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	-10%	0%	-1%	-5%	0%	0%	0%	0%	0%	2%	6%
Wet	0%	0%	0%	-2%	-1%	-1%	0%	0%	0%	0%	12%	18%
Normal	0%	0%	0%	0%	-7%	0%	0%	0%	0%	0%	13%	40%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	28%	61%
Critically Dry	-10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	55%	115%
Average All Years	-1%	-3%	0%	-1%	-2%	0%	0%	0%	0%	0%	20%	42%

Key:
% = percent
cfs = cubic feet per second

Table 4-4. Changes in Trinity River Diversion to Sacramento Basin at Lewiston Reservoir Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	827	233	235	410	7	329	278	498	407	1,836	1,526	2,079
Wet	945	541	376	482	97	322	591	0	290	1,190	1,952	2,065
Normal	792	355	193	418	243	396	228	0	472	1,553	1,991	1,471
Dry	712	418	166	385	134	153	229	247	1,011	1,973	2,098	1,358
Critically Dry	598	609	132	748	168	157	426	378	736	2,028	2,178	949
Average All Years	802	439	241	464	131	276	367	172	575	1,640	1,965	1,648
Alternative 1 (cfs)												
Extremely Wet	766	234	233	410	7	329	278	465	407	1,836	1,513	1,984
Wet	904	551	355	482	100	303	586	0	290	1,181	1,937	2,025
Normal	767	344	196	378	270	396	228	0	469	1,510	1,957	1,471
Dry	636	415	162	387	134	152	229	247	1,008	2,092	2,009	1,196
Critically Dry	521	642	132	753	143	177	426	373	736	1,701	2,092	880
Average All Years	748	443	234	457	134	272	366	167	573	1,623	1,920	1,573
No Action compared to Alternative 1 (cfs)												
Extremely Wet	-61	1	-2	0	0	0	0	-33	0	0	-13	-95
Wet	-42	10	-21	0	3	-20	-5	0	0	-9	-14	-41
Normal	-25	-10	4	-40	27	0	0	0	-3	-43	-34	0
Dry	-75	-3	-4	2	0	-1	0	0	-3	119	-89	-163
Critically Dry	-77	32	0	5	-25	20	0	-4	0	-327	-86	-69
Average All Years	-53	4	-7	-7	3	-4	-2	-5	-2	-16	-45	-74
No Action compared to Alternative 1 (%)												
Extremely Wet	-7%	0%	-1%	0%	0%	0%	0%	-7%	0%	0%	-1%	-5%
Wet	-4%	2%	-6%	0%	3%	-6%	-1%	0%	0%	-1%	-1%	-2%
Normal	-3%	-3%	2%	-10%	11%	0%	0%	0%	-1%	-3%	-2%	0%
Dry	-11%	-1%	-3%	1%	0%	0%	0%	0%	0%	6%	-4%	-12%
Critically Dry	-13%	5%	0%	1%	-15%	13%	0%	-1%	0%	-16%	-4%	-7%
Average All Years	-7%	1%	-3%	-1%	3%	-1%	0%	-3%	0%	-1%	-2%	-5%

Key:
% = percent
cfs = cubic feet per second

Lower Klamath River from Trinity River Confluence to the Pacific Ocean Klamath River flow at the mouth is summarized in Table 4-5. Flows increase in August and September in all year types except extremely wet, from 4 percent in August of wet years to 183 percent in September of critically dry years. In other months for all year types there were no changes except extremely wet, where there was a 1 percent reduction in February. The increases in August and September are due to flow augmentation releases from Lewiston Dam.

Table 4-5. Changes in the Klamath River near Klamath Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type (1980-2003)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	2,905	7,625	18,274	27,315	34,866	36,035	23,665	22,135	15,466	6,395	3,011	2,921
Wet	2,764	6,383	18,076	21,408	24,660	20,999	15,107	16,919	9,822	3,790	2,336	2,524
Normal	2,015	6,377	9,388	14,482	11,199	19,978	14,294	11,565	6,057	2,934	1,851	2,064
Dry	2,982	5,483	6,935	7,121	9,172	9,355	8,414	8,101	4,442	2,027	1,800	1,968
Critically Dry	2,476	2,518	3,525	4,859	5,172	7,102	5,632	6,116	3,313	1,706	1,448	1,586
Average All Years	2,765	5,989	12,699	16,046	18,856	18,773	13,664	13,737	8,273	3,451	2,171	2,302
Alternative 1 (cfs)												
Extremely Wet	2,905	7,625	18,274	27,315	34,675	36,035	23,665	22,135	15,466	6,395	3,011	2,924
Wet	2,764	6,383	18,076	21,408	24,660	20,999	15,107	16,919	9,822	3,790	2,372	2,561
Normal	2,015	6,377	9,388	14,482	11,199	19,978	14,294	11,565	6,057	2,934	2,099	2,978
Dry	2,982	5,483	6,935	7,121	9,172	9,355	8,414	8,101	4,442	2,027	1,974	2,434
Critically Dry	2,476	2,518	3,525	4,859	5,172	7,102	5,632	6,116	3,313	1,706	1,787	2,680
Average All Years	2,765	5,989	12,699	16,046	18,823	18,773	13,664	13,737	8,273	3,451	2,287	2,632
No Action Compared to Alternative 1 (cfs)												
Extremely Wet	0	0	0	0	-191	0	0	0	0	0	0	3
Wet	0	0	0	0	0	0	0	0	0	0	35	37
Normal	0	0	0	0	0	0	0	0	0	0	247	914
Dry	0	0	0	0	0	0	0	0	0	0	174	466
Critically Dry	0	0	0	0	0	0	0	0	0	0	339	1,095
Average All Years	0	0	0	0	-33	0	0	0	0	0	116	330
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	1%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	44%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	10%	24%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	23%	69%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	14%

Key: % = percent cfs = cubic feet per second

Central Valley and Bay-Delta Region

Changes in CVP and SWP Reservoir Storage, Elevation and Downstream River Flows The Central Valley and Bay-Delta Region covers a large geographic area. This section is organized geographically as follows:

- Clear Creek (Whiskeytown Lake, Clear Creek below Whiskeytown)
- Sacramento River (Shasta Lake, Sacramento River below Keswick, Flow Into the Yolo Bypass)
- Feather River (Lake Oroville, Feather River below Oroville and Thermalito Afterbay)
- American River (Folsom Lake, American River below Nimbus Dam)
- San Joaquin River (New Melones, Stanislaus River below Goodwin Dam)

Whiskeytown Dam and Clear Creek Whiskeytown Lake storage is summarized in Table 4-6. Whiskeytown Lake storage under Alternative 1 is similar to the No Action Alternative with changes of less than or equal to 1 percent in all months and year types. As there are no modeled changes to Whiskeytown storage, Whiskeytown Lake elevations under Alternative 1 would also be similar to the No Action Alternative.

Flows in Clear Creek downstream from Whiskeytown Dam are summarized in Table 4-7. Flows in Clear Creek downstream from Whiskeytown Dam under Alternative 1 would be similar to the No Action Alternative with changes less than or equal to 1 percent in all months of all year types.

1 Table 4-6. Changes in Whiskeytown Lake Storage Under Alternative 1 as Compared to the No
2 Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	217	206	206	206	207	218	240	238	240	240	240	235
Above Normal	211	202	205	206	206	217	240	240	239	240	240	235
Below Normal	214	204	204	205	205	217	240	237	240	240	240	235
Dry	215	205	205	204	206	217	239	239	240	237	237	232
Critical	211	202	201	203	204	216	240	240	240	235	220	215
Average All Years	214	204	205	205	206	217	240	239	240	239	236	231
Alternative 1 (TAF)												
Wet	217	206	206	206	207	218	240	238	240	240	240	235
Above Normal	211	202	205	206	206	217	240	240	239	240	240	235
Below Normal	214	204	204	205	205	217	240	237	240	240	240	235
Dry	215	205	205	204	206	217	239	239	240	237	237	232
Critical	211	202	201	203	204	216	240	240	240	235	220	216
Average All Years	214	204	204	205	206	217	240	239	240	239	236	232
No Action compared to Alternative 1 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	1	0	0	0	0	0	0	0	0	0	0	1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

3

Key:
% = percent
TAF= thousand acre-feet

Table 4-7. Changes in Clear Creek Flows Below Whiskeytown Dam Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	200	200	200	309	249	207	200	277	200	85	85	150
Above Normal	181	182	188	192	196	196	196	277	200	85	85	150
Below Normal	195	195	195	195	195	195	195	274	191	85	85	150
Dry	178	184	188	190	190	190	190	267	183	85	85	150
Critical	163	167	167	167	167	167	167	214	111	85	85	133
Average All Years	185	188	190	225	207	194	191	265	181	85	85	148
Alternative 1 (cfs)												
Wet	200	200	200	309	249	207	200	277	200	85	85	150
Above Normal	181	182	188	192	196	196	196	277	200	85	85	150
Below Normal	195	195	195	195	195	195	195	274	191	85	85	150
Dry	178	184	188	190	190	190	190	267	183	85	85	150
Critical	161	167	167	167	167	167	167	214	111	85	85	133
Average All Years	185	188	190	225	207	194	191	265	181	85	85	148
No Action compared to Alternative 1 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	-2	0	0	0	0	0	0	0	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Sacramento River Shasta Lake storage and elevation are summarized in Tables 4-8 and 4-9. Sacramento River Flow Downstream from Keswick Dam is summarized in Table 4-10.

Shasta Lake storage under Alternative 1 is similar to the No Action Alternative with changes of less than or equal to 1 percent in all months and year types.

Shasta Lake elevation under Alternative 1 is similar to the No Action Alternative with changes of less than or equal to 1 percent in all months and year types.

Sacramento River flow downstream from Keswick Dam under Alternative 1 would be similar to the No Action Alternative with most months of all year types changing less than 1 percent, with the exception of a decrease of 2 percent in August of dry years and 4 percent in September of critical years.

Table 4-8. Changes in Shasta Lake Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	2,699	2,718	3,078	3,384	3,639	3,863	4,298	4,460	4,242	3,741	3,414	2,986
Above Normal	2,357	2,373	2,595	3,160	3,451	4,021	4,404	4,429	4,039	3,405	3,069	2,831
Below Normal	2,576	2,537	2,675	3,050	3,430	3,802	4,018	3,952	3,583	3,006	2,649	2,615
Dry	2,343	2,277	2,425	2,619	3,032	3,503	3,735	3,664	3,272	2,745	2,472	2,442
Critical	1,704	1,641	1,725	1,878	2,040	2,282	2,209	2,094	1,723	1,244	983	940
Average All Years	2,396	2,374	2,590	2,897	3,199	3,561	3,834	3,847	3,516	2,981	2,671	2,480
Alternative 1 (TAF)												
Wet	2,698	2,716	3,074	3,381	3,639	3,863	4,299	4,460	4,242	3,740	3,413	2,984
Above Normal	2,354	2,368	2,591	3,158	3,451	4,021	4,404	4,428	4,039	3,406	3,069	2,830
Below Normal	2,576	2,536	2,674	3,050	3,433	3,805	4,022	3,955	3,585	3,013	2,658	2,624
Dry	2,344	2,280	2,428	2,620	3,033	3,504	3,735	3,666	3,274	2,750	2,477	2,443
Critical	1,688	1,627	1,710	1,863	2,023	2,266	2,194	2,079	1,710	1,234	978	929
Average All Years	2,393	2,371	2,587	2,894	3,197	3,559	3,833	3,845	3,515	2,981	2,673	2,479
No Action compared to Alternative 1 (TAF)												
Wet	-1	-2	-4	-3	0	0	0	0	0	-1	-1	-3
Above Normal	-3	-5	-4	-2	0	0	0	0	0	0	0	-1
Below Normal	0	-1	-1	0	3	3	4	2	3	7	8	9
Dry	1	2	3	1	1	0	1	1	2	5	6	1
Critical	-16	-14	-15	-15	-17	-16	-16	-15	-13	-10	-5	-11
Average All Years	-3	-3	-3	-3	-2	-2	-2	-2	-1	0	1	-1
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-9. Changes in Shasta Lake Elevation Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	992	993	1,010	1,024	1,034	1,042	1,058	1,064	1,056	1,038	1,025	1,006
Above Normal	968	968	983	1,013	1,026	1,048	1,062	1,063	1,049	1,025	1,010	1,000
Below Normal	987	985	992	1,009	1,025	1,040	1,048	1,045	1,031	1,007	990	989
Dry	970	968	976	987	1,007	1,027	1,037	1,034	1,019	995	982	980
Critical	929	925	931	941	953	970	966	959	936	900	877	873
Average All Years	973	972	983	999	1,013	1,029	1,039	1,039	1,025	1,001	986	977
Alternative 1 (feet)												
Wet	992	993	1,010	1,024	1,034	1,042	1,058	1,064	1,056	1,038	1,025	1,006
Above Normal	967	968	983	1,013	1,026	1,048	1,062	1,063	1,049	1,025	1,011	1,000
Below Normal	987	985	992	1,009	1,025	1,040	1,048	1,045	1,031	1,007	991	989
Dry	970	968	976	987	1,007	1,027	1,037	1,034	1,019	995	982	980
Critical	928	924	930	941	952	969	965	959	935	900	877	873
Average All Years	973	972	983	999	1,013	1,029	1,039	1,039	1,025	1,001	986	977
No Action compared to Alternative 1 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	1
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	-1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:

[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.

Key:

% = percent

Table 4-10. Changes in Sacramento River Flow Downstream from Keswick Dam Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	6,818	8,363	11,973	17,356	19,393	16,389	9,092	8,198	10,102	13,287	10,378	13,022
Above Normal	6,075	7,101	7,675	7,991	16,094	7,942	6,236	7,332	11,099	14,708	10,512	9,046
Below Normal	6,653	6,916	4,069	3,777	6,831	4,216	5,631	7,238	11,103	14,132	10,963	5,299
Dry	5,992	6,421	3,860	4,070	3,581	3,828	4,809	6,916	11,036	13,306	9,226	4,580
Critical	4,978	4,601	3,634	3,409	3,563	3,382	6,285	6,445	9,713	11,908	8,895	4,437
Average All Years	6,207	6,944	7,032	8,768	11,012	8,450	6,720	7,363	10,565	13,428	9,980	8,040
Alternative 1 (cfs)												
Wet	6,795	8,372	11,984	17,346	19,345	16,371	9,089	8,183	10,100	13,287	10,371	12,991
Above Normal	6,127	7,139	7,659	7,958	16,057	7,947	6,236	7,332	11,100	14,705	10,499	9,023
Below Normal	6,615	6,928	4,070	3,777	6,803	4,216	5,629	7,255	11,098	14,078	10,918	5,274
Dry	5,989	6,402	3,858	4,061	3,592	3,831	4,806	6,906	11,012	13,233	9,087	4,583
Critical	4,908	4,606	3,645	3,413	3,568	3,382	6,280	6,431	9,686	11,807	8,778	4,257
Average All Years	6,192	6,951	7,034	8,758	10,990	8,446	6,717	7,356	10,554	13,388	9,918	7,998
No Action compared to Alternative 1 (cfs)												
Wet	-23	9	12	-10	-49	-18	-3	-14	-1	0	-7	-30
Above Normal	52	37	-16	-33	-37	5	-1	0	1	-3	-13	-22
Below Normal	-37	12	1	0	-28	0	-2	17	-4	-54	-45	-25
Dry	-3	-19	-2	-9	11	3	-3	-10	-24	-74	-139	3
Critical	-69	6	12	4	6	0	-5	-14	-27	-100	-117	-180
Average All Years	-15	6	2	-10	-21	-4	-3	-7	-11	-40	-61	-42
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%	0%
Critical	-1%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	-4%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%

Key:
% = percent
cfs = cubic feet per second

Feather River Lake Oroville storage and elevation are summarized in Tables 4-11 and 4-12. Flows in the Feather River downstream from the Thermalito Afterbay Return are summarized in Table 4-13.

Lake Oroville storage under Alternative 1 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Lake Oroville elevation under Alternative 1 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

The Feather River Flow below the Thermalito Afterbay Return under Alternative 1 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types except for an increase of 6% in June of critical years. The change in OMR was mainly driven by a release from Oroville Dam and related increase in Banks Pumping Plant pumping, which in turn was driven by a slight decrease in SWP San Luis storage. This is a unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis.

Table 4-11. Changes in Lake Oroville Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	1,682	1,721	2,177	2,547	2,830	2,942	3,300	3,487	3,441	2,961	2,623	2,109
Above Normal	1,254	1,294	1,461	1,933	2,504	2,894	3,245	3,391	3,227	2,594	2,110	1,653
Below Normal	1,543	1,501	1,513	1,723	2,129	2,404	2,660	2,716	2,531	1,921	1,504	1,295
Dry	1,203	1,153	1,173	1,301	1,578	1,932	2,172	2,203	1,951	1,456	1,277	1,135
Critical	1,081	1,010	1,006	1,095	1,213	1,368	1,397	1,382	1,229	1,025	914	857
Average All Years	1,391	1,381	1,558	1,823	2,142	2,386	2,652	2,747	2,598	2,113	1,813	1,507
Alternative 1 (TAF)												
Wet	1,682	1,722	2,179	2,549	2,830	2,942	3,300	3,487	3,441	2,962	2,624	2,109
Above Normal	1,254	1,294	1,461	1,933	2,504	2,894	3,245	3,391	3,227	2,594	2,110	1,653
Below Normal	1,543	1,501	1,514	1,723	2,130	2,404	2,660	2,717	2,531	1,923	1,505	1,296
Dry	1,203	1,154	1,174	1,302	1,578	1,933	2,172	2,204	1,951	1,456	1,276	1,134
Critical	1,084	1,015	1,013	1,102	1,217	1,375	1,404	1,389	1,230	1,024	913	856
Average All Years	1,391	1,382	1,560	1,825	2,143	2,387	2,653	2,749	2,598	2,113	1,813	1,507
No Action compared to Alternative 1 (TAF)												
Wet	0	1	2	2	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	1	1	1
Dry	1	1	0	0	0	0	0	1	0	0	0	-1
Critical	3	5	7	7	4	7	7	7	1	0	0	-1
Average All Years	1	1	2	2	1	1	1	1	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	1%	1%	1%	0%	1%	1%	1%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

1 Table 4-12. Changes in Lake Oroville Elevation Under Alternative 1 as Compared to the No
2 Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	743	747	796	833	858	867	890	900	898	867	840	792
Above Normal	694	699	719	775	831	863	886	895	885	839	795	745
Below Normal	730	725	727	752	795	821	844	848	832	774	728	703
Dry	688	682	685	703	737	776	799	802	776	721	700	682
Critical	672	663	662	674	691	710	713	711	691	664	648	639
Average All Years	710	708	728	758	791	815	835	841	827	785	755	723
Alternative 1 (feet)												
Wet	743	747	796	833	858	867	890	900	898	867	840	792
Above Normal	694	699	719	775	831	863	886	895	885	839	795	746
Below Normal	730	726	727	752	795	821	844	848	832	774	728	703
Dry	688	682	686	703	737	776	800	802	776	721	700	682
Critical	673	664	663	675	691	711	714	712	691	664	648	639
Average All Years	710	709	728	758	791	815	835	841	827	785	755	723
No Action compared to Alternative 1 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	1	1	1	1	1	1	1	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

3

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.
Key:
% = percent

4

Table 4-13. Changes in Feather River Flow Downstream from Oroville Dam and Thermalito Afterbay Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	2,124	1,879	3,257	9,436	11,076	12,309	5,889	6,234	3,138	7,085	5,117	8,426
Above Normal	1,516	908	1,807	1,538	2,670	5,724	1,278	1,376	2,233	8,890	7,005	6,992
Below Normal	2,249	1,218	1,538	795	789	1,124	578	1,114	2,246	8,258	5,756	2,558
Dry	1,773	871	1,233	560	705	495	562	1,096	3,063	6,214	1,790	1,361
Critical	815	619	795	308	611	754	605	942	1,774	2,117	1,097	526
Average All Years	1,767	1,206	1,943	3,524	4,303	5,192	2,373	2,749	2,657	6,589	4,102	4,532
Alternative 1 (cfs)												
Wet	2,124	1,879	3,255	9,432	11,115	12,309	5,886	6,232	3,135	7,073	5,121	8,423
Above Normal	1,494	908	1,803	1,537	2,670	5,724	1,279	1,376	2,232	8,888	7,003	6,992
Below Normal	2,249	1,218	1,538	795	789	1,124	578	1,113	2,245	8,247	5,758	2,559
Dry	1,770	871	1,243	560	705	496	562	1,093	3,069	6,221	1,797	1,362
Critical	817	629	794	308	611	753	604	938	1,885	2,136	1,092	525
Average All Years	1,763	1,207	1,944	3,523	4,315	5,192	2,372	2,747	2,673	6,588	4,104	4,532
No Action compared to Alternative 1 (cfs)												
Wet	0	0	-3	-4	39	0	-2	-2	-3	-12	4	-2
Above Normal	-21	0	-4	-1	0	0	1	0	0	-2	-2	-1
Below Normal	0	0	0	0	0	0	0	-1	-1	-11	2	1
Dry	-3	0	10	0	0	1	-1	-3	6	7	6	2
Critical	1	10	0	0	0	0	-1	-4	110	19	-5	-1
Average All Years	-4	1	1	-2	12	0	-1	-2	16	-1	2	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	2%	0%	0%	0%	0%	0%	0%	6%	1%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Flows into the Yolo Bypass Flows from the Sacramento River into the Yolo Bypass at Fremont Weir are summarized in Table 4-14.

Flows from the Sacramento River into the Yolo Bypass at Fremont Weir under Alternative 1 are similar to the No Action Alternative, with changes less than or equal to 1 percent in all months of all water year types.

Table 4-14. Changes in Flows into the Yolo Bypass at Fremont Weir Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	180	912	8,417	24,250	28,263	18,803	5,735	289	113	0	0	100
Above Normal	100	100	2,726	6,023	12,784	7,789	1,704	100	100	0	0	100
Below Normal	100	100	241	1,005	3,058	880	294	100	100	0	0	100
Dry	100	100	308	903	2,004	1,396	407	100	100	0	0	100
Critical	100	100	147	528	536	396	106	100	100	0	0	100
Average All Years	125	357	3,230	9,076	11,965	7,713	2,243	160	104	0	0	100
Alternative 1 (cfs)												
Wet	180	914	8,436	24,241	28,229	18,799	5,733	289	113	0	0	100
Above Normal	100	100	2,730	5,997	12,751	7,791	1,704	100	100	0	0	100
Below Normal	100	100	241	1,005	3,068	878	294	100	100	0	0	100
Dry	100	100	308	898	2,006	1,397	407	100	100	0	0	100
Critical	100	100	147	527	534	396	106	100	100	0	0	100
Average All Years	125	358	3,237	9,068	11,951	7,712	2,242	160	104	0	0	100
No Action compared to Alternative 1 (cfs)												
Wet	0	2	19	-9	-34	-4	-2	0	0	0	0	0
Above Normal	0	0	5	-26	-32	3	0	0	0	0	0	0
Below Normal	0	0	0	0	10	-2	0	0	0	0	0	0
Dry	0	0	0	-5	1	1	0	0	0	0	0	0
Critical	0	0	0	0	-2	0	0	0	0	0	0	0
Average All Years	0	0	7	-8	-14	-1	-1	0	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

American River Folsom Lake storage and elevation are summarized in Tables 4-15 and 4-16. Changes in flows in the American River downstream from Nimbus Dam are summarized in Table 4-17.

Folsom Lake storage under Alternative 1 is similar to the No Action Alternative, with changes of less than or equal to 2 percent in all months of all water year types.

Folsom Lake elevation under Alternative 1 is similar to the No Action Alternative, with changes of less than or equal to 1 percent in all months of all water year types.

The American River flow below Nimbus Dam is generally similar to Alternative 1 with changes of less than 3 percent in all months of all water year types except for a reduction of 5 percent in July and an increase of 5 percent in September of Critical years. The reduction in July is mainly due to larger reductions in two years, 1989 and 1995, the increase in September is mainly due to a single reduction in 1993 with most other years having no or relatively smaller changes. The changes are not related to within year operations but are unique response to isolated conditions and are not expected to occur on a regular basis.

Table 4-15. Changes in Folsom Lake Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	450	433	514	518	515	632	785	950	938	797	706	574
Above Normal	366	375	427	511	530	640	786	945	883	613	542	471
Below Normal	439	426	464	483	533	619	756	840	775	511	455	434
Dry	384	374	401	418	477	576	688	755	648	490	435	408
Critical	317	299	311	318	365	432	472	481	411	325	267	230
Average All Years	400	389	436	459	489	589	712	818	760	585	516	448
Alternative 1 (TAF)												
Wet	451	433	514	518	515	632	785	950	938	797	706	573
Above Normal	369	375	427	511	530	640	786	945	883	613	542	470
Below Normal	439	426	464	483	533	619	756	840	775	512	457	436
Dry	386	376	402	419	477	576	688	755	648	494	437	410
Critical	317	299	311	318	366	433	473	482	411	329	271	232
Average All Years	401	389	437	459	489	589	712	819	760	587	517	449
No Action compared to Alternative 1 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	-1
Above Normal	2	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	1	2	2
Dry	3	2	1	0	0	0	0	0	0	4	2	3
Critical	0	0	0	0	1	1	1	1	0	4	5	2
Average All Years	1	1	0	0	0	0	0	0	0	2	2	1
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-16. Changes in Folsom Lake Elevation Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	408	407	419	419	419	433	449	463	462	449	440	425
Above Normal	393	395	405	418	421	434	449	463	457	430	422	413
Below Normal	406	406	411	414	421	431	446	453	446	416	408	406
Dry	398	398	402	405	414	426	438	444	433	414	406	402
Critical	384	382	387	388	395	405	410	411	400	385	373	366
Average All Years	399	399	407	410	415	427	440	449	443	423	415	406
Alternative 1 (feet)												
Wet	408	407	419	419	419	433	449	463	462	449	440	425
Above Normal	393	395	405	418	421	434	449	463	457	430	422	413
Below Normal	406	406	411	414	421	431	446	453	446	416	408	406
Dry	398	398	402	405	414	426	438	444	433	414	406	403
Critical	384	382	387	388	395	405	410	411	400	386	374	366
Average All Years	400	399	407	410	415	427	440	449	443	424	415	406
No Action compared to Alternative 1 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	1	0	0
Critical	0	0	0	0	0	0	0	0	0	1	1	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.
Key:
% = percent

Table 4-17. Changes in American River Flows Downstream from Nimbus Dam Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	1,736	3,365	6,769	10,469	10,488	7,194	5,486	5,492	4,111	3,479	2,294	3,238
Above Normal	1,601	2,758	3,643	5,426	7,647	5,971	3,533	2,494	2,348	4,760	1,910	2,082
Below Normal	1,862	2,195	2,227	2,250	4,755	2,165	2,423	1,913	2,131	4,532	1,466	1,200
Dry	1,513	1,733	1,561	1,536	2,119	2,365	2,211	1,937	2,399	2,651	1,433	1,244
Critical	1,238	1,389	1,309	1,065	887	1,010	1,240	1,352	1,779	1,458	1,212	1,027
Average All Years	1,604	2,425	3,595	5,012	5,822	4,243	3,345	3,064	2,807	3,325	1,754	1,971
Alternative 1 (cfs)												
Wet	1,749	3,370	6,766	10,476	10,489	7,194	5,486	5,492	4,111	3,478	2,294	3,249
Above Normal	1,548	2,798	3,641	5,424	7,648	5,975	3,535	2,495	2,349	4,760	1,908	2,091
Below Normal	1,866	2,194	2,225	2,252	4,757	2,166	2,423	1,913	2,131	4,515	1,449	1,203
Dry	1,516	1,747	1,575	1,547	2,129	2,359	2,212	1,940	2,403	2,594	1,458	1,241
Critical	1,240	1,391	1,310	1,066	880	1,010	1,240	1,363	1,793	1,393	1,198	1,077
Average All Years	1,601	2,436	3,597	5,017	5,824	4,242	3,346	3,066	2,810	3,300	1,755	1,983
No Action compared to Alternative 1 (cfs)												
Wet	13	5	-3	7	1	0	0	0	0	0	0	11
Above Normal	-53	40	-2	-3	1	3	1	1	1	0	-1	9
Below Normal	4	-1	-1	1	2	1	0	0	-1	-16	-17	2
Dry	3	13	14	11	10	-7	1	3	4	-57	25	-3
Critical	2	2	1	2	-8	0	0	11	14	-66	-14	50
Average All Years	-3	11	2	5	2	-1	1	2	3	-26	1	12
No Action compared to Alternative 1 (%)												
Wet	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	-3%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Dry	0%	1%	1%	1%	0%	0%	0%	0%	0%	-2%	2%	0%
Critical	0%	0%	0%	0%	-1%	0%	0%	1%	1%	-5%	-1%	5%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	1%

Key:
cfs = cubic feet per second

Stanislaus River New Melones Reservoir storage is summarized in Table 4-18. Changes in flows in the Stanislaus River downstream from Goodwin Dam are summarized in Table 4-19.

New Melones storage under Alternative 1 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

As shown in Table 4-18 no changes in storage are identified at New Melones. Accordingly, New Melones elevations under Alternative 1 are similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Flows in the Stanislaus River downstream from Goodwin Dam under Alternative 1 are similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Table 4-18. Changes in New Melones Reservoir Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	1,379	1,390	1,454	1,562	1,666	1,724	1,758	1,878	1,968	1,890	1,773	1,703
Above Normal	1,030	1,061	1,125	1,215	1,317	1,407	1,414	1,484	1,467	1,373	1,277	1,232
Below Normal	1,294	1,305	1,326	1,351	1,413	1,438	1,390	1,383	1,359	1,268	1,175	1,133
Dry	1,094	1,094	1,106	1,122	1,156	1,188	1,154	1,132	1,088	997	914	871
Critical	624	623	638	645	662	657	602	555	527	477	432	409
Average All Years	1,132	1,142	1,180	1,237	1,305	1,348	1,338	1,373	1,381	1,300	1,209	1,159
Alternative 1 (TAF)												
Wet	1,379	1,390	1,454	1,562	1,666	1,724	1,758	1,878	1,968	1,890	1,773	1,703
Above Normal	1,030	1,061	1,125	1,215	1,317	1,407	1,414	1,484	1,467	1,373	1,277	1,232
Below Normal	1,294	1,305	1,326	1,351	1,413	1,438	1,390	1,383	1,359	1,268	1,175	1,133
Dry	1,095	1,094	1,106	1,122	1,156	1,188	1,154	1,132	1,088	997	914	871
Critical	624	624	639	646	662	657	603	555	527	477	432	409
Average All Years	1,133	1,142	1,180	1,237	1,306	1,349	1,338	1,374	1,381	1,300	1,209	1,159
No Action compared to Alternative 1 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	1	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-19. Changes in Stanislaus River Flow Downstream from Goodwin Dam Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	789	435	694	1,139	1,273	1,762	1,538	1,642	1,129	617	549	583
Above Normal	706	200	204	229	273	414	1,244	1,085	717	354	286	257
Below Normal	740	209	211	237	316	320	1,262	1,099	448	275	285	254
Dry	698	210	215	236	274	200	872	797	397	279	283	249
Critical	622	200	218	217	265	261	627	607	350	254	236	212
Average All Years	723	278	365	518	595	754	1,158	1,123	680	394	361	351
Alternative 1 (cfs)												
Wet	789	435	694	1,139	1,273	1,762	1,538	1,642	1,129	617	549	583
Above Normal	706	200	204	229	273	414	1,244	1,085	717	354	286	257
Below Normal	740	209	211	237	316	320	1,262	1,099	448	275	285	254
Dry	698	210	215	236	274	200	872	797	397	279	283	249
Critical	622	200	218	217	265	261	626	607	349	253	236	212
Average All Years	723	278	365	518	595	754	1,158	1,123	679	394	361	351
No Action compared to Alternative 1 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	-1	0	-1	-1	0	0
Average All Years	0	0	0	0	0	0	0	0	-1	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

San Luis Reservoir San Luis Reservoir is jointly operated by the CVP and the SWP, they each have a share of the total storage. San Luis Reservoir CVP and SWP storage is summarized in Tables 4-20 and 4-21. The elevation in San Luis Reservoir is based on the sum of the CVP and SWP volumes and is summarized in Table 4-22.

San Luis Reservoir CVP storage under Alternative 1 is similar to the No Action Alternative with increases of 0 to 2 percent in most months of most years but up to an increase of 4 percent in June of critical years.

San Luis Reservoir SWP storage under Alternative 1 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

San Luis elevation under Alternative 1 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

Table 4-20. Changes in San Luis Reservoir CVP Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	234	352	523	652	778	884	810	661	518	309	195	204
Above Normal	232	377	547	648	733	823	724	544	360	163	109	125
Below Normal	239	357	533	641	698	749	662	496	299	221	166	207
Dry	239	345	510	639	711	751	691	562	389	311	209	223
Critical	266	334	460	582	634	629	579	485	332	258	217	229
Average All Years	240	353	516	636	723	786	714	570	405	267	184	200
Alternative 1 (TAF)												
Wet	235	355	525	654	780	886	812	663	521	312	198	207
Above Normal	235	381	551	651	736	826	727	547	363	165	109	125
Below Normal	241	360	536	645	700	751	665	500	305	225	168	209
Dry	242	348	514	643	715	754	696	570	399	319	213	229
Critical	269	339	467	592	646	640	592	499	347	266	222	229
Average All Years	243	356	520	641	727	790	718	576	412	272	187	203
No Action compared to Alternative 1 (TAF)												
Wet	1	3	2	3	2	2	2	2	3	3	3	2
Above Normal	2	4	5	2	2	3	3	3	3	2	0	0
Below Normal	2	3	3	4	2	2	3	4	6	4	2	2
Dry	3	2	3	4	4	4	5	7	10	8	4	6
Critical	3	5	7	10	11	12	13	14	15	8	5	0
Average All Years	2	3	4	4	4	4	5	6	7	5	3	2
No Action compared to Alternative 1 (%)												
Wet	1%	1%	0%	0%	0%	0%	0%	0%	1%	1%	2%	1%
Above Normal	1%	1%	1%	0%	0%	0%	0%	1%	1%	1%	0%	0%
Below Normal	1%	1%	1%	1%	0%	0%	0%	1%	2%	2%	1%	1%
Dry	1%	1%	1%	1%	1%	0%	1%	1%	3%	2%	2%	3%
Critical	1%	2%	2%	2%	2%	2%	2%	3%	4%	3%	2%	0%
Average All Years	1%	1%	1%	1%	1%	1%	1%	1%	2%	2%	2%	1%

Key:
% = percent
TAF = thousand acre-feet

Table 4-21. Changes in San Luis Reservoir SWP Storage Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	310	310	379	555	729	903	788	590	432	431	434	470
Above Normal	236	259	390	550	690	827	713	502	304	302	321	382
Below Normal	258	220	309	433	553	685	608	446	238	264	262	261
Dry	222	232	336	491	616	728	685	563	395	385	184	156
Critical	146	138	203	373	496	556	543	477	354	226	105	81
Average All Years	246	246	335	496	638	768	691	534	365	347	284	295
Alternative 1 (TAF)												
Wet	310	310	377	554	729	903	788	590	432	430	433	470
Above Normal	236	256	387	551	690	827	713	502	304	302	320	381
Below Normal	259	220	309	433	553	685	608	446	238	263	262	261
Dry	220	230	333	489	614	727	684	562	394	385	183	156
Critical	145	137	203	371	492	552	539	473	355	228	105	81
Average All Years	245	245	333	495	637	768	690	533	365	347	283	294
No Action compared to Alternative 1 (TAF)												
Wet	-1	0	-1	-1	0	0	0	0	0	-1	-1	-1
Above Normal	0	-3	-3	1	0	0	0	0	-1	-1	-1	-1
Below Normal	0	0	0	0	1	0	0	0	0	0	0	0
Dry	-2	-2	-2	-2	-2	-1	-1	-1	-1	0	0	0
Critical	-1	-2	0	-3	-4	-4	-4	-4	2	2	0	0
Average All Years	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	-1%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	-1%	-1%	0%	-1%	-1%	-1%	-1%	-1%	0%	1%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-22. Changes in San Luis Reservoir Surface Elevation Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	399	413	440	471	499	523	507	476	445	422	410	416
Above Normal	390	410	443	469	491	511	493	456	415	390	386	397
Below Normal	393	405	435	459	475	492	477	445	398	391	384	390
Dry	390	405	435	465	483	496	487	464	427	418	379	377
Critical	382	391	414	446	463	468	462	446	416	392	366	365
Average All Years	392	406	435	464	485	503	489	461	425	407	389	393
Alternative 1 (feet)												
Wet	399	413	441	471	499	523	507	476	445	423	410	416
Above Normal	390	411	443	470	491	511	493	456	415	390	386	397
Below Normal	394	405	435	459	476	493	478	446	399	391	384	390
Dry	390	405	435	465	483	497	488	464	428	419	379	378
Critical	383	391	415	447	464	469	463	448	418	393	367	365
Average All Years	392	407	435	464	486	503	490	462	426	408	389	393
No Action compared to Alternative 1 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	1	0	0	0
Dry	0	0	0	0	0	0	0	1	1	1	0	1
Critical	0	1	1	1	1	1	1	1	2	2	1	0
Average All Years	0	0	0	0	0	0	0	0	1	1	0	0
No Action compared to Alternative 1 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation
Key:
% = percent

Changes in Delta Conditions

San Joaquin River Delta Inflow The San Joaquin River flow at Vernalis was selected to represent the San Joaquin River inflow to the Sacramento-San Joaquin Delta and is summarized in Table 4-23.

The San Joaquin River flow at Vernalis under Alternative 1 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

Table 4-23. Changes in San Joaquin River Flows at Vernalis Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,041	3,335	5,580	10,083	12,545	14,021	13,228	11,380	8,751	5,260	2,788	3,061
Above Normal	2,386	2,213	3,279	4,375	6,150	6,704	7,694	5,514	3,482	2,016	1,765	2,214
Below Normal	2,869	2,552	2,414	2,701	4,590	4,249	5,597	3,698	2,029	1,491	1,576	1,997
Dry	2,554	2,344	2,084	2,295	3,120	3,599	4,311	3,240	1,729	1,221	1,343	1,762
Critical	2,196	1,975	1,842	1,757	2,223	2,198	2,129	1,848	1,184	933	983	1,395
Average All Years	2,672	2,611	3,391	5,070	6,655	7,278	7,528	6,039	4,194	2,622	1,847	2,223
Alternative 1 (cfs)												
Wet	3,041	3,335	5,580	10,083	12,545	14,021	13,228	11,380	8,751	5,260	2,788	3,061
Above Normal	2,386	2,213	3,279	4,375	6,151	6,704	7,695	5,514	3,482	2,016	1,765	2,214
Below Normal	2,869	2,552	2,414	2,701	4,591	4,249	5,597	3,698	2,029	1,491	1,576	1,997
Dry	2,554	2,344	2,084	2,295	3,120	3,599	4,311	3,240	1,729	1,221	1,343	1,762
Critical	2,196	1,975	1,842	1,757	2,223	2,198	2,128	1,847	1,183	932	982	1,395
Average All Years	2,672	2,611	3,391	5,070	6,655	7,278	7,528	6,039	4,194	2,621	1,847	2,223
No Action compared to Alternative 1 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	1	0	1	0	0	0	0	0
Below Normal	0	0	0	0	1	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	-1	-1	-1	-1	-1	0
Average All Years	0	0	0	0	0	0	0	0	0	-1	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Sacramento River Delta Inflow The Sacramento River flow at Freeport was selected to represent the Sacramento River inflow to the Sacramento-San Joaquin Delta and is summarized in Table 4-24.

The Sacramento River flow at Freeport under Alternative 1 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

Table 4-24. Changes in Sacramento River Flow at Freeport Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	13,044	20,443	36,311	49,134	56,402	48,167	35,405	29,889	20,143	20,340	16,057	27,926
Above Normal	10,198	17,154	24,532	38,476	46,555	40,701	24,151	16,803	13,676	23,093	16,887	21,166
Below Normal	12,209	15,828	15,772	18,275	30,217	18,597	14,072	12,614	12,955	22,230	15,653	12,113
Dry	10,200	12,772	13,617	17,174	23,405	21,310	14,907	11,791	12,985	17,454	10,500	9,981
Critical	8,103	8,465	11,077	14,101	15,881	12,532	10,341	8,367	9,833	10,892	8,758	7,214
Average All Years	11,064	15,679	22,460	30,383	37,350	31,251	22,092	17,933	14,899	18,943	13,711	17,325
Alternative 1 (cfs)												
Wet	13,034	20,455	36,289	49,132	56,401	48,153	35,404	29,875	20,143	20,332	16,057	27,907
Above Normal	10,179	17,221	24,498	38,465	46,554	40,706	24,154	16,806	13,681	23,093	16,875	21,154
Below Normal	12,172	15,840	15,769	18,275	30,208	18,590	14,072	12,635	12,954	22,158	15,600	12,092
Dry	10,198	12,765	13,639	17,179	23,422	21,305	14,910	11,791	12,986	17,347	10,400	9,987
Critical	8,053	8,482	11,087	14,104	15,830	12,532	10,341	8,368	9,941	10,755	8,659	7,151
Average All Years	11,045	15,695	22,455	30,382	37,345	31,245	22,093	17,932	14,916	18,885	13,663	17,307
No Action compared to Alternative 1 (cfs)												
Wet	-10	12	-22	-2	-1	-14	-1	-14	0	-8	0	-19
Above Normal	-19	67	-34	-11	-1	5	3	3	5	0	-12	-12
Below Normal	-37	12	-3	0	-9	-7	0	21	-1	-72	-53	-21
Dry	-2	-7	22	5	17	-5	3	0	1	-107	-100	6
Critical	-50	17	10	3	-51	0	0	1	108	-137	-99	-63
Average All Years	-19	16	-5	-1	-5	-6	1	-1	17	-58	-48	-18
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%
Critical	-1%	0%	0%	0%	0%	0%	0%	0%	1%	-1%	-1%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Sacramento-San Joaquin Delta Outflow The Sacramento-San Joaquin Delta outflow is summarized in Table 4-25.

The Sacramento-San Joaquin Delta outflow under Alternative 1 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

Table 4-25 Changes in Delta Outflow Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	8,445	17,135	47,370	89,535	101,936	81,603	55,719	38,900	18,814	10,606	4,430	19,051
Above Normal	5,404	12,250	24,302	49,849	67,107	52,281	32,579	19,505	8,147	10,852	4,082	11,130
Below Normal	7,669	10,903	9,449	17,479	36,356	17,934	17,060	12,805	7,484	8,246	4,129	3,550
Dry	5,539	7,902	7,600	15,914	25,698	22,720	16,749	11,073	7,229	5,144	4,178	3,194
Critical	4,126	4,980	6,727	11,691	15,322	12,160	9,391	6,693	5,845	4,053	3,786	3,000
Average All Years	6,518	11,494	22,978	44,229	56,347	43,889	30,580	20,824	10,880	8,037	4,179	9,499
Alternative 1 (cfs)												
Wet	8,443	17,139	47,374	89,526	101,912	81,598	55,716	38,886	18,814	10,603	4,430	19,051
Above Normal	5,404	12,346	24,276	49,823	67,091	52,291	32,582	19,507	8,152	10,852	4,082	11,130
Below Normal	7,669	10,904	9,446	17,479	36,401	17,926	17,061	12,827	7,483	8,226	4,127	3,543
Dry	5,539	7,911	7,606	15,912	25,720	22,716	16,752	11,072	7,229	5,144	4,191	3,198
Critical	4,125	4,980	6,723	11,703	15,269	12,160	9,391	6,693	5,844	4,052	3,766	3,000
Average All Years	6,517	11,512	22,976	44,223	56,341	43,887	30,580	20,823	10,880	8,033	4,179	9,499
No Action compared to Alternative 1 (cfs)												
Wet	-2	4	4	-9	-24	-5	-3	-14	0	-3	0	0
Above Normal	0	96	-26	-26	-16	10	3	2	5	0	0	0
Below Normal	0	1	-3	0	45	-8	1	22	-1	-20	-2	-7
Dry	0	9	6	-2	22	-4	3	-1	0	0	13	4
Critical	-1	0	-4	12	-53	0	0	0	-1	-1	-20	0
Average All Years	-1	18	-2	-6	-6	-2	0	-1	0	-4	0	0
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Old and Middle River Flow The OMR condition in the Sacramento-San Joaquin Delta outflow is summarized in Table 4-26.

OMR under Alternative 1 is similar to the No Action Alternative in all months and year types with reductions of 0 to 3 percent except in June of critical years where there is an increase of 6 percent. The average is from a single critical year, 1992 with a change in OMR from -1943 cfs in the No Action to -3140 cfs in Alternative 1. The change in OMR was mainly driven by a single month increase in Banks pumping, which in turn was driven by a slight decrease in SWP San Luis storage. This is a unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis. CalSim II modifies exports as required in order to maintain the final OMR within regulatory limits.

Table 4-26. Changes in OMR Conditions Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	-5,951	-7,307	-5,524	-1,904	-2,002	-1,613	3,109	2,002	-4,331	-8,978	-10,576	-9,279
Above Normal	-5,597	-6,892	-6,821	-3,501	-3,371	-4,176	1,189	408	-4,525	-9,238	-10,834	-9,539
Below Normal	-5,714	-6,856	-7,653	-4,379	-3,499	-4,036	157	-327	-3,445	-10,570	-9,719	-8,150
Dry	-5,507	-6,045	-6,697	-4,620	-3,705	-3,079	-675	-925	-3,405	-9,211	-4,766	-6,299
Critical	-4,670	-4,396	-4,948	-4,339	-2,969	-1,782	-797	-982	-1,608	-4,015	-3,372	-3,794
Average All Years	-5,567	-6,447	-6,217	-3,508	-2,977	-2,727	914	286	-3,619	-8,564	-8,031	-7,639
Alternative 1 (cfs)												
Wet	-5,944	-7,313	-5,524	-1,904	-1,992	-1,600	3,109	2,002	-4,331	-8,974	-10,576	-9,261
Above Normal	-5,578	-6,871	-6,821	-3,491	-3,352	-4,174	1,189	408	-4,525	-9,238	-10,823	-9,534
Below Normal	-5,680	-6,867	-7,653	-4,379	-3,458	-4,035	156	-327	-3,445	-10,523	-9,671	-8,138
Dry	-5,504	-6,032	-6,712	-4,622	-3,703	-3,078	-675	-925	-3,405	-9,117	-4,666	-6,306
Critical	-4,647	-4,412	-4,959	-4,331	-2,970	-1,782	-797	-983	-1,708	-3,890	-3,303	-3,740
Average All Years	-5,553	-6,446	-6,222	-3,506	-2,965	-2,722	914	286	-3,633	-8,514	-7,988	-7,625
No Action compared to Alternative 1 (cfs)												
Wet	7	-6	0	0	10	13	0	0	0	4	0	18
Above Normal	19	21	0	10	19	2	0	0	0	0	11	5
Below Normal	34	-11	0	0	41	1	-1	0	0	47	48	12
Dry	3	13	-15	-2	2	1	0	0	0	94	100	-7
Critical	23	-16	-11	8	-1	0	0	-1	-100	125	69	54
Average All Years	14	1	-5	2	12	5	0	0	-14	50	43	14
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%
Below Normal	-1%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	6%	-3%	-2%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%

Key:
% = percent
cfs = cubic feet per second
OMR = Old and Middle River

Changes in CVP and SWP Exports

Jones Pumping Plant (CVP Exports) Jones Pumping Plant is the major CVP delta export facility. Exports at Jones Pumping Plant under Alternative 1 as compared to the No Action Alternative are summarized in Table 4-27.

Exports at Jones Pumping Plant under Alternative 1 are similar to the No Action with decreases of 0-3 percent, except in July and August of critical years where it is reduced by 7 percent.

Table 4-27. Changes in Exports at Jones Pumping Plant Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,388	3,612	4,042	3,571	3,986	3,748	1,606	1,549	3,751	4,048	4,578	4,083
Above Normal	3,221	3,857	3,754	2,695	2,873	3,512	1,104	898	2,794	3,202	4,478	3,875
Below Normal	3,595	3,603	4,104	3,192	2,841	2,831	1,009	819	1,932	4,239	3,811	3,979
Dry	3,263	3,263	3,735	3,227	2,797	2,329	1,211	992	1,549	3,373	2,569	3,334
Critical	2,792	2,396	2,816	2,668	1,912	1,337	863	827	608	2,068	2,415	2,664
Average All Years	3,272	3,387	3,750	3,165	3,063	2,889	1,241	1,106	2,358	3,485	3,653	3,646
Alternative 1 (cfs)												
Wet	3,387	3,633	4,033	3,570	3,974	3,736	1,605	1,549	3,751	4,049	4,578	4,064
Above Normal	3,221	3,882	3,754	2,647	2,867	3,504	1,104	898	2,795	3,202	4,465	3,869
Below Normal	3,560	3,610	4,103	3,192	2,785	2,827	1,009	819	1,932	4,188	3,800	3,971
Dry	3,265	3,253	3,742	3,228	2,793	2,310	1,209	993	1,539	3,288	2,499	3,352
Critical	2,774	2,430	2,840	2,699	1,929	1,336	862	827	601	1,924	2,331	2,577
Average All Years	3,264	3,401	3,753	3,162	3,052	2,878	1,240	1,107	2,355	3,437	3,620	3,629
No Action compared to Alternative 1 (cfs)												
Wet	-1	20	-9	-1	-13	-12	-1	0	0	2	0	-19
Above Normal	0	26	1	-49	-5	-8	0	0	1	0	-12	-6
Below Normal	-36	7	0	0	-55	-4	0	0	0	-51	-11	-8
Dry	1	-10	8	1	-5	-19	-2	1	-10	-85	-70	18
Critical	-19	34	25	31	17	-1	-1	0	-7	-144	-83	-87
Average All Years	-7	14	3	-3	-11	-10	-1	0	-3	-48	-33	-16
No Action compared to Alternative 1 (%)												
Wet	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	1%	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	-1%	0%	0%	0%	-2%	0%	0%	0%	0%	-1%	0%	0%
Dry	0%	0%	0%	0%	0%	-1%	0%	0%	-1%	-3%	-3%	1%
Critical	-1%	1%	1%	1%	1%	0%	0%	0%	-1%	-7%	-3%	-3%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%

Key:
% = percent
cfs = cubic feet per second

Banks Pumping Plant (SWP Exports) Banks Pumping plant is the major SWP Delta export facility. Exports at Banks Pumping Plant under Alternative 1 as compared to the No Action Alternative are summarized in Table 4-28.

Banks export under Alternative 1 is similar to the No Action Alternative in all months and year types with reduction of 0 to 2 percent except in June of critical years where it increases by 21 percent. The average is from a single critical year, 1992, with a change in Banks exports from 448 in the No Action to 1743 in Alternative 1. The change in Banks exports was mainly driven by a slight decrease in SWP San Luis storage that had accumulated over several months. This is unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis.

Table 4-28. Changes in Exports at Banks Pumping Plant Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,287	4,743	5,101	4,768	5,634	5,972	1,817	1,822	3,790	6,719	7,102	6,538
Above Normal	2,932	3,767	5,324	3,670	4,444	4,562	1,089	814	2,503	6,364	7,004	6,680
Below Normal	2,788	4,068	5,476	3,099	3,477	3,700	1,238	814	1,577	6,472	6,415	5,105
Dry	2,812	3,464	4,550	3,144	2,975	2,846	1,366	1,040	1,766	5,755	2,263	3,649
Critical	2,290	2,434	3,359	3,032	2,555	1,581	698	628	548	1,295	675	1,397
Average All Years	2,902	3,848	4,797	3,720	4,057	4,038	1,350	1,161	2,321	5,601	4,873	4,912
Alternative 1 (cfs)												
Wet	3,280	4,730	5,111	4,769	5,635	5,971	1,818	1,822	3,790	6,712	7,102	6,538
Above Normal	2,911	3,719	5,324	3,707	4,430	4,568	1,089	814	2,501	6,363	7,004	6,680
Below Normal	2,786	4,073	5,477	3,098	3,487	3,702	1,238	813	1,577	6,472	6,374	5,099
Dry	2,808	3,459	4,558	3,145	2,977	2,862	1,367	1,039	1,776	5,737	2,224	3,639
Critical	2,285	2,418	3,346	2,992	2,539	1,581	698	628	662	1,303	684	1,426
Average All Years	2,894	3,833	4,801	3,720	4,055	4,043	1,351	1,161	2,340	5,595	4,859	4,912
No Action compared to Alternative 1 (cfs)												
Wet	-7	-13	9	1	2	-1	0	0	0	-7	0	0
Above Normal	-21	-48	-1	38	-14	6	0	0	-2	0	0	0
Below Normal	-2	5	0	0	10	2	1	0	0	0	-41	-6
Dry	-4	-5	8	1	2	17	1	-1	10	-18	-39	-10
Critical	-6	-16	-12	-40	-16	0	0	0	114	8	9	28
Average All Years	-8	-15	3	1	-2	5	0	0	19	-5	-14	1
No Action compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	-1%	-1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Dry	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	-2%	0%
Critical	0%	-1%	0%	-1%	-1%	0%	0%	0%	21%	1%	1%	2%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Changes in CVP and SWP Water Supply Delivery The CVP and SWP both deliver water to a variety of customers under different contractual terms. The comparison of changes for CVP and SWP water supply delivery is divided into four categories, including CVP North-of-Delta (NOD), CVP South-of-Delta (SOD), CVP Eastside and SWP.

CVP Delivery North of the Delta CVP NOD water deliveries are summarized in Table 4-29. CVP NOD delivery under Alternative 1 is similar to the No Action Alternative with less than a 5 percent change in all year types for all customers, except critical years for CVP Agricultural Water Service Contractors where it is reduced by 10 percent (23 TAF to 21 TAF).

Table 4-29. Changes in CVP North-of-Delta Water Deliveries Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
CVP Agricultural Water Service Contractors						
No Action (TAF)	305	263	167	89	23	186
Alternative 1 (TAF)	304	262	165	84	21	184
No Action Compared to Alternative 1 (TAF)	-1	-1	-2	-4	-2	-2
No Action Compared to Alternative 1 (%)	0%	0%	-1%	-5%	-10%	-1%
CVP M&I (including Contra Costa)						
No Action (TAF)	386	383	333	292	245	335
Alternative 1 (TAF)	386	381	333	290	241	333
No Action Compared to Alternative 1 (TAF)	0	-1	0	-2	-4	-1
No Action Compared to Alternative 1 (%)	0%	0%	0%	-1%	-2%	0%
CVP Sacramento River Settlement Contractors						
No Action (TAF)	1,844	1,865	1,890	1,915	1,748	1,857
Alternative 1 (TAF)	1,844	1,865	1,890	1,915	1,744	1,856
No Action Compared to Alternative 1 (TAF)	0	0	0	0	-4	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
CVP Refuge Level 2 Deliveries						
No Action (TAF)	88	85	86	85	63	83
Alternative 1 (TAF)	88	85	86	85	62	83
No Action Compared to Alternative 1 (TAF)	0	0	0	0	-1	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	-1%	0%
Total CVP NOD Deliveries						
No Action (TAF)	2,622	2,596	2,477	2,381	2,079	2,460
Alternative 1 (TAF)	2,621	2,593	2,475	2,375	2,068	2,456
No Action Compared to Alternative 1 (TAF)	-1	-2	-3	-7	-11	-4
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	-1%	0%

Key:
% = percent
CVP = Central Valley Project
M&I – municipal and industrial
NOD = North-of-Delta
TAF = thousand acre-feet

CVP Delivery South of the Delta CVP SOD water deliveries are summarized in Table 4-30.

CVP SOD water deliveries under Alternative 1 are similar to the No Action Alternative with less than a 3 percent change or less in all year types for all customers, except critical years for CVP Agricultural Water Service Contractors where it is reduced by 7 percent (137 TAF to 127 TAF).

Table 4-30. Changes in CVP South-of-Delta Water Deliveries Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
CVP Agricultural Water Service Contractors						
No Action (TAF)	1,316	885	752	480	137	795
Alternative 1 (TAF)	1,313	884	742	463	127	787
No Action Compared to Alternative 1 (TAF)	-3	-1	-10	-17	-10	-8
No Action Compared to Alternative 1 (%)	0%	0%	-1%	-3%	-7%	-1%
CVP M&I						
No Action (TAF)	132	112	114	104	85	113
Alternative 1 (TAF)	132	112	114	103	83	112
No Action Compared to Alternative 1 (TAF)	0	0	0	-1	-2	-1
No Action Compared to Alternative 1 (%)	0%	0%	0%	-1%	-2%	-1%
San Joaquin River Exchange Contractors						
No Action (TAF)	874	870	858	871	752	853
Alternative 1 (TAF)	874	870	858	871	752	853
No Action Compared to Alternative 1 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
CVP Refuge Level 2 Deliveries						
No Action	280	276	277	276	249	273
Alternative 1	280	276	277	276	249	273
No Action Compared to Alternative 1 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
Total CVP SOD Deliveries						
No Action (TAF)	2,601	2,143	2,001	1,729	1,223	2,034
Alternative 1 (TAF)	2,598	2,142	1,991	1,712	1,211	2,025
No Action Compared to Alternative 1 (TAF)	-4	-1	-10	-18	-11	-9
No Action Compared to Alternative 1 (%)	0%	0%	-1%	-1%	-1%	0%

Key:
% = percent
CVP = Central Valley Project
SOD = South-of-Delta
TAF = thousand acre-feet

CVP Eastside Delivery CVP Eastside water deliveries are summarized in Table 4-31.

CVP Eastside water deliveries under Alternative 1 are similar to the No Action Alternative with changes to all contractors in all year types of less than 1 percent.

Table 4-31. Changes in CVP Eastside Water Deliveries Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
Water Rights						
No Action	505	518	532	532	443	508
Alternative 1	505	518	532	532	443	508
No Action Compared to Alternative 1 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
CVP Water Service Contracts						
No Action	146	116	117	86	12	103
Alternative 1	146	116	117	86	12	103
No Action Compared to Alternative 1 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
Total Eastside Deliveries						
No Action	651	634	649	618	454	611
Alternative 1	651	634	649	618	455	612
No Action Compared to Alternative 1 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
TAF = thousand acre-feet

CVP Total Water Delivery CVP Total water deliveries are summarized in Table 4-32.

CVP total water deliveries under Alternative 1 are similar to the No Action Alternative with changes to all contractors in all year types less than 1 percent.

Table 4-32. Changes in CVP Total Water Deliveries Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
All CVP Deliveries						
No Action	5,875	5,373	5,128	4,729	3,756	5,105
Alternative 1	5,870	5,369	5,115	4,705	3,734	5,093
No Action Compared to Alternative 1 (TAF)	-4	-4	-13	-24	-22	-13
No Action Compared to Alternative 1 (%)	0%	0%	0%	-1%	-1%	0%

Key:
% = percent
CVP = Central Valley Project
TAF = thousand acre-feet

SWP Table A and Article 21 Delivery SWP SOD water deliveries are summarized in Table 4-33.

SWP total water deliveries under Alternative 1 are similar to the No Action Alternative with changes to all contractors in all year types less than 3 percent.

Table 4-33. Changes in SWP Table A and Article 21 Water Deliveries Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Table A (TAF)						
Alternative/Comparison	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average All Years**
No Action	3,178	2,684	2,526	2,052	1,207	2,449
Alternative 1	3,181	2,683	2,527	2,053	1,211	2,451
No Action Compared to Alternative 1 (TAF)	2	0	1	2	4	2
No Action Compared to Alternative 1 (%)	0%	0%	0%	0%	0%	0%
Article 21 (TAF)						
Alternative/Comparison	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average All Years**
No Action	76	77	21	25	10	46
Alternative 1	74	77	21	25	10	46
No Action Compared to Alternative 1 (TAF)	-2	0	0	0	0	0
No Action Compared to Alternative 1 (%)	-3%	0%	0%	0%	0%	0%

Key:
% = percent
SWP = State Water Project
TAF = thousand acre-feet

Trinity River Record of Decision Flow Rescheduling Alternative (Alternative 2)

Lower Klamath and Trinity River Region

Changes in CVP and SWP Reservoir Storage, Elevation and Downstream River Flows Lower Klamath and Trinity River Region is divided into two sub-regions for this analysis. The Trinity River watershed includes the Trinity River from the headwaters to Lewiston Reservoir downstream from Trinity Lake. The lower Klamath River from Trinity River Confluence to the Pacific Ocean includes the Trinity River from Lewiston Reservoir downstream to the confluence with the Klamath River and the Klamath River downstream from the confluence to the ocean.

Trinity River Watershed Changes in the release to the Trinity River at Lewiston would result in changes to Trinity Lake operations and the Lewiston diversion into the Sacramento River basin. Trinity Lake storage and elevation is summarized in Tables 4-34 and 4-35, the release from Lewiston Dam to the Trinity River is summarized in Table 4-36. Changes in Trinity River Diversion to Sacramento Basin at Lewiston Reservoir are summarized in Table 4-37.

Trinity Lake storage under Alternative 2 would be similar to the No Action Alternative, with 1 percent or less change in most months and year types—with the exceptions of 2 percent decreases in October of extremely wet years and in September of critically dry years, and increases of 2 percent in dry years and 2 percent to 4 percent in June, July and August of critically dry years. Trinity Lake elevation under Alternative 2 is similar to the No Action Alternative with 1 percent or less change in all months of all year types.

The Lewiston Dam release to the Trinity River under Alternative 2 shows reductions from 1 percent to 38 percent in May and June of all year types with the larger reductions in the drier years and increases from 12 percent to 132 percent in August and September with the larger increases in the drier years as compared to the No Action Alternative. These changes are due to the reshaping of the ROD flows to save water earlier in the year to be used for augmentation purposes later in the year if required with the project.

The Trinity River Diversion to Sacramento Basin at Lewiston Reservoir under Alternative 2 shows reductions of up to 11 percent in February of critical years and increases of up to 9 percent in February of normal years as compared to the No Action Alternative. These changes do not follow the same pattern as the changes in Lewiston release to the Trinity River because they are dependent on both Trinity Lake conditions and operations and Sacramento Basin operations.

Table 4-34. Changes in Trinity Lake Storage Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Extremely Wet	1,197	1,258	1,399	1,618	1,839	1,998	2,208	2,300	2,236	2,105	1,993	1,850
Wet	1,373	1,393	1,507	1,621	1,806	1,952	2,114	2,090	2,018	1,896	1,752	1,606
Normal	1,322	1,324	1,346	1,415	1,529	1,669	1,843	1,773	1,689	1,534	1,386	1,276
Dry	1,096	1,089	1,113	1,127	1,189	1,292	1,403	1,361	1,302	1,159	1,005	901
Critically Dry	1,051	1,016	1,014	988	1,012	1,068	1,087	1,048	985	836	676	598
Average All Years	1,233	1,242	1,306	1,385	1,511	1,637	1,779	1,755	1,686	1,548	1,403	1,283
Alternative 2 (TAF)												
Extremely Wet	1,176	1,241	1,381	1,601	1,823	1,981	2,192	2,285	2,223	2,092	1,980	1,841
Wet	1,371	1,391	1,506	1,621	1,805	1,952	2,112	2,090	2,023	1,896	1,752	1,602
Normal	1,328	1,330	1,352	1,422	1,536	1,676	1,850	1,788	1,705	1,552	1,401	1,276
Dry	1,099	1,091	1,116	1,129	1,190	1,294	1,404	1,378	1,323	1,177	1,018	901
Critically Dry	1,052	1,014	1,013	986	1,011	1,066	1,085	1,061	1,013	867	690	585
Average All Years	1,232	1,241	1,305	1,384	1,510	1,636	1,778	1,762	1,698	1,558	1,409	1,279
No Action compared to Alternative 2 (TAF)												
Extremely Wet	-21	-18	-18	-18	-16	-17	-17	-16	-13	-13	-13	-8
Wet	-2	-2	-1	0	-2	0	-1	0	5	0	0	-4
Normal	6	7	7	8	8	8	7	16	17	18	15	1
Dry	2	2	2	2	2	2	2	17	21	17	13	0
Critically Dry	1	-2	-2	-2	-1	-2	-2	13	28	30	14	-14
Average All Years	-1	-1	-1	-1	-1	-1	-1	7	11	10	6	-4
No Action compared to Alternative 2 (%)												
Extremely Wet	-2%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	0%	1%	0%	1%	0%	0%	0%	1%	1%	1%	1%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	1%	2%	1%	1%	0%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	1%	3%	4%	2%	-2%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-35. Changes in Trinity Lake Elevation Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Extremely Wet	2,268	2,275	2,289	2,311	2,328	2,340	2,355	2,360	2,356	2,347	2,340	2,330
Wet	2,286	2,289	2,299	2,309	2,325	2,336	2,348	2,346	2,341	2,332	2,322	2,310
Normal	2,283	2,283	2,285	2,292	2,302	2,314	2,328	2,323	2,316	2,303	2,291	2,281
Dry	2,254	2,253	2,256	2,258	2,265	2,278	2,290	2,286	2,281	2,268	2,251	2,238
Critically Dry	2,251	2,248	2,248	2,247	2,250	2,257	2,260	2,255	2,249	2,231	2,206	2,194
Average All Years	2,271	2,272	2,278	2,286	2,297	2,309	2,320	2,318	2,313	2,301	2,287	2,276
Alternative 2 (feet)												
Extremely Wet	2,265	2,272	2,287	2,309	2,327	2,339	2,353	2,359	2,355	2,347	2,339	2,329
Wet	2,286	2,288	2,299	2,308	2,324	2,336	2,348	2,346	2,341	2,332	2,322	2,310
Normal	2,283	2,284	2,286	2,293	2,303	2,315	2,328	2,324	2,317	2,305	2,292	2,281
Dry	2,254	2,253	2,256	2,258	2,265	2,278	2,290	2,288	2,283	2,270	2,252	2,238
Critically Dry	2,251	2,248	2,248	2,247	2,250	2,257	2,259	2,257	2,252	2,235	2,208	2,192
Average All Years	2,271	2,272	2,278	2,286	2,297	2,309	2,320	2,319	2,314	2,302	2,288	2,275
No Action compared to Alternative 2 (feet)												
Extremely Wet	-3	-3	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Normal	1	1	1	1	1	1	1	1	1	2	1	0
Dry	0	0	0	0	0	0	0	2	2	2	1	0
Critically Dry	0	0	0	0	0	0	0	2	4	4	2	-2
Average All Years	0	0	0	0	0	0	0	1	1	1	1	-1
No Action compared to Alternative 2 (%)[1]												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.

Key:
% = percent

Table 4-36. Changes in Trinity River Flow Below Lewiston Dam Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	373	796	930	1,264	1,525	2,458	1,042	4,570	4,626	1,241	450	450
Wet	373	300	1,023	1,175	915	510	481	4,687	2,862	1,102	450	450
Normal	373	300	300	300	385	302	477	4,189	2,120	1,102	450	450
Dry	337	286	300	300	300	300	543	2,848	847	481	450	450
Critically Dry	368	267	300	300	300	300	600	1,498	783	450	450	400
Average All Years	363	359	605	696	668	654	584	3,753	2,210	890	450	445
Alternative 2 (cfs)												
Extremely Wet	373	730	935	1,262	1,491	2,471	1,042	4,570	4,572	1,241	460	477
Wet	373	300	1,030	1,166	930	507	481	4,658	2,777	1,102	503	533
Normal	373	300	300	300	363	302	477	4,052	2,085	1,102	508	632
Dry	337	286	300	300	300	300	543	2,567	738	481	574	725
Critically Dry	352	267	300	300	300	300	600	1,243	487	450	699	926
Average All Years	362	350	608	693	664	655	584	3,618	2,109	890	538	637
No Action compared to Alternative 2 (cfs)												
Extremely Wet	0	-66	5	-2	-34	13	0	0	-54	0	10	27
Wet	0	0	6	-10	15	-3	0	-29	-85	0	53	83
Normal	0	0	0	0	-22	0	0	-137	-35	0	58	182
Dry	0	0	0	0	0	0	0	-281	-109	0	124	275
Critically Dry	-17	0	0	0	0	0	0	-255	-296	0	249	526
Average All Years	-2	-9	3	-3	-4	1	0	-135	-100	0	88	193
No Action compared to Alternative 2 (%)												
Extremely Wet	0%	-8%	1%	0%	-2%	1%	0%	0%	-1%	0%	2%	6%
Wet	0%	0%	1%	-1%	2%	-1%	0%	-1%	-3%	0%	12%	18%
Normal	0%	0%	0%	0%	-6%	0%	0%	-3%	-2%	0%	13%	40%
Dry	0%	0%	0%	0%	0%	0%	0%	-10%	-13%	0%	28%	61%
Critically Dry	-5%	0%	0%	0%	0%	0%	0%	-17%	-38%	0%	55%	132%
Average All Years	-1%	-2%	0%	0%	-1%	0%	0%	-4%	-5%	0%	20%	43%

Key:
% = percent
cfs = cubic feet per second

Table 4-37. Changes in Trinity River Diversion to Sacramento Basin at Lewiston Reservoir under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	827	233	235	410	7	329	278	498	407	1,836	1,526	2,079
Wet	945	541	376	482	97	322	591	0	290	1,190	1,952	2,065
Normal	792	355	193	418	243	396	228	0	472	1,553	1,991	1,471
Dry	712	418	166	385	134	153	229	247	1,011	1,973	2,098	1,358
Critically Dry	598	609	132	748	168	157	426	378	736	2,028	2,178	949
Average All Years	802	439	241	464	131	276	367	172	575	1,640	1,965	1,648
Alternative 2 (cfs)												
Extremely Wet	803	252	233	410	7	329	278	480	417	1,846	1,513	1,974
Wet	927	552	350	482	103	306	606	0	293	1,275	1,895	2,048
Normal	783	345	197	402	265	396	234	0	489	1,526	1,992	1,518
Dry	662	422	162	394	134	157	229	277	1,058	2,025	2,044	1,305
Critically Dry	650	654	132	752	150	171	426	394	773	1,988	2,190	891
Average All Years	784	449	232	464	135	274	373	179	596	1,671	1,933	1,618
No Action compared to Alternative 2 (cfs)												
Extremely Wet	-24	19	-2	0	0	0	0	-18	10	9	-13	-104
Wet	-18	10	-26	0	6	-16	15	0	4	85	-57	-17
Normal	-9	-10	4	-16	22	0	5	0	16	-27	1	47
Dry	-50	4	-4	10	0	4	0	30	46	52	-54	-53
Critically Dry	53	44	0	4	-19	14	0	17	37	-40	12	-58
Average All Years	-17	10	-8	0	4	-2	6	7	22	31	-31	-30
No Action compared to Alternative 2 (%)												
Extremely Wet	-3%	8%	-1%	0%	0%	0%	0%	-4%	2%	1%	-1%	-5%
Wet	-2%	2%	-7%	0%	6%	-5%	3%	0%	1%	7%	-3%	-1%
Normal	-1%	-3%	2%	-4%	9%	0%	2%	0%	3%	-2%	0%	3%
Dry	-7%	1%	-3%	2%	0%	3%	0%	12%	5%	3%	-3%	-4%
Critically Dry	9%	7%	0%	1%	-11%	9%	0%	4%	5%	-2%	1%	-6%
Average All Years	-2%	2%	-4%	0%	3%	-1%	2%	4%	4%	2%	-2%	-2%

Key:
% = percent
cfs = cubic feet per second

Lower Klamath River from Trinity River Confluence to the Pacific Ocean Flow augmentation releases to the Trinity River under Alternative 2 (Table 4-38) would increase flows at the mouth of the Klamath River in August and September in all year types except extremely wet, from 1 percent in August of wet years to 69 percent in September of critically dry years. Decreased inflows occurred in all year types except in May of extremely wet and wet years (ranging from 1 percent to 4 percent), and in June for all year types except extremely wet (ranging from 1 percent to 9 percent). The increases in August and September are due to potential augmentation releases while the reductions in the other portion of the years are due to changes in Trinity Lake releases due to reshaping the ROD flows.

Table 4-38. Changes in the Klamath River near Klamath Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type (1980-2003)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Extremely Wet	2,905	7,625	18,287	27,315	34,773	36,035	23,665	22,135	15,412	6,395	3,011	2,924
Wet	2,764	6,383	18,091	22,061	24,264	20,527	14,685	16,405	9,417	3,765	2,351	2,541
Normal	2,015	6,377	9,388	14,482	11,199	19,978	14,294	11,428	6,021	2,934	2,099	2,978
Dry	2,982	5,483	6,935	7,121	9,172	9,355	8,414	7,808	4,350	2,027	1,974	2,434
Critically Dry	2,476	2,518	3,525	4,859	5,172	7,102	5,632	5,861	3,017	1,706	1,787	2,680
Average All Years	2,765	5,989	12,706	16,514	18,934	18,689	13,566	13,559	8,122	3,455	2,283	2,622
Alternative 2 (cfs)												
Extremely Wet	2,905	7,625	18,287	27,315	34,773	36,035	23,665	22,135	15,412	6,395	3,011	2,924
Wet	2,764	6,383	18,091	22,061	24,264	20,527	14,685	16,405	9,417	3,765	2,351	2,541
Normal	2,015	6,377	9,388	14,482	11,199	19,978	14,294	11,428	6,021	2,934	2,099	2,978
Dry	2,982	5,483	6,935	7,121	9,172	9,355	8,414	7,808	4,350	2,027	1,974	2,434
Critically Dry	2,476	2,518	3,525	4,859	5,172	7,102	5,632	5,861	3,017	1,706	1,787	2,680
Average All Years	2,765	5,989	12,706	16,514	18,934	18,689	13,566	13,559	8,122	3,455	2,283	2,622
No Action compared to Alternative 2 (cfs)												
Extremely Wet	0	0	13	0	-93	0	0	0	-54	0	0	3
Wet	0	0	15	0	0	0	0	-31	-88	0	31	33
Normal	0	0	0	0	0	0	0	-137	-35	0	247	914
Dry	0	0	0	0	0	0	0	-292	-92	0	174	466
Critically Dry	0	0	0	0	0	0	0	-255	-296	0	339	1,095
Average All Years	0	0	7	0	-16	0	0	-130	-96	0	112	316
No Action compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	1%	1%
Normal	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%	13%	44%
Dry	0%	0%	0%	0%	0%	0%	0%	-4%	-2%	0%	10%	24%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	-4%	-9%	0%	23%	69%
Average All Years	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%	5%	14%

Key:
% = percent
cfs = cubic feet per second

Central Valley and Bay-Delta Region

Changes in CVP and SWP Reservoir Storage, Elevation and Downstream River Flows This section is organized geographically as follows:

- Clear Creek (Whiskeytown Lake, Clear Creek below Whiskeytown)
- Sacramento River (Shasta Lake, Sacramento River below Keswick, Flow Into the Yolo Bypass)
- Feather River (Lake Oroville, Feather River below Oroville and Thermalito Afterbay)
- American River (Folsom Lake, American River below Nimbus Dam)
- San Joaquin River (New Melones, Stanislaus River below Goodwin Dam)

Clear Creek Whiskeytown Lake storage is summarized in Table 4-39. Whiskeytown Lake storage under Alternative 2 is similar to the No Action Alternative with changes of less than or equal to 2 percent in all months and year types. As there are no modeled changes to Whiskeytown storage, Whiskeytown Lake elevations under Alternative 2 would also be similar to the No Action Alternative.

Flows in Clear Creek downstream from Whiskeytown Dam are summarized in Table 4-40. Flows in Clear Creek downstream from Whiskeytown Dam under Alternative 2 would be similar to the No Action Alternative with changes less than or equal to 1 percent in all months of all year types.

Table 4-39. Changes in Whiskeytown Lake Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	217	206	206	206	207	218	240	238	240	240	240	235
Above Normal	211	202	205	206	206	217	240	239	239	240	240	235
Below Normal	217	206	205	206	206	217	240	236	240	240	240	235
Dry	215	205	205	204	205	217	240	239	240	240	240	235
Critical	208	200	199	202	204	216	239	240	240	230	215	210
Average All Years	214	204	205	205	206	217	240	239	240	239	236	231
Alternative 2 (TAF)												
Wet	217	206	206	206	207	218	240	238	240	240	240	235
Above Normal	211	202	205	206	206	217	240	239	239	240	240	235
Below Normal	217	206	205	206	206	217	240	236	240	240	240	235
Dry	215	205	205	204	205	217	240	239	240	240	240	235
Critical	208	200	199	202	204	216	239	240	240	230	215	214
Average All Years	214	204	204	205	206	217	240	239	240	239	236	232
No Action compared to Alternative 2 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	1	0	0	0	0	0	0	0	0	0	0	3
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF= thousand acre-feet

Table 4-40. Changes in Clear Creek Flows Below Whiskeytown Dam Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	200	200	200	309	249	207	200	277	200	85	85	150
Above Normal	181	182	188	192	196	196	196	277	200	85	85	150
Below Normal	195	195	195	195	195	195	195	274	191	85	85	150
Dry	178	184	188	190	190	190	190	267	183	85	85	150
Critical	163	167	167	167	167	167	167	214	111	85	85	133
Average All Years	185	188	190	225	207	194	191	265	181	85	85	148
Alternative 2 (cfs)												
Wet	200	200	200	309	249	207	200	277	200	85	85	150
Above Normal	181	182	188	192	196	196	196	277	200	85	85	150
Below Normal	195	195	195	195	195	195	195	274	191	85	85	150
Dry	178	184	188	190	190	190	190	267	183	85	85	150
Critical	163	167	167	167	167	167	167	214	111	85	85	133
Average All Years	185	188	190	225	207	194	191	265	181	85	85	148
No Action compared to Alternative 2 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Sacramento River Shasta Lake storage and elevation are summarized in Tables 4-41 and 4-42. Sacramento River Flow Downstream from Keswick Dam is summarized in Table 4-43.

Shasta Lake storage under Alternative 2 is similar to the No Action Alternative with changes of less than or equal to 1 percent in all months and year types.

Shasta Lake elevation under Alternative 2 is similar to the No Action Alternative with changes of less than or equal to 1 percent in all months and year types.

Sacramento River Flow Downstream from Keswick Dam under Alternative 2 would be similar to the No Action Alternative with most months of all year types changing less than 1 percent, with the exception of a reduction of 3 percent in September of Critical years.

Table 4-41. Changes in Shasta Lake Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	2,699	2,718	3,078	3,384	3,639	3,863	4,298	4,460	4,242	3,741	3,414	2,986
Above Normal	2,357	2,373	2,595	3,160	3,451	4,021	4,404	4,429	4,039	3,405	3,069	2,831
Below Normal	2,576	2,537	2,675	3,050	3,430	3,802	4,018	3,952	3,583	3,006	2,649	2,615
Dry	2,343	2,277	2,425	2,619	3,032	3,503	3,735	3,664	3,272	2,745	2,472	2,442
Critical	1,704	1,641	1,725	1,878	2,040	2,282	2,209	2,094	1,723	1,244	983	940
Average All Years	2,396	2,374	2,590	2,897	3,199	3,561	3,834	3,847	3,516	2,981	2,671	2,480
Alternative 2 (TAF)												
Wet	2,700	2,717	3,075	3,381	3,639	3,863	4,299	4,461	4,242	3,745	3,415	2,985
Above Normal	2,354	2,369	2,592	3,157	3,451	4,021	4,405	4,430	4,040	3,408	3,070	2,831
Below Normal	2,577	2,537	2,675	3,052	3,433	3,805	4,021	3,957	3,590	3,015	2,657	2,626
Dry	2,345	2,279	2,427	2,621	3,034	3,505	3,737	3,667	3,277	2,749	2,473	2,442
Critical	1,693	1,631	1,714	1,867	2,027	2,269	2,197	2,082	1,714	1,239	977	933
Average All Years	2,395	2,372	2,588	2,894	3,198	3,560	3,834	3,847	3,517	2,984	2,672	2,479
No Action compared to Alternative 2 (TAF)												
Wet	1	-1	-2	-3	0	0	0	0	0	5	1	-2
Above Normal	-3	-4	-3	-2	1	0	1	1	1	3	1	0
Below Normal	1	0	0	1	3	3	3	5	7	8	7	11
Dry	2	2	2	1	1	2	2	3	5	4	1	0
Critical	-11	-10	-11	-11	-13	-12	-12	-12	-10	-6	-6	-7
Average All Years	-1	-2	-2	-2	-1	-1	-1	0	1	3	1	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	0%	-1%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-42. Changes in Shasta Lake Elevation Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	992	993	1,010	1,024	1,034	1,042	1,058	1,064	1,056	1,038	1,025	1,006
Above Normal	968	968	983	1,013	1,026	1,048	1,062	1,063	1,049	1,025	1,010	1,000
Below Normal	987	985	992	1,009	1,025	1,040	1,048	1,045	1,031	1,007	990	989
Dry	970	968	976	987	1,007	1,027	1,037	1,034	1,019	995	982	980
Critical	929	925	931	941	953	970	966	959	936	900	877	873
Average All Years	973	972	983	999	1,013	1,029	1,039	1,039	1,025	1,001	986	977
Alternative 2 (feet)												
Wet	992	993	1,010	1,024	1,034	1,042	1,058	1,064	1,056	1,038	1,025	1,006
Above Normal	967	968	983	1,013	1,026	1,048	1,062	1,063	1,049	1,025	1,011	1,000
Below Normal	987	985	992	1,009	1,025	1,040	1,048	1,045	1,031	1,007	991	989
Dry	970	968	976	987	1,007	1,027	1,037	1,034	1,019	995	982	980
Critical	928	924	930	941	952	969	965	959	935	900	877	873
Average All Years	973	972	983	999	1,013	1,029	1,039	1,039	1,025	1,001	986	977
No Action compared to Alternative 2 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	1
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	-1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.
Key:
% = percent

Table 4-43. Changes in Sacramento River Flow Downstream from Keswick Dam Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	6,818	8,363	11,973	17,356	19,393	16,389	9,092	8,198	10,102	13,287	10,378	13,022
Above Normal	6,075	7,101	7,675	7,991	16,094	7,942	6,236	7,332	11,099	14,708	10,512	9,046
Below Normal	6,653	6,916	4,069	3,777	6,831	4,216	5,631	7,238	11,103	14,132	10,963	5,299
Dry	5,992	6,421	3,860	4,070	3,581	3,828	4,809	6,916	11,036	13,306	9,226	4,580
Critical	4,978	4,601	3,634	3,409	3,563	3,382	6,285	6,445	9,713	11,908	8,895	4,437
Average All Years	6,207	6,944	7,032	8,768	11,012	8,450	6,720	7,363	10,565	13,428	9,980	8,040
Alternative 2 (cfs)												
Wet	6,804	8,403	11,984	17,367	19,345	16,370	9,093	8,191	10,106	13,290	10,376	13,012
Above Normal	6,121	7,152	7,653	7,982	16,040	7,952	6,237	7,334	11,104	14,707	10,541	9,061
Below Normal	6,656	6,911	4,066	3,777	6,838	4,216	5,632	7,245	11,104	14,156	10,981	5,296
Dry	6,000	6,434	3,864	4,061	3,584	3,826	4,810	6,919	11,039	13,319	9,208	4,581
Critical	4,971	4,629	3,648	3,410	3,569	3,382	6,284	6,440	9,697	11,845	8,911	4,283
Average All Years	6,211	6,972	7,035	8,768	10,990	8,445	6,720	7,362	10,566	13,426	9,984	8,017
No Action compared to Alternative 2 (cfs)												
Wet	-15	41	11	12	-49	-19	0	-7	5	3	-2	-10
Above Normal	45	50	-22	-10	-54	10	1	2	5	-1	29	15
Below Normal	3	-5	-3	0	7	0	1	7	1	24	18	-4
Dry	8	13	4	-8	4	-3	1	3	3	13	-18	1
Critical	-7	28	14	1	6	0	-1	-5	-16	-63	16	-154
Average All Years	4	27	3	0	-21	-5	0	-1	1	-2	4	-24
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	1%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	-3%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Feather River Lake Oroville storage and elevation are summarized in Tables 4-44 and 4-45. Flows in the Feather River downstream from the Thermalito Afterbay Return are summarized in Table 4-46.

Lake Oroville storage under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Lake Oroville elevation under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

The Feather River Flow below the Thermalito Afterbay Return under Alternative 2 is similar to No Action Alternative with changes of 1 percent or less in all months of all year types except for a 6 percent change in June of critical year types. This change is due to one instance in 1992 of an operations difference that is mirrored by changes in OMR flow and Banks export, as described later in this section.

Table 4-44. Changes in Lake Oroville Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	1,682	1,721	2,177	2,547	2,830	2,942	3,300	3,487	3,441	2,961	2,623	2,109
Above Normal	1,254	1,294	1,461	1,933	2,504	2,894	3,245	3,391	3,227	2,594	2,110	1,653
Below Normal	1,543	1,501	1,513	1,723	2,129	2,404	2,660	2,716	2,531	1,921	1,504	1,295
Dry	1,203	1,153	1,173	1,301	1,578	1,932	2,172	2,203	1,951	1,456	1,277	1,135
Critical	1,081	1,010	1,006	1,095	1,213	1,368	1,397	1,382	1,229	1,025	914	857
Average All Years	1,391	1,381	1,558	1,823	2,142	2,386	2,652	2,747	2,598	2,113	1,813	1,507
Alternative 2 (TAF)												
Wet	1,682	1,720	2,176	2,547	2,830	2,942	3,300	3,487	3,441	2,961	2,623	2,109
Above Normal	1,254	1,294	1,461	1,933	2,503	2,894	3,245	3,390	3,227	2,593	2,109	1,653
Below Normal	1,543	1,501	1,514	1,723	2,130	2,404	2,660	2,717	2,531	1,921	1,504	1,295
Dry	1,202	1,152	1,173	1,301	1,578	1,932	2,172	2,203	1,950	1,456	1,277	1,135
Critical	1,083	1,014	1,012	1,101	1,216	1,374	1,403	1,388	1,229	1,025	914	856
Average All Years	1,391	1,382	1,559	1,824	2,143	2,386	2,653	2,748	2,598	2,113	1,813	1,506
No Action compared to Alternative 2 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	-1	0	0	0	0	0	0	0	0	0	0
Critical	2	5	6	7	3	6	6	6	0	0	0	0
Average All Years	0	0	1	1	0	1	1	1	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-45. Changes in Lake Oroville Elevation Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	743	747	796	833	858	867	890	900	898	867	840	792
Above Normal	694	699	719	775	831	863	886	895	885	839	795	745
Below Normal	730	725	727	752	795	821	844	848	832	774	728	703
Dry	688	682	685	703	737	776	799	802	776	721	700	682
Critical	672	663	662	674	691	710	713	711	691	664	648	639
Average All Years	710	708	728	758	791	815	835	841	827	785	755	723
Alternative 2 (feet)												
Wet	743	747	796	833	858	867	890	900	898	867	840	792
Above Normal	694	699	719	775	831	863	886	895	885	839	795	745
Below Normal	730	726	727	752	795	821	844	848	832	774	728	703
Dry	688	682	685	703	737	776	799	802	776	721	700	682
Critical	673	664	663	675	691	711	714	712	691	664	648	639
Average All Years	710	708	728	758	791	815	835	841	827	785	755	723
No Action compared to Alternative 2 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	1	1	1	0	1	1	1	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.
Key:
% = percent

Table 4-46. Changes in Feather River Flow Downstream from Oroville Dam and Thermalito Afterbay Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	2,124	1,879	3,257	9,436	11,076	12,309	5,889	6,234	3,138	7,085	5,117	8,426
Above Normal	1,516	908	1,807	1,538	2,670	5,724	1,278	1,376	2,233	8,890	7,005	6,992
Below Normal	2,249	1,218	1,538	795	789	1,124	578	1,114	2,246	8,258	5,756	2,558
Dry	1,773	871	1,233	560	705	495	562	1,096	3,063	6,214	1,790	1,361
Critical	815	619	795	308	611	754	605	942	1,774	2,117	1,097	526
Average All Years	1,767	1,206	1,943	3,524	4,303	5,192	2,373	2,749	2,657	6,589	4,102	4,532
Alternative 2 (cfs)												
Wet	2,124	1,878	3,259	9,430	11,076	12,309	5,887	6,233	3,138	7,089	5,118	8,426
Above Normal	1,513	910	1,807	1,539	2,670	5,722	1,278	1,377	2,233	8,892	7,005	6,994
Below Normal	2,249	1,218	1,538	795	789	1,124	578	1,114	2,253	8,260	5,752	2,561
Dry	1,774	871	1,226	560	705	496	562	1,096	3,063	6,217	1,784	1,358
Critical	816	620	795	308	619	754	605	941	1,880	2,121	1,088	525
Average All Years	1,767	1,207	1,941	3,522	4,304	5,192	2,372	2,749	2,673	6,592	4,099	4,532
No Action compared to Alternative 2 (cfs)												
Wet	0	0	2	-6	-1	0	-2	-1	0	4	1	0
Above Normal	-3	2	0	1	0	-2	0	0	1	2	0	2
Below Normal	0	0	0	0	0	0	0	0	7	2	-4	3
Dry	1	0	-7	0	0	1	0	0	0	3	-6	-2
Critical	0	1	0	0	8	0	0	-1	106	4	-9	-1
Average All Years	0	1	-1	-2	1	0	0	0	16	3	-3	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	1%	0%	0%	0%	6%	0%	-1%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Flows into the Yolo Bypass Flows from the Sacramento River into the Yolo Bypass at Fremont Weir are summarized in Table 4-47.

Flows from the Sacramento River into the Yolo Bypass at Fremont Weir under Alternative 2 are similar to the No Action Alternative, with changes less than or equal to 1 percent in all months of all water year types.

Table 4-47. Changes in Flows into the Yolo Bypass at Fremont Weir Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	180	912	8,417	24,250	28,263	18,803	5,735	289	113	0	0	100
Above Normal	100	100	2,726	6,023	12,784	7,789	1,704	100	100	0	0	100
Below Normal	100	100	241	1,005	3,058	880	294	100	100	0	0	100
Dry	100	100	308	903	2,004	1,396	407	100	100	0	0	100
Critical	100	100	147	528	536	396	106	100	100	0	0	100
Average All Years	125	357	3,230	9,076	11,965	7,713	2,243	160	104	0	0	100
Alternative 2 (cfs)												
Wet	180	912	8,433	24,257	28,219	18,799	5,735	289	113	0	0	100
Above Normal	100	100	2,728	6,013	12,730	7,764	1,704	100	100	0	0	100
Below Normal	100	100	241	1,005	3,076	880	294	100	100	0	0	100
Dry	100	100	308	898	2,005	1,395	407	100	100	0	0	100
Critical	100	100	147	527	535	396	106	100	100	0	0	100
Average All Years	125	357	3,235	9,076	11,946	7,708	2,243	160	104	0	0	100
No Action compared to Alternative 2 (cfs)												
Wet	0	0	16	7	-44	-4	0	0	0	0	0	0
Above Normal	0	0	2	-10	-54	-25	0	0	0	0	0	0
Below Normal	0	0	0	0	18	0	0	0	0	0	0	0
Dry	0	0	0	-5	1	-1	0	0	0	0	0	0
Critical	0	0	0	0	-1	0	0	0	0	0	0	0
Average All Years	0	0	6	-1	-20	-5	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

American River Folsom Lake storage and elevation are summarized in Tables 4-48 and 4-49. Changes in flows in the American River downstream from Nimbus Dam are summarized in Table 4-50.

Folsom Lake storage under Alternative 2 is similar to the No Action Alternative, with changes of less than or equal to 1 percent in all months of all water year types.

Folsom Lake elevation under Alternative 2 is similar to the No Action Alternative, with changes of less than or equal to 1 percent in all months of all water year types.

The American River flow below Nimbus Dam is generally similar under Alternative 2 with changes of less than 2 percent in all months of all water year types except for an increase of 5 percent in September of Critical years.

Table 4-48. Changes in Folsom Lake Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	450	433	514	518	515	632	785	950	938	797	706	574
Above Normal	366	375	427	511	530	640	786	945	883	613	542	471
Below Normal	439	426	464	483	533	619	756	840	775	511	455	434
Dry	384	374	401	418	477	576	688	755	648	490	435	408
Critical	317	299	311	318	365	432	472	481	411	325	267	230
Average All Years	400	389	436	459	489	589	712	818	760	585	516	448
Alternative 2 (TAF)												
Wet	450	433	514	518	515	632	785	950	938	797	706	574
Above Normal	367	376	428	511	530	640	786	945	883	613	542	471
Below Normal	439	425	463	482	533	619	756	840	775	512	457	436
Dry	384	374	401	418	477	576	688	755	648	489	433	405
Critical	316	299	311	319	366	433	473	482	411	327	268	230
Average All Years	400	389	436	459	489	589	712	818	760	586	516	448
No Action compared to Alternative 2 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	1	1	1	0	0	0	0	0	0	0	0	1
Below Normal	0	0	0	0	0	0	0	0	0	2	2	1
Dry	1	0	0	-1	0	0	0	0	0	-1	-2	-2
Critical	-1	0	0	1	1	1	1	1	0	2	2	-1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-49. Changes in Folsom Lake Elevation Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	408	407	419	419	419	433	449	463	462	449	440	425
Above Normal	393	395	405	418	421	434	449	463	457	430	422	413
Below Normal	406	406	411	414	421	431	446	453	446	416	408	406
Dry	398	398	402	405	414	426	438	444	433	414	406	402
Critical	384	382	387	388	395	405	410	411	400	385	373	366
Average All Years	399	399	407	410	415	427	440	449	443	423	415	406
Alternative 2 (feet)												
Wet	408	407	419	419	419	433	449	463	462	449	440	425
Above Normal	393	395	405	418	421	434	449	463	457	430	422	413
Below Normal	406	406	411	414	421	431	446	453	447	416	408	406
Dry	398	398	402	405	414	426	438	444	433	414	406	402
Critical	384	382	387	389	396	405	410	411	400	385	373	365
Average All Years	400	399	407	410	415	427	440	449	443	423	415	406
No Action compared to Alternative 2 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	0	0	0	-1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:
[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.
Key:
% = percent

Table 4-50. Changes in American River Flows Downstream from Nimbus Dam Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	1,736	3,365	6,769	10,469	10,488	7,194	5,486	5,492	4,111	3,479	2,294	3,238
Above Normal	1,601	2,758	3,643	5,426	7,647	5,971	3,533	2,494	2,348	4,760	1,910	2,082
Below Normal	1,862	2,195	2,227	2,250	4,755	2,165	2,423	1,913	2,131	4,532	1,466	1,200
Dry	1,513	1,733	1,561	1,536	2,119	2,365	2,211	1,937	2,399	2,651	1,433	1,244
Critical	1,238	1,389	1,309	1,065	887	1,010	1,240	1,352	1,779	1,458	1,212	1,027
Average All Years	1,604	2,425	3,595	5,012	5,822	4,243	3,345	3,064	2,807	3,325	1,754	1,971
Alternative 2 (cfs)												
Wet	1,740	3,362	6,765	10,471	10,488	7,194	5,486	5,492	4,111	3,476	2,294	3,245
Above Normal	1,547	2,752	3,640	5,435	7,648	5,977	3,534	2,494	2,348	4,760	1,910	2,071
Below Normal	1,861	2,196	2,226	2,250	4,753	2,165	2,422	1,911	2,125	4,511	1,462	1,204
Dry	1,522	1,743	1,566	1,540	2,113	2,367	2,209	1,935	2,397	2,661	1,459	1,243
Critical	1,229	1,380	1,300	1,057	886	1,010	1,240	1,356	1,796	1,430	1,205	1,070
Average All Years	1,598	2,424	3,593	5,014	5,821	4,244	3,345	3,064	2,808	3,320	1,759	1,979
No Action compared to Alternative 2 (cfs)												
Wet	4	-3	-4	2	0	0	0	0	0	-2	0	7
Above Normal	-54	-6	-3	9	1	6	0	0	1	0	0	-10
Below Normal	0	1	0	0	-2	0	-1	-3	-6	-20	-4	4
Dry	9	10	5	3	-6	2	-2	-2	-2	10	26	-1
Critical	-9	-9	-9	-7	-1	0	0	3	17	-28	-7	42
Average All Years	-6	-1	-2	2	-2	1	0	0	1	-5	5	7
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Critical	0%	-1%	-1%	-1%	0%	0%	0%	0%	1%	-2%	-1%	5%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Stanislaus River New Melones Reservoir storage and elevation are summarized in Tables 4-51 and 4-52. Changes in flows in the Stanislaus River downstream from Goodwin Dam are summarized in Table 4-53.

New Melones storage under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types. New Melones elevations under Alternative 2 are similar to under the No Action Alternative with changes of 1 percent or less in all months of all year types. Flows in the Stanislaus River downstream from Goodwin Dam under Alternative 2 are similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Table 4-51. Changes in New Melones Reservoir Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	1,379	1,390	1,454	1,562	1,666	1,724	1,758	1,878	1,968	1,890	1,773	1,703
Above Normal	1,030	1,061	1,125	1,215	1,317	1,407	1,414	1,484	1,467	1,373	1,277	1,232
Below Normal	1,294	1,305	1,326	1,351	1,413	1,438	1,390	1,383	1,359	1,268	1,175	1,133
Dry	1,094	1,094	1,106	1,122	1,156	1,188	1,154	1,132	1,088	997	914	871
Critical	624	623	638	645	662	657	602	555	527	477	432	409
Average All Years	1,132	1,142	1,180	1,237	1,305	1,348	1,338	1,373	1,381	1,300	1,209	1,159
Alternative 2 (TAF)												
Wet	1,379	1,390	1,454	1,562	1,666	1,724	1,758	1,878	1,968	1,890	1,773	1,703
Above Normal	1,030	1,061	1,125	1,215	1,317	1,407	1,414	1,484	1,467	1,373	1,277	1,232
Below Normal	1,294	1,305	1,326	1,351	1,413	1,438	1,390	1,383	1,359	1,268	1,175	1,133
Dry	1,095	1,094	1,106	1,122	1,156	1,188	1,154	1,132	1,088	997	914	871
Critical	624	623	638	646	662	657	602	555	527	477	432	409
Average All Years	1,132	1,142	1,180	1,237	1,306	1,348	1,338	1,374	1,381	1,300	1,209	1,159
No Action compared to Alternative 2 (TAF)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-52. Changes in New Melones Reservoir Elevation Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	982	984	992	1,006	1,017	1,024	1,028	1,040	1,048	1,041	1,030	1,023
Above Normal	935	940	948	962	976	988	990	999	997	987	975	970
Below Normal	970	972	974	978	987	991	987	987	985	974	963	957
Dry	946	946	947	950	954	959	957	956	950	938	926	919
Critical	861	861	866	869	874	876	864	853	845	833	823	818
Average All Years	947	948	953	961	970	976	975	978	978	968	957	950
Alternative 2 (feet)												
Wet	982	984	992	1,006	1,017	1,024	1,028	1,040	1,048	1,041	1,030	1,023
Above Normal	935	940	948	962	976	988	990	999	997	987	975	970
Below Normal	970	972	974	978	987	991	987	987	985	974	963	957
Dry	946	946	947	950	954	959	957	956	950	938	926	919
Critical	861	861	867	869	874	876	865	853	845	833	823	818
Average All Years	947	948	953	961	970	976	975	978	978	968	957	950
No Action compared to Alternative 2 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	0	0	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)[1]												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note:

[1] Percent change estimated based on the change in active storage elevation (i.e., top of dead pool elevation to top of conservation pool elevation) not the change in total absolute elevation.

Key:

% = percent

Table 4-53. Changes in Stanislaus River Flow Downstream from Goodwin Dam Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	789	435	694	1,139	1,273	1,762	1,538	1,642	1,129	617	549	583
Above Normal	706	200	204	229	273	414	1,244	1,085	717	354	286	257
Below Normal	740	209	211	237	316	320	1,262	1,099	448	275	285	254
Dry	698	210	215	236	274	200	872	797	397	279	283	249
Critical	622	200	218	217	265	261	627	607	350	254	236	212
Average All Years	723	278	365	518	595	754	1,158	1,123	680	394	361	351
Alternative 2 (cfs)												
Wet	789	435	694	1,139	1,273	1,762	1,538	1,642	1,129	617	549	583
Above Normal	706	200	204	229	273	414	1,244	1,085	717	354	286	257
Below Normal	740	209	211	237	316	320	1,262	1,099	448	275	285	254
Dry	698	210	215	236	274	200	872	797	397	279	283	249
Critical	622	200	218	217	265	261	627	607	349	253	236	212
Average All Years	723	278	365	518	595	754	1,158	1,123	679	394	361	351
No Action compared to Alternative 2 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	-1	-1	0	0
Average All Years	0	0	0	0	0	0	0	0	-1	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

San Luis Reservoir San Luis Reservoir is operated by the CVP and SWP, they each have a share of the total storage. San Luis Reservoir CVP and SWP storage is summarized in Tables 4-54 and 4-55. The elevation in San Luis Reservoir is based on the sum of the CVP and SWP volumes and is summarized in Table 4-56.

San Luis Reservoir CVP storage under Alternative 2 is similar to the No Action Alternative with changes of less than 1 percent in all months of wet, above normal, below normal, and dry years and increases of 1 to 2 percent in most months of critical years.

San Luis Reservoir SWP storage under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

San Luis elevation under Alternative 2 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

Table 4-54. Changes in San Luis Reservoir CVP Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	234	352	523	652	778	884	810	661	518	309	195	204
Above Normal	232	377	547	648	733	823	724	544	360	163	109	125
Below Normal	239	357	533	641	698	749	662	496	299	221	166	207
Dry	239	345	510	639	711	751	691	562	389	311	209	223
Critical	266	334	460	582	634	629	579	485	332	258	217	229
Average All Years	240	353	516	636	723	786	714	570	405	267	184	200
Alternative 2 (TAF)												
Wet	233	353	523	652	778	884	810	661	518	309	195	204
Above Normal	231	377	547	650	735	824	725	544	360	162	109	124
Below Normal	239	357	532	641	698	749	661	495	298	220	165	206
Dry	238	346	511	640	711	751	692	562	389	311	210	223
Critical	266	336	464	585	639	634	584	491	338	259	218	226
Average All Years	240	353	517	637	724	787	715	571	406	267	184	200
No Action compared to Alternative 2 (TAF)												
Wet	-1	0	0	0	0	0	0	0	0	0	0	0
Above Normal	-1	0	0	1	1	1	1	0	0	-1	0	0
Below Normal	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1
Dry	-1	0	1	1	0	0	0	0	0	0	0	0
Critical	0	2	3	3	5	5	5	5	6	1	2	-3
Average All Years	-1	0	1	1	1	1	1	1	1	0	0	-1
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	-1%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	-1%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-55. Changes in San Luis Reservoir SWP Storage Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (TAF)												
Wet	310	310	379	555	729	903	788	590	432	431	434	470
Above Normal	236	259	390	550	690	827	713	502	304	302	321	382
Below Normal	258	220	309	433	553	685	608	446	238	264	262	261
Dry	222	232	336	491	616	728	685	563	395	385	184	156
Critical	146	138	203	373	496	556	543	477	354	226	105	81
Average All Years	246	246	335	496	638	768	691	534	365	347	284	295
Alternative 2 (TAF)												
Wet	310	310	377	554	728	903	788	590	432	431	434	470
Above Normal	236	256	387	549	689	826	712	502	304	301	320	381
Below Normal	258	220	309	433	552	685	608	446	238	264	262	261
Dry	222	231	334	490	615	727	684	562	394	384	183	156
Critical	145	137	202	372	493	553	540	474	356	228	104	82
Average All Years	246	245	333	495	636	767	690	533	365	347	283	294
No Action compared to Alternative 2 (TAF)												
Wet	-1	0	-2	-1	0	0	0	0	0	0	0	0
Above Normal	0	-3	-3	-2	-1	-1	-1	-1	-1	-1	-1	-1
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Critical	-1	-2	-1	-2	-3	-3	-3	-3	3	2	0	0
Average All Years	0	-1	-1	-1	-1	-1	-1	-1	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	-1%	0%	0%	-1%	-1%	-1%	-1%	1%	1%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
TAF = thousand acre-feet

Table 4-56. Changes in San Luis Reservoir Surface Elevation Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (feet)												
Wet	399	413	440	471	499	523	507	476	445	422	410	416
Above Normal	390	410	443	469	491	511	493	456	415	390	386	397
Below Normal	393	405	435	459	475	492	477	445	398	391	384	390
Dry	390	405	435	465	483	496	487	464	427	418	379	377
Critical	382	391	414	446	463	468	462	446	416	392	366	365
Average All Years	392	406	435	464	485	503	489	461	425	407	389	393
Alternative 2 (feet)												
Wet	399	413	440	471	499	523	507	476	445	422	410	416
Above Normal	390	410	443	469	491	511	493	456	415	389	386	397
Below Normal	393	405	435	459	475	492	477	445	398	391	384	390
Dry	390	405	435	465	483	496	487	464	427	418	379	377
Critical	382	391	414	446	463	468	463	447	417	392	367	365
Average All Years	392	406	435	464	485	503	489	461	426	407	389	393
No Action compared to Alternative 2 (feet)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	1	1	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent

Changes in Delta Conditions

San Joaquin River Delta Inflow The San Joaquin River flow at Vernalis was selected to represent the San Joaquin River inflow to the Sacramento-San Joaquin Delta and is summarized in Table 4-57.

The San Joaquin River flow at Vernalis, the San Joaquin River inflow to the Sacramento-San Joaquin Delta, under Alternative 2 is similar to the No Action Alternative with changes of less than 1 percent in all months of all year types.

1 Table 4-57. Changes in San Joaquin River Flows at Vernalis Under Alternative 2 as Compared
2 to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,041	3,335	5,580	10,083	12,545	14,021	13,228	11,380	8,751	5,260	2,788	3,061
Above Normal	2,386	2,213	3,279	4,375	6,150	6,704	7,694	5,514	3,482	2,016	1,765	2,214
Below Normal	2,869	2,552	2,414	2,701	4,590	4,249	5,597	3,698	2,029	1,491	1,576	1,997
Dry	2,554	2,344	2,084	2,295	3,120	3,599	4,311	3,240	1,729	1,221	1,343	1,762
Critical	2,196	1,975	1,842	1,757	2,223	2,198	2,129	1,848	1,184	933	983	1,395
Average All Years	2,672	2,611	3,391	5,070	6,655	7,278	7,528	6,039	4,194	2,622	1,847	2,223
Alternative 2 (cfs)												
Wet	3,041	3,335	5,580	10,083	12,545	14,021	13,228	11,380	8,751	5,260	2,788	3,061
Above Normal	2,386	2,213	3,279	4,375	6,150	6,704	7,695	5,514	3,482	2,016	1,765	2,214
Below Normal	2,869	2,552	2,414	2,701	4,590	4,249	5,597	3,698	2,029	1,491	1,576	1,997
Dry	2,554	2,344	2,084	2,295	3,119	3,599	4,311	3,240	1,729	1,221	1,343	1,762
Critical	2,196	1,975	1,842	1,757	2,223	2,198	2,129	1,848	1,183	932	983	1,395
Average All Years	2,672	2,611	3,391	5,070	6,655	7,278	7,528	6,039	4,194	2,622	1,847	2,223
No Action compared to Alternative 2 (cfs)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	1	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	-1	0	0	0	0	0	0	0
Critical	0	0	0	0	0	0	0	0	-1	-1	0	0
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

3

Key:
% = percent
cfs = cubic feet per second

Sacramento River Delta Inflow The Sacramento River flow at Freeport was selected to represent the Sacramento River inflow to the Sacramento-San Joaquin Delta and is summarized in Table 4-58.

The Sacramento River flow at Freeport under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Table 4-58. Changes in Sacramento River Flow at Freeport Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	13,044	20,443	36,311	49,134	56,402	48,167	35,405	29,889	20,143	20,340	16,057	27,926
Above Normal	10,198	17,154	24,532	38,476	46,555	40,701	24,151	16,803	13,676	23,093	16,887	21,166
Below Normal	12,209	15,828	15,772	18,275	30,217	18,597	14,072	12,614	12,955	22,230	15,653	12,113
Dry	10,200	12,772	13,617	17,174	23,405	21,310	14,907	11,791	12,985	17,454	10,500	9,981
Critical	8,103	8,465	11,077	14,101	15,881	12,532	10,341	8,367	9,833	10,892	8,758	7,214
Average All Years	11,064	15,679	22,460	30,383	37,350	31,251	22,092	17,933	14,899	18,943	13,711	17,325
Alternative 2 (cfs)												
Wet	13,033	20,482	36,300	49,134	56,397	48,153	35,405	29,881	20,147	20,344	16,057	27,923
Above Normal	10,190	17,195	24,498	38,487	46,563	40,738	24,151	16,802	13,679	23,094	16,914	21,169
Below Normal	12,212	15,824	15,769	18,274	30,205	18,597	14,071	12,617	12,954	22,231	15,658	12,113
Dry	10,217	12,795	13,618	17,174	23,402	21,311	14,906	11,791	12,985	17,478	10,499	9,981
Critical	8,088	8,486	11,081	14,094	15,847	12,532	10,341	8,367	9,944	10,808	8,748	7,161
Average All Years	11,062	15,705	22,452	30,383	37,343	31,253	22,091	17,931	14,917	18,939	13,714	17,317
No Action compared to Alternative 2 (cfs)												
Wet	-11	39	-11	0	-5	-14	0	-8	4	4	0	-3
Above Normal	-8	41	-34	11	8	37	0	-1	3	1	27	3
Below Normal	3	-4	-3	-1	-12	0	-1	3	-1	1	5	0
Dry	17	23	1	0	-3	1	-1	0	0	24	-1	0
Critical	-15	21	4	-7	-34	0	0	0	111	-84	-10	-53
Average All Years	-2	26	-8	0	-7	2	-1	-2	18	-4	3	-8
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	1%	-1%	0%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Sacramento-San Joaquin Delta Outflow The Sacramento-San Joaquin Delta outflow is summarized in Table 4-59.

The Sacramento-San Joaquin Delta outflow under Alternative 2 is similar to the No Action Alternative with changes of 1 percent or less in all months of all year types.

Table 4-59. Changes in Delta Outflow Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	8,445	17,135	47,370	89,535	101,936	81,603	55,719	38,900	18,814	10,606	4,430	19,051
Above Normal	5,404	12,250	24,302	49,849	67,107	52,281	32,579	19,505	8,147	10,852	4,082	11,130
Below Normal	7,669	10,903	9,449	17,479	36,356	17,934	17,060	12,805	7,484	8,246	4,129	3,550
Dry	5,539	7,902	7,600	15,914	25,698	22,720	16,749	11,073	7,229	5,144	4,178	3,194
Critical	4,126	4,980	6,727	11,691	15,322	12,160	9,391	6,693	5,845	4,053	3,786	3,000
Average All Years	6,518	11,494	22,978	44,229	56,347	43,889	30,580	20,824	10,880	8,037	4,179	9,499
Alternative 2 (cfs)												
Wet	8,445	17,158	47,378	89,542	101,885	81,586	55,719	38,893	18,818	10,607	4,430	19,051
Above Normal	5,404	12,312	24,272	49,835	67,056	52,295	32,579	19,504	8,150	10,851	4,082	11,130
Below Normal	7,669	10,903	9,448	17,479	36,364	17,933	17,059	12,809	7,483	8,246	4,129	3,549
Dry	5,539	7,906	7,598	15,909	25,696	22,719	16,748	11,073	7,229	5,144	4,175	3,195
Critical	4,124	4,980	6,726	11,693	15,286	12,153	9,391	6,693	5,845	4,053	3,780	3,000
Average All Years	6,518	11,512	22,975	44,228	56,318	43,885	30,580	20,822	10,881	8,038	4,177	9,499
No Action compared to Alternative 2 (cfs)												
Wet	0	23	8	7	-51	-17	0	-7	4	1	0	0
Above Normal	0	62	-30	-14	-51	14	0	-1	3	-1	0	0
Below Normal	0	0	-1	0	8	-1	-1	4	-1	0	0	-1
Dry	0	4	-2	-5	-2	-1	-1	0	0	0	-3	1
Critical	-2	0	-1	2	-36	-7	0	0	0	0	-6	0
Average All Years	0	18	-3	-1	-29	-4	0	-2	1	1	-2	0
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Old and Middle River Flow The OMR condition in the Sacramento-San Joaquin Delta outflow is summarized in Table 4-60.

OMR under Alternative 2 is similar to the No Action Alternative in all months and year types with change of less than 1 percent except in June and July of Critical years where there is an increase of 6 percent and a reduction of 2 percent respectively. The average is from a single critical year, 1992 with a change in OMR from -1943 cfs in the No Action to -3164 cfs in Alterative 2. The change in OMR was mainly driven by a single month increase in Banks pumping, which in turn was driven by a slight decrease in SWP San Luis storage. This is a unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis. CalSim II modifies exports as required in order to maintain the final OMR within regulatory limits.

Table 4-60. Changes in OMR Conditions Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	-5,951	-7,307	-5,524	-1,904	-2,002	-1,613	3,109	2,002	-4,331	-8,978	-10,576	-9,279
Above Normal	-5,597	-6,892	-6,821	-3,501	-3,371	-4,176	1,189	408	-4,525	-9,238	-10,834	-9,539
Below Normal	-5,714	-6,856	-7,653	-4,379	-3,499	-4,036	157	-327	-3,445	-10,570	-9,719	-8,150
Dry	-5,507	-6,045	-6,697	-4,620	-3,705	-3,079	-675	-925	-3,405	-9,211	-4,766	-6,299
Critical	-4,670	-4,396	-4,948	-4,339	-2,969	-1,782	-797	-982	-1,608	-4,015	-3,372	-3,794
Average All Years	-5,567	-6,447	-6,217	-3,508	-2,977	-2,727	914	286	-3,619	-8,564	-8,031	-7,639
Alternative 2 (cfs)												
Wet	-5,941	-7,319	-5,524	-1,904	-2,004	-1,612	3,109	2,002	-4,331	-8,981	-10,576	-9,276
Above Normal	-5,591	-6,874	-6,823	-3,515	-3,370	-4,177	1,189	408	-4,524	-9,239	-10,858	-9,542
Below Normal	-5,717	-6,852	-7,651	-4,379	-3,496	-4,037	157	-327	-3,445	-10,569	-9,723	-8,152
Dry	-5,521	-6,062	-6,700	-4,620	-3,705	-3,079	-675	-925	-3,405	-9,232	-4,768	-6,299
Critical	-4,665	-4,413	-4,953	-4,331	-2,970	-1,789	-797	-982	-1,710	-3,938	-3,369	-3,746
Average All Years	-5,566	-6,454	-6,219	-3,509	-2,977	-2,728	914	286	-3,634	-8,558	-8,035	-7,632
No Action compared to Alternative 2 (cfs)												
Wet	10	-12	0	0	-2	1	0	0	0	-3	0	3
Above Normal	6	18	-2	-14	1	-1	0	0	1	-1	-24	-3
Below Normal	-3	4	2	0	3	-1	0	0	0	1	-4	-2
Dry	-14	-17	-3	0	0	0	0	0	0	-21	-2	0
Critical	5	-17	-5	8	-1	-7	0	0	-102	77	3	48
Average All Years	1	-7	-2	-1	0	-1	0	0	-15	6	-4	7
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	6%	-2%	0%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second
OMR = Old and Middle River

Changes in CVP and SWP Exports The CVP and SWP both deliver water to a variety of customers under different contractual terms. The comparison of changes for CVP and SWP water supply delivery is divided into four categories, including CVP NOD, CVP SOD, CVP Eastside and SWP.

Jones Pumping Plant (CVP Exports) Jones Pumping Plant is the major CVP delta export facility. Exports at Jones Pumping Plant under Alternative 2 as compared to the No Action Alternative are summarized in Table 4-61.

Exports at Jones Pumping Plant under Alternative 2 are similar to the No Action with increases of up to 2 percent, except in July of critical years where it is reduced by 4 percent.

Table 4-61. Changes in Exports at Jones Pumping Plant Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,388	3,612	4,042	3,571	3,986	3,748	1,606	1,549	3,751	4,048	4,578	4,083
Above Normal	3,221	3,857	3,754	2,695	2,873	3,512	1,104	898	2,794	3,202	4,478	3,875
Below Normal	3,595	3,603	4,104	3,192	2,841	2,831	1,009	819	1,932	4,239	3,811	3,979
Dry	3,263	3,263	3,735	3,227	2,797	2,329	1,211	992	1,549	3,373	2,569	3,334
Critical	2,792	2,396	2,816	2,668	1,912	1,337	863	827	608	2,068	2,415	2,664
Average All Years	3,272	3,387	3,750	3,165	3,063	2,889	1,241	1,106	2,358	3,485	3,653	3,646
Alternative 2 (cfs)												
Wet	3,378	3,626	4,044	3,571	3,987	3,746	1,607	1,549	3,751	4,046	4,578	4,080
Above Normal	3,214	3,881	3,756	2,707	2,873	3,513	1,104	898	2,795	3,201	4,504	3,877
Below Normal	3,598	3,598	4,101	3,192	2,837	2,832	1,009	819	1,926	4,238	3,812	3,974
Dry	3,277	3,283	3,743	3,227	2,797	2,327	1,211	992	1,550	3,385	2,577	3,336
Critical	2,806	2,433	2,836	2,669	1,941	1,340	863	827	607	1,986	2,411	2,588
Average All Years	3,273	3,404	3,756	3,167	3,067	2,888	1,241	1,106	2,358	3,475	3,658	3,634
No Action compared to Alternative 2 (cfs)												
Wet	-11	13	2	0	1	-2	0	0	0	-2	0	-3
Above Normal	-7	24	3	12	1	1	0	0	1	-1	26	3
Below Normal	3	-5	-2	0	-3	1	0	0	-6	0	1	-4
Dry	14	20	8	0	0	-2	0	0	0	12	8	2
Critical	13	37	20	1	28	4	0	0	-1	-82	-4	-76
Average All Years	1	18	6	2	4	0	0	0	-1	-10	6	-12
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	2%	1%	0%	1%	0%	0%	0%	0%	-4%	0%	-3%
Average All Years	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Banks Pumping Plant (SWP Exports) Banks Pumping plant is the major SWP Delta export facility. Exports at Banks Pumping Plant under Alternative 2 as compared to the No Action Alternative are summarized in Table 4-62.

Banks export under Alternative 2 is similar to the No Action Alternative with change of less than 2 percent in all months and year types except in June of Critical years where it increases by 20 percent. The average is from a single critical year, 1992 with a change in Banks exports from 448 cfs in the No Action to 1769 cfs in Alternative 2. The change in Banks exports was mainly driven by a slight decrease in SWP San Luis storage that had accumulated over several months. This is unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis.

Table 4-62. Changes in Exports at Banks Pumping Plant Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (cfs)												
Wet	3,287	4,743	5,101	4,768	5,634	5,972	1,817	1,822	3,790	6,719	7,102	6,538
Above Normal	2,932	3,767	5,324	3,670	4,444	4,562	1,089	814	2,503	6,364	7,004	6,680
Below Normal	2,788	4,068	5,476	3,099	3,477	3,700	1,238	814	1,577	6,472	6,415	5,105
Dry	2,812	3,464	4,550	3,144	2,975	2,846	1,366	1,040	1,766	5,755	2,263	3,649
Critical	2,290	2,434	3,359	3,032	2,555	1,581	698	628	548	1,295	675	1,397
Average All Years	2,902	3,848	4,797	3,720	4,057	4,038	1,350	1,161	2,321	5,601	4,873	4,912
Alternative 2 (cfs)												
Wet	3,287	4,743	5,100	4,768	5,635	5,974	1,817	1,822	3,790	6,724	7,102	6,538
Above Normal	2,932	3,723	5,324	3,674	4,443	4,562	1,089	814	2,502	6,365	7,004	6,680
Below Normal	2,788	4,068	5,476	3,099	3,476	3,700	1,238	814	1,583	6,472	6,418	5,111
Dry	2,814	3,462	4,544	3,144	2,975	2,848	1,366	1,040	1,766	5,765	2,256	3,648
Critical	2,273	2,415	3,344	3,022	2,527	1,585	698	628	659	1,292	675	1,421
Average All Years	2,900	3,838	4,793	3,719	4,053	4,040	1,350	1,161	2,338	5,604	4,872	4,916
No Action compared to Alternative 2 (cfs)												
Wet	0	0	-1	0	1	2	0	0	0	5	0	0
Above Normal	0	-43	0	4	-1	0	0	0	-1	2	0	0
Below Normal	0	0	0	0	-1	0	0	0	6	0	3	6
Dry	2	-2	-6	0	0	2	0	0	0	10	-6	-1
Critical	-18	-19	-14	-10	-28	4	0	0	111	-2	0	24
Average All Years	-2	-10	-4	-1	-4	2	0	0	17	4	-1	4
No Action compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	-1%	-1%	0%	0%	-1%	0%	0%	0%	20%	0%	0%	2%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%

Key:
% = percent
cfs = cubic feet per second

Changes in CVP and SWP Water Supply Delivery

CVP Delivery North of the Delta CVP NOD water deliveries are summarized in Table 4-63.

CVP NOD delivery under Alternative 2 is similar to the No Action Alternative with less than a 3 percent change (critical years from 23 TAF to 22 TAF) in all year types for contractors.

Table 4-63. Changes in CVP North-of-Delta Water Deliveries Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
CVP Agricultural Water Service Contractors						
No Action (TAF)	305	263	167	89	23	186
Alternative 2 (TAF)	304	264	168	89	22	186
No Action Compared to Alternative 2 (TAF)	0	1	1	0	-1	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	-3%	0%
CVP M&I (including Contra Costa)						
No Action (TAF)	386	383	333	292	245	335
Alternative 2 (TAF)	386	383	333	292	244	335
No Action Compared to Alternative 2 (TAF)	0	0	0	0	-1	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
CVP Sacramento River Settlement Contractors						
No Action (TAF)	1,844	1,865	1,890	1,915	1,748	1,857
Alternative 2 (TAF)	1,844	1,865	1,890	1,915	1,747	1,857
No Action Compared to Alternative 2 (TAF)	1	0	0	0	-1	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
CVP Refuge Level 2 Deliveries						
No Action (TAF)	88	85	86	85	63	83
Alternative 2 (TAF)	88	85	86	85	62	83
No Action Compared to Alternative 2 (TAF)	0	0	0	0	-1	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	-1%	0%
Total CVP NOD Deliveries						
No Action (TAF)	2,622	2,596	2,477	2,381	2,079	2,460
Alternative 2 (TAF)	2,622	2,597	2,478	2,382	2,075	2,460
No Action Compared to Alternative 2 (TAF)	0	1	1	0	-4	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
NOD = North-of-Delta
TAF = thousand acre-feet

CVP Delivery South of the Delta CVP SOD water deliveries are summarized in Table 4-64.

CVP SOD water deliveries under Alternative 2 are similar to the No Action Alternative with reductions of 1 percent or less in all year types for all contractors.

Table 4-64. Changes in CVP South-of-Delta Water Deliveries Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
CVP Agricultural Water Service Contractors						
No Action (TAF)	1,316	885	752	480	137	795
Alternative 2 (TAF)	1,316	888	753	482	135	796
No Action Compared to Alternative 2 (TAF)	0	3	1	2	-2	1
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	-1%	0%
CVP M&I						
No Action (TAF)	132	112	114	104	85	113
Alternative 2 (TAF)	132	112	114	104	84	113
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
San Joaquin River Exchange Contractors						
No Action (TAF)	874	870	858	871	752	853
Alternative 2 (TAF)	874	870	858	871	752	853
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
CVP Refuge Level 2 Deliveries						
No Action (TAF)	280	276	277	276	249	273
Alternative 2 (TAF)	280	276	277	276	249	273
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
Total CVP SOD Deliveries						
No Action (TAF)	2,601	2,143	2,001	1,729	1,223	2,034
Alternative 2 (TAF)	2,601	2,146	2,003	1,732	1,221	2,035
No Action Compared to Alternative 2 (TAF)	0	3	1	2	-2	1
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
M&I = municipal and industrial
SOD = South-of-Delta
TAF = thousand acre-feet

CVP Eastside Delivery CVP SOD water deliveries are summarized in Table 4-65.

CVP Eastside water deliveries under Alternative 2 are similar to the No Action Alternative with changes to all contractors in all year types less than 1 percent.

Table 4-65. Changes in CVP Eastside Water Deliveries Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
Water Rights						
No Action (TAF)	505	518	532	532	443	508
Alternative 2 (TAF)	505	518	532	532	443	508
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
CVP Water Service Contracts						
No Action (TAF)	146	116	117	86	12	103
Alternative 2 (TAF)	146	116	117	86	12	103
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
Total Eastside Deliveries						
No Action (TAF)	651	634	649	618	454	611
Alternative 2 (TAF)	651	634	649	618	455	612
No Action Compared to Alternative 2 (TAF)	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
TAF = thousand acre-feet

CVP Total Water Delivery CVP Total water deliveries are summarized in Table 4-66.

CVP total water deliveries under Alternative 2 are similar to the No Action Alternative with changes to all contractors in all year types less than 1 percent.

Table 4-66. Changes in CVP Total Water Deliveries Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Alternative/Comparison	Wet	Above Normal	Below Normal	Dry	Critical	Average All Years
All CVP Deliveries						
No Action (TAF)	5,875	5,373	5,128	4,729	3,756	5,105
Alternative 2 (TAF)	5,875	5,377	5,130	4,732	3,751	5,106
No Action Compared to Alternative 2 (TAF)	0	4	2	3	-6	1
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
TAF = thousand acre-feet

SWP Table A and Article 21 Delivery SWP CVP SOD water deliveries are summarized in Table 4-67.

SWP total water deliveries under Alternative 2 are similar to the No Action Alternative with changes to all contractors in all year types less than 1 percent except for a reduction in Article 21 delivery of 3 percent in wet years.

Table 4-67. Changes in SWP Table A and Article 21 Water Deliveries Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Table A (TAF)						
Alternative/Comparison	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average All Years**
No Action (TAF)	3,178	2,684	2,526	2,052	1,207	2,449
Alternative 2 (TAF)	3,181	2,682	2,526	2,051	1,209	2,450
No Action Compared to Alternative 2 (TAF)	3	-2	0	0	3	1
No Action Compared to Alternative 2 (%)	0%	0%	0%	0%	0%	0%
Article 21 (TAF)						
Alternative/Comparison	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average All Years**
No Action (TAF)	76	81	36	13	10	46
Alternative 2 (TAF)	74	81	36	13	10	46
No Action Compared to Alternative 2 (TAF)	-2	0	0	0	0	0
No Action Compared to Alternative 2 (%)	-3%	0%	0%	0%	0%	0%

Key:
% = percent
CVP = Central Valley Project
SWP = State Water Project
TAF = thousand acre-feet

Summary of Environmental Consequences

Table 4-68 presents the results of the environmental consequences analysis for implementing the action alternatives compared to the No Action Alternative.

Table 4-68. Comparison of Action Alternatives to No Action Alternative

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1	*Trinity River* Trinity Lake storage would be similar to the No Action Alternative, with less than a 1% decrease in most months and year types—with the exceptions of a 2% decrease in October, November, and December of extremely wet years and in September of dry years, and a 4% decrease in September of critically dry years. Trinity Lake elevation would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months and year types. Lewiston Dam flow releases to the Trinity River would increase in August and September in all year types, from 2% in August of extremely wet years to 115% in September of critically dry years, and decrease by 10% in November of extremely wet years, 10% in October of critically dry years, and 7% in February of normal years. TRD diversions to the Sacramento Basin at Lewiston Reservoir would change in various months—with reductions of 16% in July during critically dry years to increases of 13% in March of critically dry years. The long-term changes range from -7% in October to 3% in February. *Klamath River* Flows in Klamath River, at Klamath, would increase in August and September in all year types (except extremely wet), ranging from 1% in August of wet years to 69% in September of critically dry years. In all other months and year types, changes were 1% or less. *Clear Creek* Storage and elevation levels in Whiskeytown Lake would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months and year types. Flows in Clear Creek, downstream from Whiskeytown Dam, would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months of all year types. *Sacramento River* Shasta Lake storage and elevation levels would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months and year types. Sacramento River flow, downstream from Keswick Dam, would be similar to the No Action Alternative with most months of all year types changing less than 1%, with the exception of reductions of 2% in August of dry years and 4% in September of critical years.	Environmental effects associated with changes in water storage, flows and supply may affect physical conditions in other resource categories and are related to impacts on surface water quality (as described in Chapter 5, “Surface Water Quality”), groundwater (as described in Chapter 6, “Groundwater Resources/ Groundwater Quality”), biological resources (as described in Chapter 7, “Biological Resources – Fisheries” and Chapter 8, “Biological Resources – Terrestrial”), hydropower (as described in Chapter 9, “Hydropower Generation”), agriculture (as described in Chapter 11, “Agricultural Resources”), and recreation (as described in Chapter 12, “Socioeconomics”) Mitigation measures, if needed, related to environmental changes caused by changes in surface water conditions are presented in Chapters 5, 6, 7, 8, 9, 11, and 12.

1 Table 4-68. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1 (contd.)	*Feather River* Lake Oroville storage and elevation, and Feather River flow below Oroville Dam and Thermalito Afterbay Return, would be similar to the No Action Alternative with changes of 1% or less in all months of all year types except for an increase of 6% in June of Critical years. This was driven by a release from Lake Oroville to support an increase in Banks pumping, which in turn was driven by a slight decrease in SWP San Luis storage. This is a unique occurrence without large consequences that may not have occurred under shorter term real time operation decisions and is not expected to occur on a regular basis. *Sacramento River Flow Into the Yolo Bypass at Fremont Weir* Flows from the Sacramento River into the Yolo Bypass would be similar to the No Action Alternative, with changes less than, or equal to, 1% in all months of all water year types. *American River* Folsom Lake storage and elevation would be similar to the No Action Alternative, with changes of less than, or equal to, 1% in all months of all water year types, except for a 2% increase in storage in August of critical years. The American River flow, below Nimbus Dam, would be generally similar to the No Action Alternative with changes of less than 3% in all months of all water year types, except for a reduction of 5% in July and an increase of 5% in September of critical years. *Stanislaus River* New Melones storage and elevation, and flows in the Stanislaus River downstream from Goodwin Dam, would be similar to the No Action Alternative with changes of 1% or less in all months of all year types. *San Luis Reservoir Storage* San Luis Reservoir CVP storage would be similar to the No Action Alternative with increases of 0 to 2% in most months of most years, but up to an increase of 4% in June of critical years. San Luis Reservoir SWP storage would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. San Luis elevation would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *San Joaquin River Delta Inflow* The San Joaquin River inflow to the Sacramento-San Joaquin Delta would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *Sacramento River Delta Inflow* The Sacramento River flow at Freeport would be similar to the No Action Alternative with changes of less than 1% in all months of all year types.	See above

1 Table 4-68. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1 (contd.)	*Sacramento-San Joaquin Delta Outflow* The Sacramento-San Joaquin Delta outflow would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *Old and Middle River Flow (OMR)* OMR conditions would be similar to the No Action Alternative in all months and year types with reductions of 0 to 3%, except in June of critical years where there is an increase of 6%. This change in June of critical years is from a single critical year, 1992, with a change in OMR from -1943 cfs in the No Action to -3140 cfs in Alternative 1. This change in OMR was mainly driven by a single-month increase in Banks pumping, which in turn was driven by a slight decrease in SWP San Luis storage. CalSim II modifies exports as required, in order to maintain the final OMR within regulatory limits, which was -3500 cfs in this month (June). *Jones Pumping Plant (CVP Exports)* Exports at Jones Pumping Plant would be similar to the No Action Alternative with decreases of 0 to 3%, except in July, and August of critical years, where it is reduced by 7%. *Banks Pumping Plant (SWP Exports)* Banks export would be similar to the No Action Alternative in all months and year types with reduction of 0 to 3%, except in June of critical years where it increases by 21%. The June increase is from a single critical year, 1992, with a change in Banks' exports from 448 cfs in the No Action to 1,743 cfs in Alternative 1. This is a unique occurrence—that may not have occurred under shorter-term real-time operation decisions—and is not expected to occur on a regular basis. *CVP North of Delta Water Deliveries* CVP North of Delta delivery would be similar to under the No Action Alternative with less than a 5% change in all year types for all water contractors/customers, except critical years for CVP Agricultural Water Service Contractors, where it is reduced by 10% percent (23 TAF to 21 TAF). *CVP South of Delta water deliveries* CVP South of Delta delivery would be similar to under the No Action Alternative with less than a 3% change in all year types for all water contractors/customers, except critical years for CVP Agricultural Water Service Contractors, where it is reduced by 7% percent (137 TAF to 127 TAF). *CVP Eastside Water Deliveries* CVP Eastside water deliveries would be similar to the No Action Alternative with changes to all contractors in all year types of less than 1%. *Total CVP Deliveries* Long-term average CVP water deliveries would be similar to the No Action Alternative with changes in all year types of less than 1%, with an average reduction of 13 TAF. This represents reductions of 22 TAF in critical years, 24 TAF in dry years, 13 TAF in below normal years, 4 TAF in above normal years, and 4 TAF in wet years.	See above

Table 4-68. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 2	*Trinity River* Trinity Lake storage would be similar to the No Action Alternative, with 1% or less change in most months and year types—with the exceptions of 2% decreases in October of extremely wet years and in September of critically dry years, and increases of 2% in dry years and 2% to 4% in June, July and August of critically dry years. Trinity Lake elevation would be similar to the No Action Alternative with increases of 1% or less in all months of all year types. Lewiston Dam flow releases to the Trinity River would increase in August and September in all year types, from 2% in August of extremely wet years to 132% in September of critically dry years. Lewiston Dam releases to the Trinity River show reductions from 1% to 38% in May and June of most year types, with the larger reductions in the drier years, as well as decreases of 8% in November of extremely wet years and 6% in February of normal years. TRD diversions to the Sacramento Basin at Lewiston Reservoir would change in various months—with reductions of up to 11% in February of critically dry years to increases of up to 9% in February of normal years. The long-term changes range from -4% in December to 4% in both May and June. *Klamath River* Flows in Klamath River, at Klamath, would increase in August and September in all year types (except extremely wet), ranging from 1% in August and September of wet years to 69% in September of critically dry years. Flows would be reduced in May and June of dry and critically dry years, with reductions up to 9% in June of critically dry years. In all other months and year types, changes were 1% or less. *Clear Creek downstream from Whiskeytown Dam* Storage and elevation levels in Whiskeytown Lake would be similar to the No Action Alternative with changes less than, or equal to, 2% in all months and year types. Flows in Clear Creek, downstream from Whiskeytown Dam, would be similar to the No Action Alternative with changes less than, or equal to, 1% in all months of all year types. *Sacramento River* Shasta Lake storage and elevation would be similar to the No Action Alternative with changes of less than, or equal to, 1% in all months and year types. Sacramento River flow, downstream from Keswick Dam, would be similar to the No Action Alternative with most months of all year types changing less than 1%, with the exception of a reduction of 3% in September of critical years. *Feather River* Lake Oroville storage and elevation, and Feather River flow below the Oroville Dam and Thermalito Afterbay Return, is similar to the No Action Alternative with changes of 1% or less in all months of all year types, except for an increase of 6% in river flow in June of critical years.	Environmental effects associated with changes in water storage, flows and supply may affect physical conditions in other resource categories and are related to impacts on surface water quality (as described in Chapter 5, "Surface Water Quality"), groundwater (as described in Chapter 6, "Groundwater Resources/ Groundwater Quality"), biological resources (as described in Chapter 7, "Biological Resources – Fisheries" and Chapter 8, "Biological Resources – Terrestrial"), hydropower (as described in Chapter 9, "Hydropower Generation"), agriculture (as described in Chapter 11, "Agricultural Resources"), and recreation (as described in Chapter 12, "Socioeconomics") Mitigation measures, if needed, related to environmental changes caused by changes in surface water conditions are presented in Chapters 5, 6, 7, 8, 9, 11, and 12.

Table 4-68. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 2 (contd.)	*Sacramento River Flow Into the Yolo Bypass at Fremont Weir* Flows from the Sacramento River into the Yolo Bypass would be similar to the No Action Alternative, with changes less than, or equal to, 1% in all months of all water year types. *American River* Folsom Lake storage and elevation would be similar to the No Action Alternative, with changes of less than, or equal to, 1% in all months of all water year types. The American River flow, below Nimbus Dam, would be generally similar to the No Action Alternative with changes of less than 2% in all months of all water year types, except for an increase of 5% in September of critical years. *Stanislaus River* New Melones storage and elevation, and flows in the Stanislaus River downstream from Goodwin Dam, would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *San Luis Reservoir Storage* San Luis Reservoir CVP storage would be similar to the No Action Alternative with changes of less than 1% in all months of wet, above normal, below normal, and dry years and increases of 1 to 2% in most months of Critical years. San Luis Reservoir SWP storage would be similar to the No Action Alternative with changes of 1% or less in all months of all year types. San Luis Reservoir elevation would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *San Joaquin River Delta Inflow* The San Joaquin River inflow to the Sacramento-San Joaquin Delta would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *Sacramento River Delta Inflow* The Sacramento River flow at Freeport would be similar to the No Action Alternative with changes of less than 1% in all months of all year types. *Sacramento-San Joaquin Delta Outflow* The Sacramento-San Joaquin Delta outflow would be similar to the No Action Alternative with changes of 1% or less in all months of all year types.	See above

Table 4-68. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 2 (contd.)	*Old and Middle River Flow (OMR)* OMR would be similar to the No Action Alternative in all months and year types with change of less than 1%, except in June and July of critical years where there is an increase of 6% and a reduction of 2% respectively. This change in June of critical years is from a single critical year, 1992, with a change in OMR from -1943 cfs in the No Action to -3164 cfs in Alternative 2. This change in OMR was mainly driven by a single-month increase in Banks pumping, which in turn was driven by a slight decrease in SWP San Luis storage. CalSim II modifies exports as required in order to maintain the final OMR within regulatory limits which was -3500 cfs in this month (June). *Jones Pumping Plant (CVP Exports)* Exports at Jones Pumping Plant would be similar to the No Action Alternative with increases of 0 to 2%, except in July of critical years, where it is reduced by 4%. *Banks Pumping Plant (SWP Exports)* Banks export would be similar to the No Action Alternative with changes of 2% or less in all months and year types, except in June of critical years where it increases by 20%. The average is from a single critical year, 1992, with a change in Banks' exports from 448 cfs to 1769 cfs. This is a unique occurrence—that may not have occurred under shorter-term real-time operation decisions—and is not expected to occur on a regular basis. *CVP Delivery North of Delta* CVP North of Delta delivery would be similar to the No Action Alternative with reductions of 2% or less (critical years from 23 TAF to 22 TAF) in all year types for all water contractors/customers. *CVP Delivery South of Delta* CVP South-of-Delta delivery would be similar to the No Action Alternative with reductions of 1% or less in all year types for all contractors. *CVP Eastside Water Deliveries* CVP Eastside water deliveries would be similar to the No Action Alternative with changes to all contractors in all year types of less than 1%. *Total CVP Deliveries* Total CVP water deliveries would be similar to the No Action Alternative with changes to all contractors in all year types of less than 1%, with an average increase of 1 TAF. Changes by year type range from an increase of 4 TAF in above normal years to a decrease of 6 TAF in critical years.	See above

Key:
% = percent
cfs = cubic feet per second
CVP = Central Valley Project
ROD = Record of Decision
SWP = State Water Project
TAF = thousand acre-feet

Potential Mitigation Measures

Mitigation measures are identified, as appropriate, to avoid, minimize, rectify, reduce, eliminate, or compensate for adverse environmental effects of action alternatives, as compared to the No Action Alternative.

There are no mitigation measures proposed for direct environmental impacts from changes to CVP and SWP operational related changes in reservoir storage, elevation, downstream flows or deliveries. Impacts of these changes on other resource areas and potential mitigation measures, if required, are included in the chapters dealing with the specific resource area.

Cumulative Effects Analysis

The cumulative effects analysis considers projects, programs, and policies that are not speculative; and are based upon known or reasonably foreseeable long-range plans, regulations, operating agreements, or other information that establishes them as reasonably foreseeable. The cumulative effects analysis for surface water resources are summarized in Table 4-69. The methodology for this cumulative effects analysis is described in the Cumulative Effects Technical Appendix.

Table 4-69. Summary of Cumulative Effects on Surface Water Resources of Action Alternatives as Compared to the No Action Alternative

Scenarios	Cumulative Effects of Actions
No Action Alternative with Associated Cumulative Effects Actions in Year 2030	*Conditions and Actions included in Quantitative Analyses* *(Conditions and actions incorporated into No Action Alternative modeling)* Climate change and sea-level rise, development under the general plans, FERC relicensing projects, and some future projects to improve water quality or habitat are anticipated to reduce carryover storage in reservoirs and change timing of stream flows as compared to past conditions. In the Central Valley, Delta outflow and the availability of CVP and SWP water deliveries are anticipated to be reduced as compared to past conditions. *Additional Identified Actions* *(Additional reasonably foreseeable projects or actions identified in Cumulative Effects Technical Appendix)* Additional reasonably foreseeable actions related to improved water quality and habitat conditions (e.g., FERC relicensing projects), could affect timing of stream flows, but are not anticipated to change CVP and SWP water deliveries.
Alternative 1 with Associated Cumulative Effects Actions in Year 2030	*Alternative 1 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 1 would result in reduced CVP water deliveries (long-term average) as compared to the No Action Alternative. *Alternative 1 with Additional Identified Actions* Additional reasonably foreseeable actions are not anticipated to result in additional cumulative reductions of CVP or SWP water deliveries.
Alternative 2 with Associated Cumulative Effects Actions in Year 2030	*Alternative 2 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 2 would result in comparable CVP water deliveries (long-term average) as compared to the No Action Alternative. *Alternative 2 with Additional Identified Actions* The additional reasonably foreseeable actions are not anticipated to result in changes to CVP or SWP water deliveries.

Key:
CVP = Central Valley Project
FERC = Federal Energy Regulatory Commission
SWP = State Water Project

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Chapter 5
Surface Water Quality

Introduction

This chapter describes the surface water quality in the study area and potential changes that could occur as a result of implementing the alternatives evaluated in this Environmental Impact Statement (EIS). Implementation of the alternatives could affect these resources through potential changes in operation of the Central Valley Project (CVP), including the Trinity River Division (TRD), and the State Water Project (SWP), as a result of augmenting flows in the lower Klamath River.

Regulatory Environment and Compliance Requirements

Federal or State regulations relevant to implementation of the alternatives evaluated in this EIS for surface water quality include:

- **Clean Water Act** – The Federal Water Pollution Control Act Amendments of 1972, also known as the Clean Water Act (CWA), established the institutional structure for the U.S. Environmental Protection Agency (USEPA) to regulate discharges of pollutants into the waters of the United States, establish water quality standards, conduct planning studies, and provide funding for specific grant projects. The CWA was further amended through the Clean Water Act of 1977 and the Water Quality Act of 1987. The California State Water Resources Control Board (SWRCB) was designated by the USEPA along with the nine Regional Water Quality Control Boards (RWQCB) to develop and enforce water quality objectives and implementation plans in California. Section 303 requires preparation of basin plans that designate the beneficial uses of waters within each watershed basin and identify water quality objectives designed to protect the beneficial uses. Under Section 303(d), the USEPA identifies and ranks waterbodies for which existing pollution controls are insufficient to attain or maintain water quality standards based upon information prepared by all states, territories, and authorized Indian tribes. This list of impaired waters for each state comprises the state's 303(d) list.

- **Porter-Cologne Water Quality Control Act** – The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) established surface water and groundwater quality guidelines and provided the authority for the SWRCB to protect the state's surface water and groundwater. Nine RWQCBs have been established to oversee and implement specific water quality activities in their geographic jurisdictions. The Porter-Cologne Act also requires that each RWQCB develop basin plans that establish and periodically review the beneficial uses and water quality objectives for groundwater and surface waterbodies within its jurisdiction.

- **Regional Water Quality Control Board Basin Plans –** The RWQCBs are required to formulate and adopt basin plans for all areas under their jurisdiction under the Porter-Cologne Act. Each basin plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the basin plans.

Affected Environment

This section describes the surface water quality that could potentially be affected by the implementation of the alternatives considered in this EIS. Changes in water quality due to changes in the operation of the TRD (and related changes at CVP and SWP facilities) may occur in the Trinity River, lower Klamath River, Sacramento Valley, and Sacramento-San Joaquin River Delta (Delta).

Beneficial Uses of Surface Waters in the Study Area

Water quality conditions throughout the study area are assessed and described by the RWQCB Basin Plans and Integrated Reports. Each region has specific beneficial uses of surface waters (as summarized in Table 5-1) and water quality constituents of concern (e.g., nutrients, salinity, dissolved oxygen (DO)); however, several pollutants are prevalent throughout the study area. The origins and prevalence of these pollutants are discussed below.

Table 5-1. Designated Beneficial Uses Within Project Study Area

Surface Water Body	Municipal and Domestic Supply (MUN)	Agricultural Supply (AGR)	Industrial Service Supply (IND)	Industrial Process Supply (PRO)	Groundwater Recharge (GWR)	Freshwater Replenishment (FRSH)	Navigation (NAV)	Hydropower Generation (POW)	Water Contact Recreation (REC-1)	Non-Contact Water Recreation (REC-2)	Commercial and Sport Fishing (COMM)	Warm Freshwater Habitat (WARM)	Cold Freshwater Habitat (COLD)	Wildlife Habitat (WILD)	Rare, Threatened, or Endangered Species (RARE)	Marine Habitat (MAR)	Migration of Aquatic Organisms (MIGR)	Spawning, Reproduction, and/or Early Development (SPWN)	Shellfish Harvesting (SHELL)	Estuarine Habitat (EST)	Aquaculture (AQUA)	Native American Culture (CUL)	Flood Peak Attenuation/ Flood Water Storage (FLD)	Wetland Habitat (WET)	Water Quality Enhancement (WQE)
Trinity and Lower Klamath Rivers																									
Lower Klamath River and Klamath Glen Hydrologic Subarea	E	E	P	P	E	E	E	P	E	E	E	E	E	E	E	E	E	E	E	E	P	E	-	-	-
Trinity Lake	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	-	P	E	-	-	P	-	-	-	-
Lewiston Reservoir	E	E	P	P	E	E	E	E	E	E	E	P	E	E	E	-	P	E	-	-	E	-	-	-	-
Middle Trinity River and Surrounding Hydrologic Area	E	E	E	P	E	E	E	P	E	E	E	-	E	E	E	-	E	E	-	-	E&P	-	-	-	-
Lower Trinity River and Surrounding Hydrologic Area[1]	E&P	E&P	E	E&P	E	E	E	E&P	E	E	E	-	E	E	E	-	E	E	P	-	E&P	E[2]	-	-	-

Table 5-1. Designated Beneficial Uses Within Project Study Area (contd.)

Surface Water Body	Municipal and Domestic Supply (MUN)	Agricultural Supply (AGR)	Industrial Service Supply (IND)	Industrial Process Supply (PRO)	Groundwater Recharge (GWR)	Fresh water Replenishment (FRSH)	Navigation (NAV)	Hydropower Generation (POW)	Water Contact Recreation (REC-1)	Non-Contact Water Recreation (REC-2)	Commercial and Sport Fishing (COMM)	Warm Freshwater Habitat (WARM)	Cold Freshwater Habitat (COLD)	Wildlife Habitat (WILD)	Rare, Threatened, or Endangered Species (RARE)	Marine Habitat (MAR)	Migration of Aquatic Organisms (MIGR)	Spawning, Reproduction, and/or Early Development (SPWN)	Shellfish Harvesting (SHELL)	Estuarine Habitat (EST)	Aquaculture (AQUA)	Native American Culture (CUL)	Flood Peak Attenuation/ Flood Water Storage (FLD)	Wetland Habitat (WET)	Water Quality Enhancement (WQE)
Sacramento River Basin																									
Shasta Lake	E	E	-	-	-	-	-	E	E	E	-	E[4]	E[4]	E	-	-	-	E[5,6]	-	-	-	-	-	-	-
Sacramento River: Shasta Dam to Colusa Basin Drain	E	E	E	-	-	-	E	E	E[3]	E	-	E[4]	E[4]	E	-	-	E[5,6]	E[5,6]	-	-	-	-	-	-	-
Colusa Basin Drain	-	E	-	-	-	-	-	-	E[3]	-	-	E[4]	P[4]	E	-	-	E[6]	E[6]	-	-	-	-	-	-	-
Sacramento River: Colusa Basin Drain to Eye (“I”) Street Bridge	E	E	-	-	-	-	E	-	E[3]	E	-	E[4]	E[4]	E	-	-	E[5,6]	E[5,6]	-	-	-	-	-	-	-
Whiskeytown Lake	E	E	-	-	-	-	-	E	E	E	-	E[4]	E[4]	E	-	-	-	E[6]	-	-	-	-	-	-	-
Cedar Creek below Whiskeytown Lake	E	E	-	-	-	-	-		E[3]	E	-	E[4]	E[4]	E	-	-	E[5]	E[5,6]	-	-	-	-	-	-	-

Table 5-1. Designated Beneficial Uses Within Project Study Area (contd.)

Surface Water Body	Municipal and Domestic Supply (MUN)	Agricultural Supply (AGR)	Industrial Service Supply (IND)	Industrial Process Supply (PRO)	Groundwater Recharge (GWR)	Fresh water Replenishment (FRSH)	Navigation (NAV)	Hydropower Generation (POW)	Water Contact Recreation (REC-1)	Non-Contact Water Recreation (REC-2)	Commercial and Sport Fishing (COMM)	Warm Freshwater Habitat (WARM)	Cold Freshwater Habitat (COLD)	Wildlife Habitat (WILD)	Rare, Threatened, or Endangered Species (RARE)	Marine Habitat (MAR)	Migration of Aquatic Organisms (MIGR)	Spawning, Reproduction, and/or Early Development (SPWN)	Shellfish Harvesting (SHELL)	Estuarine Habitat (EST)	Aquaculture (AQUA)	Native American Culture (CUL)	Flood Peak Attenuation/ Flood Water Storage (FLD)	Wetland Habitat (WET)	Water Quality Enhancement (WQE)
Sacramento River Basin (contd.)																									
Feather River below Lake Oroville (Fish Barrier Dam to Sacramento River)	E	E	-	-	-	-	-	-	E[3]	E	-	E[4]	E[4]	E	-	-	E[5,6]	E[5,6]	-	-	-	-	-	-	-
American River below Lake Natoma (Folsom Dam to Sacramento River)	E	E	E	-	-	-	-	E	E[3]	E	-	E[4]	E[4]	E	-	-	E[5,6]	E[5,6]	-	-	-	-	-	-	-
Yolo Bypass[7]	-	E	-	-	-	-	-	-	E	E	-	E[4]	P[4]	E	-	-	E[5,6]	E[6]	-	-	-	-	-	-	-
Sacramento-San Joaquin River Delta																									
Sacramento-San Joaquin River Delta[7,8,9]	E	E	E	E	E	-	E	-	E	E	E	E[4]	E[4]	E	E	-	E[5,6]	E[6]	E	E	-	-	-	-	-

Table 5-1. Designated Beneficial Uses Within Project Study Area (contd.)

Surface Water Body	Municipal and Domestic Supply (MUN)	Agricultural Supply (AGR)	Industrial Service Supply (IND)	Industrial Process Supply (PRO)	Groundwater Recharge (GWR)	Fresh water Replenishment (FRSH)	Navigation (NAV)	Hydropower Generation (POW)	Water Contact Recreation (REC-1)	Non-Contact Water Recreation (REC-2)	Commercial and Sport Fishing (COMM)	Warm Freshwater Habitat (WARM)	Cold Freshwater Habitat (COLD)	Wildlife Habitat (WILD)	Rare, Threatened, or Endangered Species (RARE)	Marine Habitat (MAR)	Migration of Aquatic Organisms (MIGR)	Spawning, Reproduction, and/or Early Development (SPWN)	Shellfish Harvesting (SHELL)	Estuarine Habitat (EST)	Aquaculture (AQUA)	Native American Culture (CUL)	Flood Peak Attenuation/ Flood Water Storage (FLD)	Wetland Habitat (WET)	Water Quality Enhancement (WQE)
San Joaquin River Basin																									
San Luis Reservoir	E	E	E	-	-	-	-	E	E	E	-	E[4]	-	E	-	-	-	-	-	-	-	-	-	-	-
O'Neill Reservoir	E	E	-	-	-	-	-	-	E	E	-	E[4]	-	-	-	-	-	-	-	-	-	-	-	-	-
California Aqueduct	E	E	E	E	-	-	-	E	E	E	-	-	-	E	-	-	-	-	-	-	-	-	-	-	-
Delta-Mendota Canal	E	E	-	-	-	-	-	-	E	E	-	E[4]	-	E	-	-	-	-	-	-	-	-	-	-	-

Sources: CVRWQCB 2004, SWRCB 2006, Hoopa Valley TEPA 2008, CVRWQCB 2011, NCRWQCB 2011

Notes:
E: Existing Beneficial Use; P: Potential Beneficial Use
[1] Includes beneficial uses for the Trinity River within the Hoopa Valley Indian Reservation as designated by the Hoopa Valley Indian Reservation Water Quality Control Plan, which, in addition to beneficial uses shown, also designates the Lower Trinity River as a Wild and Scenic waterway, providing for scenic, fisheries, wildlife, and recreational purposes.
[2] Not all beneficial uses are present uniformly throughout this water body. They have been summarized to reflect beneficial uses present in multiple segments of the water body.
[3] Canoeing and rafting included in REC-1 designation.
[4] Resident does not include anadromous. Any segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.
[5] Cold water protection for salmon and steelhead.
[6] Warm water protection for striped bass, sturgeon and shad.
[7] Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis. COMM is a designated beneficial use for the Sacramento San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43 of the Basin Plan for the Sacramento River and San Joaquin River Basins and not any tributaries to the listed waterways, or portions of the listed waterways, outside of the legal Delta boundary unless specifically designated.
[8] Delta beneficial uses as shown are designated by the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin, and the Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary.
[9] Per SWRCB's Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC-1 and REC-2 (potential uses), WARM, WILD and RARE. COMM is a designated beneficial use for Marsh Creek and its tributaries listed in Appendix 43 of the Basin Plan for the Sacramento River and San Joaquin River Basins within the legal Delta boundary.

Water Temperature

Water temperature is a concern in regions throughout California including the lower Klamath River, Trinity Lake, Sacramento River, and the San Joaquin River. These regions support warm and cold freshwater habitat and other aquatic beneficial uses. Water bodies in these areas must maintain water temperatures supportive of resident and seasonal fish species habitats, particularly for endangered species. Common narrative and numeric water quality objectives for water temperature (in water bodies within the study area) are specified in each of the basin plans for the North Coast and Central Valley regions (NCRWQCB 2011; CVRWQCB 2004 and 2011):

- The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the RWQCB that such alteration in temperature does not adversely affect beneficial uses.

- At no time or place shall the temperature of cold or warm-intrastate waters be increased by more than 5 degrees Fahrenheit (°F) above natural receiving water temperature.

Water quality objectives for water temperature within the project study area are also specified in the SWRCB's *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Statewide Temperature Plan)*.

Further information on the measurement and enforcement of water quality objectives for temperature is included in the Statewide Temperature Plan (SWRCB 1998).

Salinity

Salinity, a measure of dissolved salts in water, is a concern in the tidally-influenced Delta as it can cause impacts on domestic supply, agriculture, industry, and wildlife (CALFED 2007). The impacts of salinity on the domestic supply of water in the Delta includes aesthetic (skin or tooth discoloration), or cosmetic (taste, odor, or color) effects. There may also be a need to reduce salinity for municipal and industrial (M&I) uses via blending, which can lead to a reduction in the quantity of usable water. Salts, such as bromide, in drinking water can increase the formation of harmful byproducts. Salinity in the Delta impacts agriculture by reducing crop yields and salinity in the soil can cause plant stress. Another salt ion, chloride, in high concentrations in M&I supply has been known to cause corrosion in canned goods because of residual salts in paper boxes or linerboard that are used for packaging. The CVP and SWP are operated to achieve salinity objectives in the Delta under SWRCB Water Rights Decision 1641 (D-1641).

Some fish and wildlife are also affected by salinity concentrations in the Delta because certain salinity levels are required for survival during different life stages. One measure of salinity in the western Delta is known as *X2*. X2 refers to the horizontal distance from the Golden Gate Bridge, up the axis of the Delta estuary, to where tidally averaged near-bottom salinity concentration of two parts of salt in 1,000 parts of water occurs. The X2 standard was established to improve shallow water estuarine habitat in the months of February through June, and relates to the extent of salinity movement into the Delta (DWR et al. 2013). The location of X2 is important to both aquatic life and water supply beneficial uses.

The SWRCB D-1641 includes *spring X2* criteria during February through June, and the 2008 U.S. Fish and Wildlife Service (USFWS) Biological Opinion (BO) (USFWS 2008) also includes an additional requirement in September and October in wet and above normal water years (Fall X2).

Nutrients

Nutrients are a constituent of concern in the lower Klamath River hydrologic area (Klamath Glen HSA). Nutrients (such as nitrogen and phosphorus) come from natural sources such as the weathering of rocks and soil, from the ocean when nutrients are mixed in the water current, as well as from animal manure, atmospheric deposition, and nutrient recycling in sediment (NOAA 2014; USEPA 1998). Anthropogenic sources include fertilizers, detergents, sewage treatment plants, septic systems, combined sewer overflows, and watershed sediment mobilization (USEPA 1998).

Nutrients are essential to maintaining a healthy water system. However, over enrichment of nitrogen and phosphorus can contribute to a process known as eutrophication where there is an excessive growth of macrophytes, phytoplankton, or potentially toxic algal blooms. Eutrophication may also lead to a decrease of DO—typically at night—when plants stop producing oxygen through photosynthesis, but continue to use oxygen. Low DO levels can kill fish, cause an imbalance of prey and predator species, and result in a decline in aquatic resources (USEPA 1998). Severely low DO conditions are referred to as anoxic and may enhance methylmercury production (SFB RWQCB 2012). Over enrichment can also contribute to cloudy or murky water clarity by increasing the amount of materials (i.e., algae) suspended in the water.

Dissolved Oxygen

DO is a constituent of concern in the project area primarily in the lower Klamath River and Sacramento-San Joaquin River Delta (SWRCB 2011a). Oxygen in water comes primarily from the atmosphere through diffusion at the water surface, as well as from groundwater discharge into streams and when plants undergo photosynthesis, releasing oxygen in exchange for carbon dioxide (USGS 2014; NOAA 2008a). Levels of DO vary with several factors including season, time of day, water temperature, salinity, and organic matter. The season and time of day dictate photosynthetic processes, which require sunlight. Increases in water temperature and salinity reduce the solubility of oxygen (NOAA 2008b). Fungus and bacteria use oxygen when decomposing organic matter in water bodies. The more organic matter that is present in a water body, the more potential for DO levels to decline.

Adverse effects of low DO are a concern for water quality and aquatic organisms. Low DO impairs growth, immunity, reproduction, and causes asphyxiation and death (NCRWQCB 2011).

To protect aquatic life, the USEPA has established water quality standards for DO (USEPA 1986). However, to protect the beneficial uses of California’s water bodies (Table 5-1), including warm and cold freshwater habitats in both tidal and non-tidal waters, site-specific water quality objectives were established.

Lower Klamath and Trinity River Region

The Lower Klamath and Trinity River Region includes the area in Trinity County along the Trinity River, from Trinity Lake to its confluence with the Klamath River; and in Humboldt and

Del Norte Counties along the Klamath River, from the confluence with the Trinity River to the Pacific Ocean.

This water quality analysis includes Trinity Lake, Lewiston Lake, Trinity River (downstream of Lewiston Dam), and the Klamath River from its confluence with the Trinity River to the Pacific Ocean. The analysis does not include Trinity River, upstream of Trinity Lake; the South Fork of the Trinity River; or the Klamath River, upstream of Trinity River; because these areas are not affected by changes in CVP operations.

Several water quality requirements affect the Klamath River and Trinity River Basins. Beneficial uses and water quality objectives provided by the North Coast Regional Water Quality Control Board (NCRWQCB) and the Hoopa Valley Tribal Environmental Protection Agency (TEPA) are described below, as well as relevant Total Maximum Daily Loads (TMDL). The Yurok Tribe Basin Plan for the Yurok Indian Reservation and the Resighini Rancheria Tribal Water Quality Ordinance also regulate portions of the Trinity and Klamath Rivers that flow into (and through) the reservations. Because these programs have not yet been approved by the USEPA, their objectives are not described in detail here. The State of Oregon water quality requirements also affect the water quality of the Klamath River, which originates in that state. However, this chapter only discusses the requirements within the Trinity and Lower Klamath River Basins.

Beneficial Uses

Beneficial uses for all water bodies in the study area are determined by the NCRWQCB and the Hoopa Valley TEPA (Table 5-1). In addition to the beneficial uses listed in the Trinity and Klamath River Basins, the North Coast Basin Plan notes that recreational use (i.e., water contact recreation (REC-1) and non-contact water recreation (REC-2)) occurs in all hydrologic units of the Klamath River Basin—with Trinity River being one of the rivers receiving the largest levels of recreational use (NCRWQCB 2011). Fish and wildlife reside in virtually all of the surface waters within the North Coast Region (NCRWQCB 2011). This fauna includes several species that are designated as rare, threatened, and endangered. Trinity Dam also provides the beneficial use of hydroelectric power (POW).

Constituents of Concern

The constituents of concern that are currently not in compliance with existing water quality standards and for which TMDLs are adopted (or are in development) are summarized in Table 5-2.

Table 5-2. Constituents of Concern per the 303(d) List Within the Klamath River Region

Region	Waterbody	Constituent of Concern	TMDL Status[1]
Trinity and Lower Klamath Rivers	Trinity Lake (formerly Claire Engle Lake)	Mercury	Expected: 2019
	Trinity River HU, Lower Trinity HA; Trinity River HU, Middle HA; Trinity River HU, South Fork HA; Trinity River, Upper HA; Trinity River HU, Upper HA, Trinity River, East Fork	Sedimentation/Siltation, Temperature[2], Mercury[3]	Approved: 2001
	Klamath River HU, Lower HA; Klamath Glen HSA	Nutrients, Organic Matter, Enrichment/Low DO, Water Temperature	Approved: 2010
		Sedimentation/Siltation	Expected: 2025

Source: SWRCB 2011a
Note:
[1] TMDL status is either expected to be completed or approved by USEPA in the year specified.
Key:
DO = Dissolved Oxygen
HU = Hydrologic Unit
HA = Hydrologic Area
HAS = Hydrologic Sub-Area
TMDL = Total Maximum Daily Load

Water Temperature Elevated water temperature in the project area is addressed through objectives and criteria specified for individual reaches. For example, not all reaches of the Trinity and Klamath Rivers are listed on the 303(d) list approved by the USEPA in 2010 as impaired by water temperature. However, the hydrologic area of the South Fork Trinity River and the lower hydrologic area of the Klamath River (Klamath Glen HSA), are listed for elevated water temperatures adversely affecting the cold freshwater habitat (SWRCB 2011b-g).

Further, the North Coast Basin Plan designates narrative and numeric water temperature objectives—applicable to surface waters throughout the Trinity River and the Lower Klamath River Basins—to protect and support resident and seasonal fish species habitats. Other objectives and criteria specific to each region are specified below.

Trinity River Water temperature objectives (summarized in Table 5-3) were set forth in the North Coast Basin Plan specifically applicable to the Trinity River, from Lewiston Dam to Douglas City and to the confluence with the North Fork Trinity River. These criteria are reach dependent, and vary seasonally. They were developed to enhance the productivity of the Trinity River Fish Hatchery, specifically for salmon and steelhead trout populations (NCRWQCB 2011).

The South Fork Trinity River is listed on the 303(d) list approved by the USEPA in 2010 for elevated water temperatures. This stream flows from its headwaters to its confluence with the mainstem of the Trinity River (approximately 30 miles upstream of its confluence with the Klamath River), and supports steelhead, Chinook Salmon, and Coho Salmon (below Grouse Creek) (USDAFS 2014). Elevated water temperatures in the South Fork Trinity River can be attributed to the loss of shade trees due to habitat modification, range grazing, removal of riparian vegetation, streambank modification and destabilization, and water diversions (SWRCB 2011c). Development of a temperature TMDL has not been scheduled for the South Fork Trinity River at this time.

Table 5-3. Water Quality Objectives for Temperature in the Trinity River

Source	Target Reach	Dates	Temperature Target
North Coast Regional Water Quality Control Board Basin Plan[1]	• Lewiston to Douglas City	All Years • July 1 to September 15	≤ 60° F
SWRCB's Order WR-90-5[2]	• Lewiston to Douglas City	• September 16 – 301	≤ 56° F
	• Lewiston to the confluence with the North Fork Trinity River	• October 1 to December 311	≤ 56° F
Springtime Objectives of the Record of Decision for the Trinity River Mainstem Fisheries Restoration EIS/EIR[3]	Lewiston to Weitchpec	Normal and Wetter Water Years • April 15 to May 22 • May 23 to June 4 • June 5 to July 9	 ≤ 55° F ≤ 59° F ≤ 62.5° F
		Dry and Critically Dry Water Years • April 15 to May 22 • May 23 to June 4 • June 5 to June 15	 ≤ 59° F ≤ 62.5° F ≤ 68° F

Sources:
[1] NCRWQCB 2011
[2] SWRCB 1990
[3] DOI and Hoopa Valley 2000; USFWS et al. 2000
Key:
EIR = Environmental Impact Report
EIS = Environmental Impact Statement
SWRCB=California State Water Resources Control Board

Hoopa Valley Indian Reservation Natural causes of temperature exceedances—such as unusually excessive ambient meteorological conditions coupled with seasonal low flows, intended to protect aquatic habitat specified in the Trinity River Flow Evaluation Report (TRFE) (USFWS and Hoopa Valley Tribe 1999)—will not be considered to violate the water quality objectives stated in the Hoopa Valley Indian Reservation Basin Plan.

Temperature objectives for the Trinity River (as it passes through the Hoopa Valley Reservation) vary seasonally and are hydrologically year type dependent (Table 5-4).

The water quality objectives are based on temperature-flow relationships that maintain TRFE flow regimes and protect adult salmonids holding and spawning. The objectives are also consistent with the temperature standards specified in the NCRWQCB Basin Plan (Hoopa Valley TEPA 2008).

Table 5-4. Trinity River Temperature Criteria for the Hoopa Valley Indian Reservation

	Running 7-Day Average Temperature not to Exceed[1,2]	
Dates	**Extremely Wet, Wet and Normal Water Years**	**Dry and Critically Dry Water Years**
May 23 – June 4	59ºF	62.6ºF
June 5 – July 9	62.6ºF	68ºF
July 10 – September 14	72.0ºF	74.0ºF[3]
September 15 – October 31	66.0ºF	66.0ºF
November 1 – May 22	55.4ºF	59.0ºF

Source: Adapted from Hoopa Valley TEPA 2008

Notes:

[1] Temperature standards will be monitored at the Weitchpec temperature monitoring station operated and maintained by the U.S. Department of the Interior, Bureau of Reclamation.

[2] Temperature standard violations will be determined if more than 10 percent of 7-day running averages exceed the standard, to be determined by the number of days exceeded for that seasonal period (i.e., for June 16 – September 14, a 91 day period, 10 percent exceedance will equate to 9 days).

[3] For the seasonal period of June 16 – September 14, temperatures on the mainstem Trinity River at the Weitchpec gauging station were used to determine running 7-day averages.

Key:

ºF = degrees Fahrenheit

The Hoopa Valley TEPA established a goal of attaining a temperature of 21ºC (69.8ºF), during the July 10 to September 14 period, within five years of the adoption of these standards (Hoopa Valley TEPA 2008). If monitoring reveals that temperatures continue to increase, the Hoopa Valley TEPA will employ adaptive management strategies until temperatures begin to decrease.

In addition to the seasonal water temperature criteria, the Hoopa Valley TEPA has established varying criteria for each life stage of salmonids (Table 5-5).

Table 5-5. Tributary Temperature Criteria for the Hoopa Valley Indian Reservation

Dates	Maximum Weekly Average Temperature (MWAT)[1,2] Extremely Wet, Wet and Normal Water Years	Maximum Weekly Average Temperature (MWAT)[1,2] Dry and Critically Dry Water Years	Applicable Salmonid Life Stage(s)[3]
May 23 – June 4	55.4ºF	57.2ºF	Adult holding; Coho Salmon incubation and emergence; spawning; smoltification
June 5 – July 9	60.8ºF	62.6ºF	Adult holding; peak temperatures timeframe according to Hoopa Tribal data
July 10 – September 14	64.4ºF	68.0ºF	Adult holding
September 15 – October 31	57.2ºF	60.8ºF	Adult holding; spawning
November 1 – May 22	50.0ºF	53.6ºF	Adult incubation and emergence (including Coho Salmon); smoltification; spawning

Source: Adapted from Hoopa Valley TEPA 2008

Notes:

[1] The MWAT is defined as the highest 7-day moving average of equally spaced water temperature measurements for a given time period. In this application, the time period is the duration of the existing salmonids' life stage. For the MWAT objective, temperatures may not exceed the numeric objective for every 7-day period during the given life stage.

[2] Applicable where a given species and life stage time period exist, and when and where the species and life stage time period existed historically, and have the potential to exist again.

[3] Adult migration and juvenile rearing are considered all year life stages.

Key:

ºF = degrees Fahrenheit

As shown in Table 5-6 and Figure 5-1, water temperature data for the Trinity River, between 2001 and 2015, show seasonal trends and the warming effect of ambient conditions at the downstream location. Compliance locations for water quality monitoring along the Trinity River are shown in Figure 5-2. Monitoring of water temperatures of the Trinity River on the Hoopa Valley Tribal reservation occurs at the U.S. Geological Service gage (Gage # 11530000).

Table 5-6. Monthly Average of Water Temperatures Recorded at Trinity River Compliance Locations

WY	WYT	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Douglas City													
2001	D	51.9	46.6	44.2	42.0	43.2	47.5	50.7	54.4	55.5	58.5	57.0	54.2
2002	N	51.0	47.7	42.7	43.1	43.8	46.6	52.5	49.4	56.1	58.9	56.2	54.4
2003	W	49.8	46.5	44.6	44.9	44.8	48.0	48.8	50.4	52.8	57.0	56.6	52.7
2004	W	51.2	46.6	43.7	41.5	43.7	47.5	51.4	50.3	51.4	54.9	56.4	53.0
2005	W	50.9	47.4	42.9	42.8	45.3	48.2	50.8	49.9	52.2	57.9	59.5	54.7
2006	EW	51.5	47.4	43.9	45.5	44.4	44.2	47.5	48.4	49.3	54.9	NA	NA
2007	D	NA	NA	43.0	39.5	43.1	48.4	52.5	47.9	55.8	58.7	57.2	54.1
2008	D	50.3	46.9	41.8	39.5	41.2	46.4	50.0	48.6	50.8	53.4	58.0	55.3
2009	D	51.4	49.3	43.5	43.0	43.4	46.8	51.7	50.9	56.6	60.5	58.1	55.9
2010	W	51.2	47.5	42.2	44.3	45.2	46.8	48.4	48.4	52.3	57.3	58.5	55.1
2011	W	51.4	46.7	44.4	42.3	42.6	45.2	48.8	47.7	50.4	54.4	57.6	53.9
2012	N	50.5	45.5	41.2	40.2	43.5	45.2	48.9	49.3	50.9	55.2	55.6	52.4
2013 – 2015	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trinity River above North Fork Trinity													
2001 – 2004	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	W	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	64.5	58.2
2006	EW	53.4	47.8	44.0	45.7	44.8	44.9	48.3	49.6	51.4	59.0	NA	NA
2007	D	NA	NA	42.5	39.6	43.5	48.9	53.2	49.3	59.8	65.4	63.0	58.3
2008	D	52.5	48.3	42.0	40.6	42.3	46.6	50.1	50.1	53.2	56.7	62.8	59.2
2009	D	53.3	49.6	43.0	42.5	43.4	47.0	51.8	52.6	59.7	66.0	62.9	60.0
2010	W	53.4	47.7	41.9	44.8	45.9	47.1	48.4	49.4	53.7	60.9	63.3	59.0
2011	W	53.9	47.1	45.1	43.1	43.0	45.2	45.5	NA	NA	NA	NA	NA
2012	N	52.8	46.4	40.9	39.9	43.8	45.1	49.1	50.6	53.3	59.3	60.3	55.9
2013	D	53.8	48.5	43.1	40.4	42.4	48.6	52.2	51.8	59.0	64.9	60.9	56.7
2014	CD	51.5	46.7	39.6	41.5	44.8	49.0	53.4	55.4	60.6	65.7	63.3	58.4
2015	D	55.6	51.1	47.8	44.4	47.8	51.9	55.1	53.5	62.1	66.9	60.8	57.6
Weitchpec													
2001	D	57.9	48.2	44.8	41.9	43.5	48.8	52.1	60.9	65.8	73.8	72.1	67.0
2002	N	59.3	51.2	46.0	44.7	45.8	47.4	53.9	55.9	66.1	73.6	71.1	67.2
2003	W	57.5	49.1	46.7	49.3	50.8	54.2	54.8	58.6	69.5	70.2	71.3	64.6
2004	W	59.7	50.4	46.3	45.3	46.8	53.5	58.7	56.6	62.3	70.4	72.1	64.4
2005	W	58.6	49.9	45.0	44.3	46.7	50.0	51.5	54.6	59.5	69.8	73.0	64.9
2006	EW	58.8	50.6	46.4	48.8	47.5	47.8	50.2	53.8	57.1	65.2	NA	NA
2007	D	NA	NA	47.9	44.9	48.3	52	56.2	56.3	66.6	73.2	72.6	NA
2008 – 2015	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Source: DWR 2016
Note: WYT is Trinity Water Year Type.
Key:
CD = Critically Dry
D = Dry
EW = Extremely Wet
N = Normal
W = Wet
WY = Water year
WYT = Water Year Type

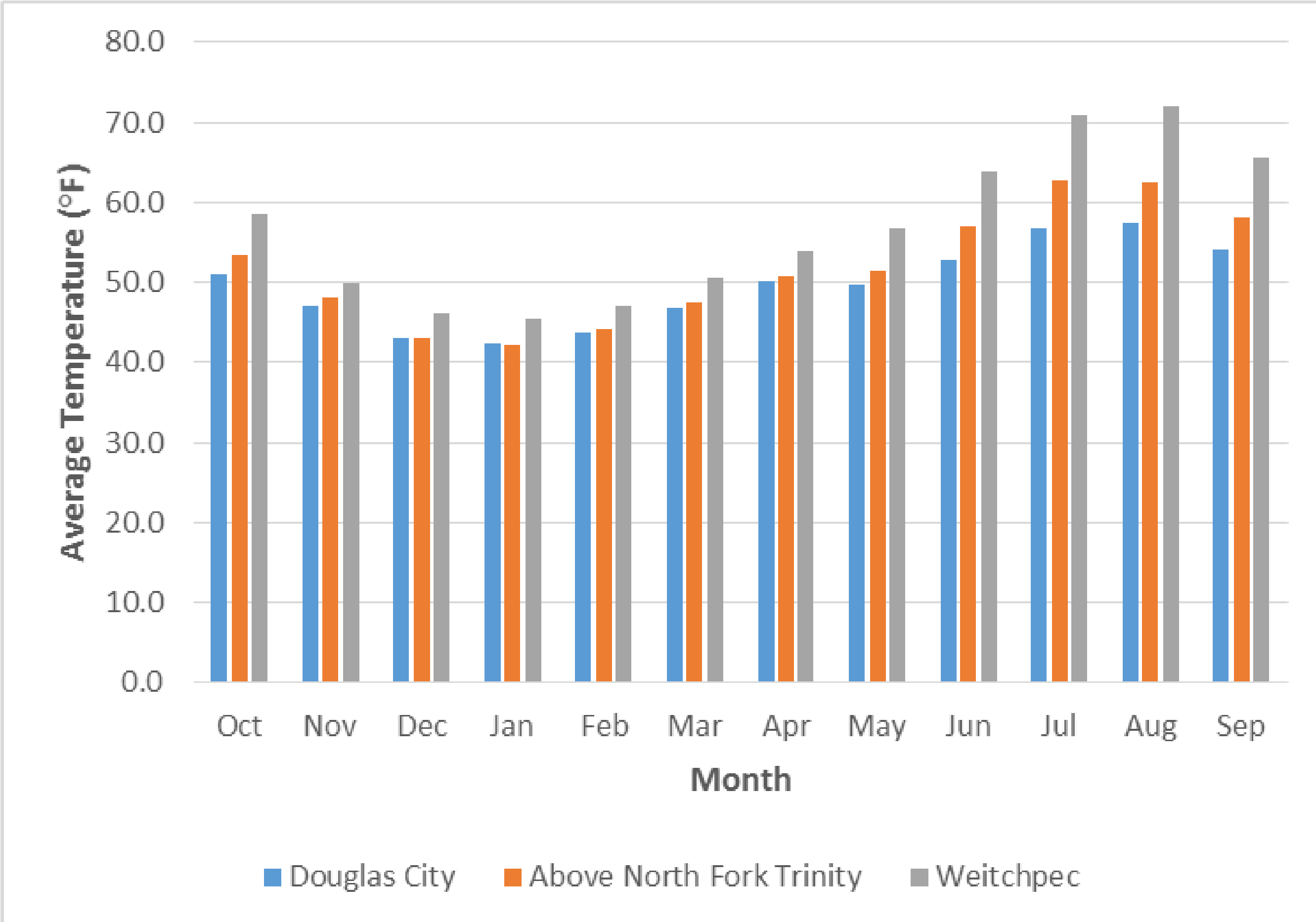


Figure 5-1. Monthly Average of Water Temperatures Recorded at Trinity River Compliance Locations (2001-2015)

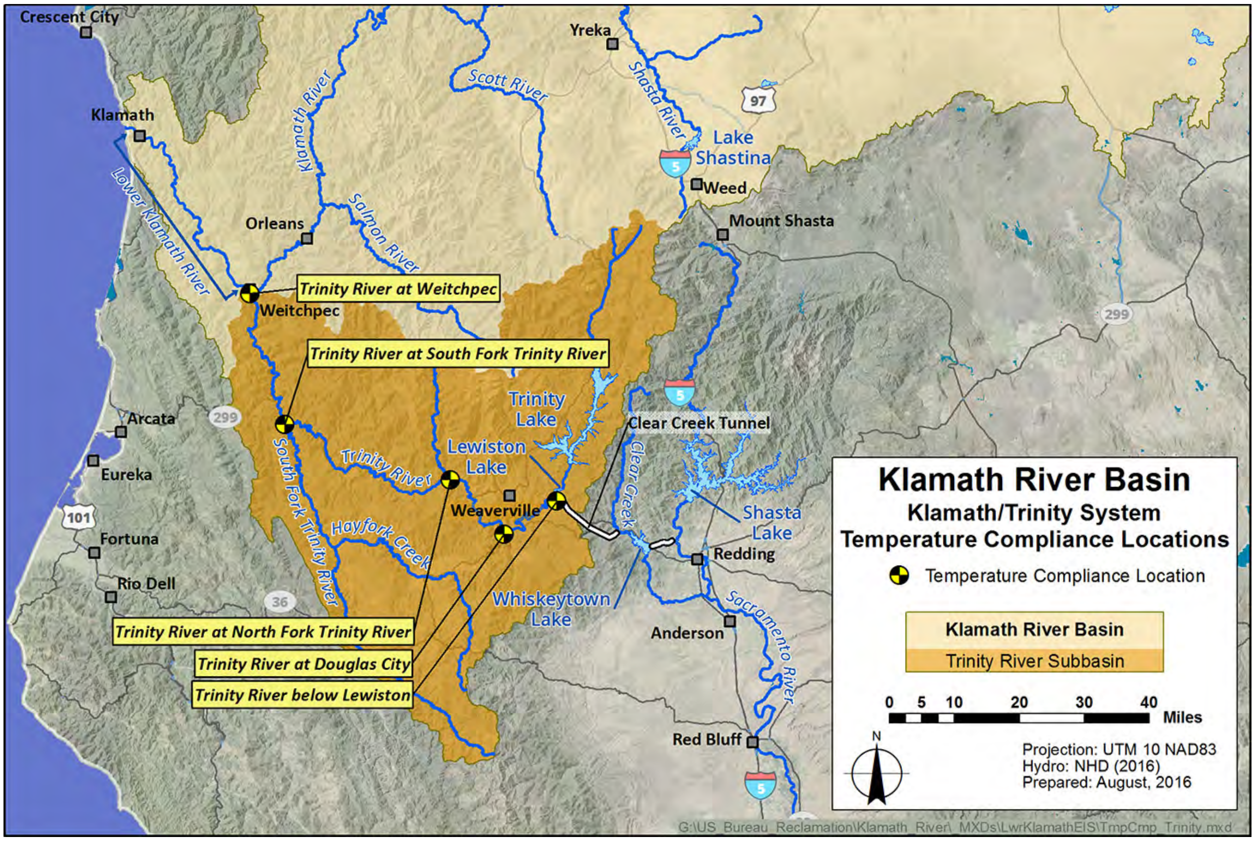


Figure 5-2. Temperature Compliance Stations Along the Trinity River

Activities that increase water temperatures must comply with tribal and Federal anti-degradation policies. The responsible party must not increase water temperatures, even if caused by their actions coupled with natural factors (Hoopa Valley TEPA 2008). In some streams, the numeric objectives may not be attainable due to site specific limitations. If this is the case, and provided that the stream has been restored to its full site potential; and the salmonid population is at a level consistent with the National Marine Fisheries Service (NMFS) concept of a ”Viable Salmonid Population” (McElhany et al. 2000), then the Hoopa Valley TEPA may not be applicable.

Nutrients The lower Klamath River was placed on the 303(d) list approved by the USEPA in 2010 for being impaired by nutrients (SWRCB 2011a). Nutrient levels in the Klamath River and Klamath River Estuary can promote levels of algal growth that cause a nuisance, or adversely affect beneficial uses, when excess growth is not consumed by animals or exported by flows (DOI and DFG 2012). The Klamath River receives the greatest nutrient loading from the Upper Klamath Basin, comprising approximately 40 percent of its total load (NCRWQCB 2010). Tributaries to the Klamath River are the greatest contributors of the remaining nutrient loads, with the Trinity River contributing the most. The Hoopa Valley TEPA also designates water quality objectives to address contamination by nutrients as shown in Table 5-7.

Table 5-7. Specific Use Water Quality Criteria for Waters of the Hoopa Valley Indian Reservation

Contaminant	Trinity River	Klamath River
Maximum Annual Periphyton Biomass	Not Applicable	150 mg chlorophyll streambed area (per m^2)
pH	MUN-designated waters: 5.0 – 9.0 All other designated uses: 7.0 – 8.5	7.0 – 8.5
Total Nitrogen[1]	Not Applicable	0.2 mg/l
Total Phosphorus[1]	Not Applicable	0.035 mg/l
Microcystis aeruginosa cell density	Not Applicable	< 5,000 cells/mL for drinking water < 40,000 cells/mL for recreational water
Microcystin toxin concentration	Not Applicable	< 1 µg/l total microcystins drinking water < 8 µg/l total microcystins recreational water
Total potentially toxigenic blue-green algal species[2]	Not Applicable	< 100,000 cells/mL for recreational water
Cyanobacterial scums	Not Applicable	There shall be no presence of cyanobacterial scums

Source: Hoopa Valley TEPA 2008

Notes:

[1] There should be at least two samples per 30-day period. If total nitrogen and total phosphorus standards are not achievable due to natural conditions, then the standards shall instead be the natural conditions for total nitrogen and total phosphorus. Through consultation, the ongoing Total Maximum Daily Load process for the Klamath River is expected to further define these natural conditions.

[2] Includes: *Anabaena*, *Microcystis*, *Planktothrix*, *Nostoc*, *Coelsphaerium*, *Anabaenopsis*, *Aphanizomenon*, Gloeotrichia, and *Oscillatoria.*

Key:
µg/l = microgram per liter
m^2 = square meter
mg/l = milligram per liter
mL = millimeter

In addition to the water quality criteria established by the Hoopa Valley TEPA (2008), the 2010 *Klamath River TMDLs Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California* provides TMDLs for nutrients which address elevated pH levels (DOI and DFG 2012). Nutrient targets include numeric targets for total phosphorus (TP) and total nitrogen (TN) (NCRWQCB 2010).

The Klamath River nutrient TMDLs are in the process of being implemented by the NCRWQCB and other affiliated agencies—including the SWRCB; the USEPA; the U.S. Department of the Interior, Bureau of Reclamation (Reclamation); the USFWS; and the Oregon Department of Environmental Quality—responsible for implementation of the Klamath TMDLs in Oregon, and other State, Federal, and private agencies with operations that affect the Klamath River (NCRWQCB 2010).

The Klamath Hydroelectric Settlement Agreement Interim Measure 15 (IM 15) - Water Quality Monitoring (funded by PacifiCorp) supports long-term baseline water quality monitoring to assist in water quality improvement activities, dam removal studies, permitting studies, and to form a long-term record to assess trends and other potential changes in the Basin (PacifiCorp 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Monitoring is performed by the Yurok Tribe, Karuk Tribe, PacifiCorp, and Reclamation. The program collects data from 254 miles of river and reservoirs from Link Dam (near Klamath Falls in Oregon) to the Klamath River Estuary in

California. The program has been in place since 2009. Available field observations from the IM 15 program for pH, TN and TP for the Trinity River (above the Klamath River) and Klamath River (near Klamath) are shown in Figure 5-3 through Figure 5-5, respectively.

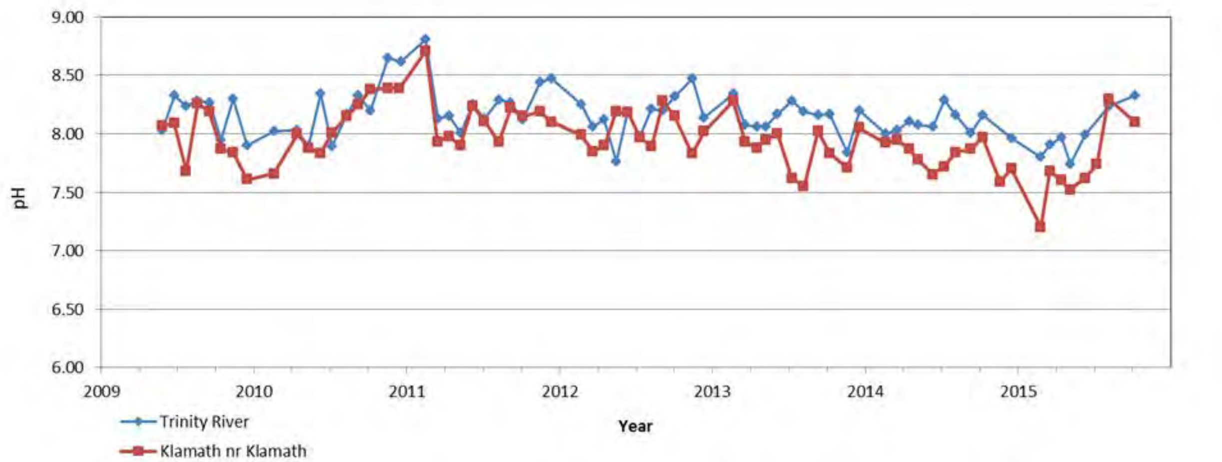


Figure 5-3. pH at Trinity River Above the Klamath River and Klamath River Near Klamath for 2009-2015

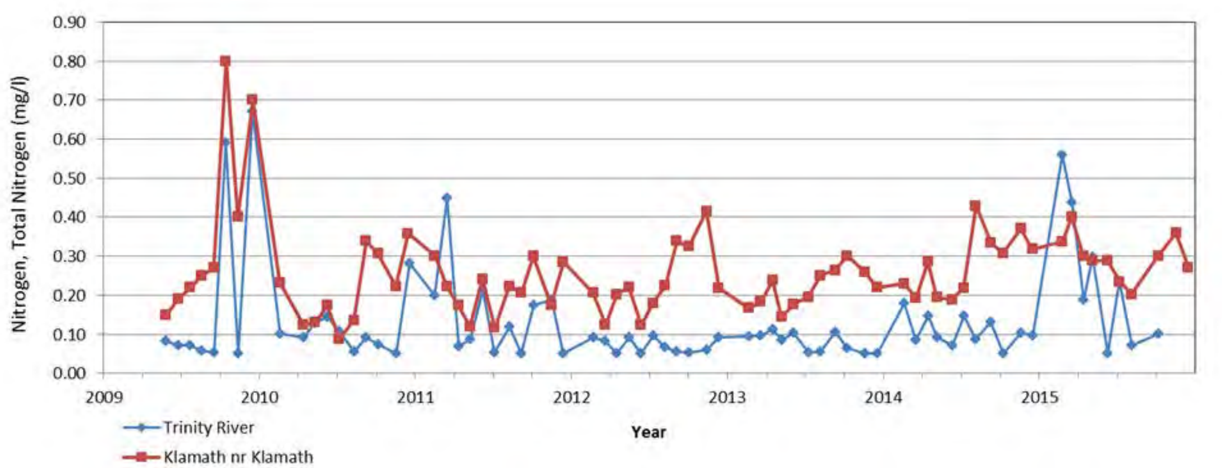


Figure 5-4. Total Nitrogen at Trinity River Above the Klamath River and Klamath River Near Klamath for 2009-2015

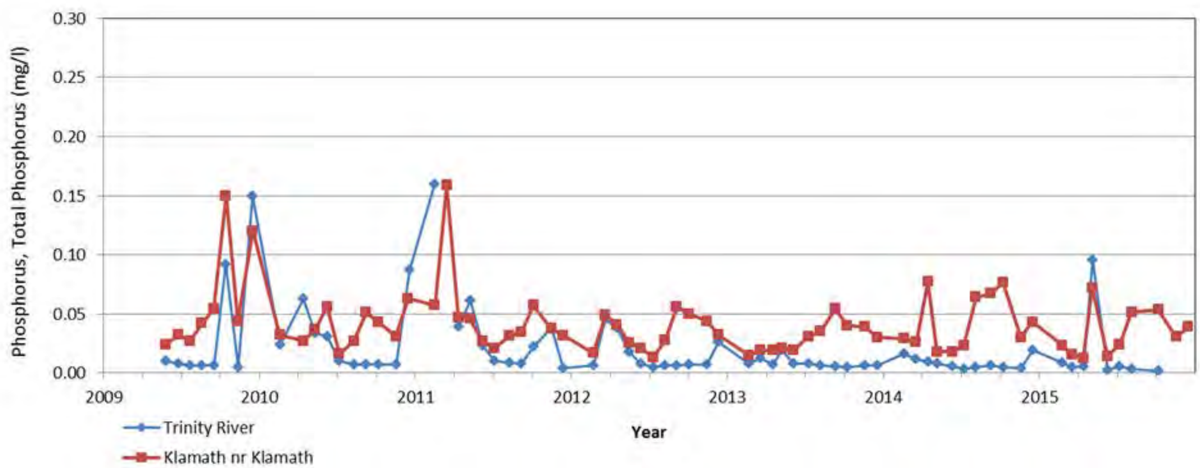


Figure 5-5. Total Phosphorus at Trinity River Above the Klamath River and Klamath River Near Klamath for 2009-2015

Organic Matter The lower Klamath River was placed on the 303(d) list approved by the USEPA in 2010 for impairment due to organic enrichment (SWRCB 2011a).

The Klamath River has several natural sources of organic matter. The river originates from Upper Klamath Lake, which is a naturally-shallow eutrophic lake, with high levels of organic matter (algae), including nitrogen fixing blue-green algae (NCRWQCB 2010). Other sources of organic matter include watershed contributions, runoff from agricultural lands (i.e., irrigation tailwater, storm runoff, subsurface drainage, and animal waste), flow regulations/modification, industrial point sources, and municipal point sources (SWRCB 2011a).

Growth of blue-green algae can contribute to nuisance conditions such as: extreme diurnal DO and pH fluctuations due to the effect of photosynthesis and respiration of the algal biomass, high concentrations of cyanotoxins produced by toxigenic blue-green algal species, DO crashes due to the decomposition of decaying algal biomass, and in extreme conditions, disruption of food webs. Blue-green algae thrive under warm water temperature, high nutrient, and stable water column conditions (Konopka and Brock 1978, Kann 2006) where they can out-compete other algal species such as diatoms. As such, they are largely restricted to impounded reaches or backwater areas that provide appropriate conditions. Algae, including blue-green algae can wash out of reservoirs and be found in downstream reaches, typically in notably lower numbers than occur in lentic environments.

To protect the beneficial uses of the lower Klamath River, including cold freshwater habitat, a TMDL was established in 2010 for organic matter and other constituents. The TMDL equals 143,019 pounds of Carbonaceous Biochemical Oxygen Demand (CBOD) per day from the Klamath River (NCRWQCB 2011). The average organic matter (measured as CBOD) loads from all other Klamath River tributaries are sufficient to meet other related objectives, including DO and biostimulatory substances objectives, in the Klamath River (NCRWQCB 2010). The DO objectives are the primary targets associated with organic matter as well as nutrients. Organic matter allocations were also established for the Klamath River below the Salmon River, and the major tributaries to the Klamath, including the Trinity River.

Implementation actions and other objectives were established to ensure the TMDL is met to protect the beneficial uses of the Klamath River and other water bodies downstream. The North Coast Basin Plan states that a water quality study will be completed to identify actions for monitoring, evaluating, and implementing any necessary actions to address organic matter loading so that the TMDL will be met (NCRWQCB 2011).

Dissolved Oxygen The lower Klamath River was placed on the 303(d) list approved by the USEPA in 2010 for low DO (SWRCB 2011a).

Sources that contribute to low DO include sources of organic enrichment, water temperature and salinity. Other sources that contribute to low DO are runoff from roads and agriculture that can transport nutrients into water bodies and lower DO through biostimulatory effects (NCRWQCB 2010). Over-enrichment and the growth of algae and aquatic plants can produce oxygen during the day through photosynthesis, but those same plants can deplete DO at night.

To protect the beneficial uses of the lower Klamath River, including the cold freshwater habitat, water quality objectives were established in the North Coast Basin Plan (2010) and the Hoopa Valley TEPA (2008) for DO in the Klamath River and its major tributary, the Trinity River (Table 5-8 and Table 5-9) (NCRWQCB 2011). Site Specific Objectives for DO were calculated as part of TMDLs developed by the NCRWQCB (2011), and have been incorporated into the North Coast Basin Plan (2011) (Table 5-10). For those waters without location-specific DO criteria, DO shall not be reduced below minimum levels (shown in Table 5-11) at any time in order to protect beneficial uses.

Table 5-8. Water Quality Objectives for Dissolved Oxygen in Trinity and Lower Klamath

Water Body	Dissolved Oxygen (milligrams per liter) Minimum	50% Lower Limit[1]
Trinity Lake and Lewiston Reservoir	7.0	10.0
Lower Trinity River	8.0	10.0
Lower Trinity Area Streams	9.0	10.0
Lower Klamath River Area Streams	8.0	10.0

Source: NCRWQCB 2011
Note:
[1] 50 percent lower limit represents the 50 percentile values of the monthly means for a calendar year. Fifty percent or more of the monthly means must be greater than, or equal to, the lower limit.
Key:
% = percent

Table 5-9. Specific Use Water Quality Criteria for Waters of the Hoopa Valley Indian Reservation

Contaminant	Trinity River	Klamath River
Minimum Water Column DO Concentration	11.0 mg/l	SPWN-designated waters1: 11.0 mg/l[2] COLD-designated waters: 8.0 mg/l[2]
Minimum Inter-gravel DO Concentration	8.0 mg/l	SPWN-designated waters1: 8.0 mg/l[2]

Source: Hoopa Valley TEPA 2008

Notes:

[1] Whenever spawning occurs, has occurred in the past, or has potential to occur.

[2] Seven-day moving average of the daily minimum DO. If DO standards are not achievable due to natural conditions, the COLD and SPWN standard shall instead be DO concentrations equivalent to 90 percent saturation under natural receiving water temperatures.

Key:

DO = dissolved oxygen

mg/l = milligram per liter

Table 5-10. Site Specific Objectives for Dissolved Oxygen in the Klamath River[1]

Location[2]	Percent Dissolved Oxygen Saturation Based On Natural Receiving Water Temperatures[3]	Time Period
Downstream of Hoopa- California Boundary to Turwar	85%	June 1 through August 31
	90%	September 1 through May 31
Upper and Middle Estuary	80%	August 1 through August 31
	85%	September 1 through October 31 and June 1 through July 31
	90%	November 1 through May 31
Lower Estuary	For the protection of estuarine habitat (EST), the DO content of the lower Klamath estuary shall not be depressed to levels adversely affecting beneficial uses as a result of controllable water quality factors.	Year round

Source: NCRWQCB 2011

Notes:

[1] States may establish site specific objectives equal to natural background (USEPA 1986. Ambient Water Quality Criteria for DO, EPA 440/5-86-033; USEPA Memo from Tudor T. Davies, Director of Office of Science and Technology, USEPA Washington, D.C. dated November 5, 1997). For aquatic life uses, where the natural background condition for a specific parameter is documented, by definition that condition is sufficient to support the level of aquatic life expected to occur naturally at the site absent any interference by humans (Davies 1997). These DO objectives are derived from the T1BSR run of the Klamath Total Maximum Daily Load (TMDL) model and described in Tetra Tech, December 23, 2009 Modeling Scenarios: Klamath River Model for TMDL Development (Tetra Tech and WR and TMDL Center 2009). They represent natural DO background conditions due only to non-anthropogenic sources and a natural flow regime.

[2] These objectives apply to the maximum extent allowed by law. To the extent that the State lacks jurisdiction, the Site Specific DO Objectives for the Mainstem Klamath River are extended as a recommendation to the applicable regulatory authority.

[3] Corresponding DO concentrations are calculated as daily minima, based on site-specific barometric pressure, site-specific salinity, and natural receiving water temperatures as estimated by the T1BSR run of the Klamath TMDL model and described in Tetra Tech, December 23, 2009 (Tetra Tech and WR and TMDL Center 2009). Modeling Scenarios: Klamath River Model for TMDL Development. The estimates of natural receiving water temperatures used in these calculations may be updated as new data or method(s) become available. After opportunity for public comment, any update or improvements to the estimate of natural receiving water temperature must be reviewed and approved by Executive Officer before being used for this purpose.

Key:

% = percent

DO = dissolved oxygen

Table 5-11. Water Quality Objectives for Dissolved Oxygen for Specified Beneficial Uses

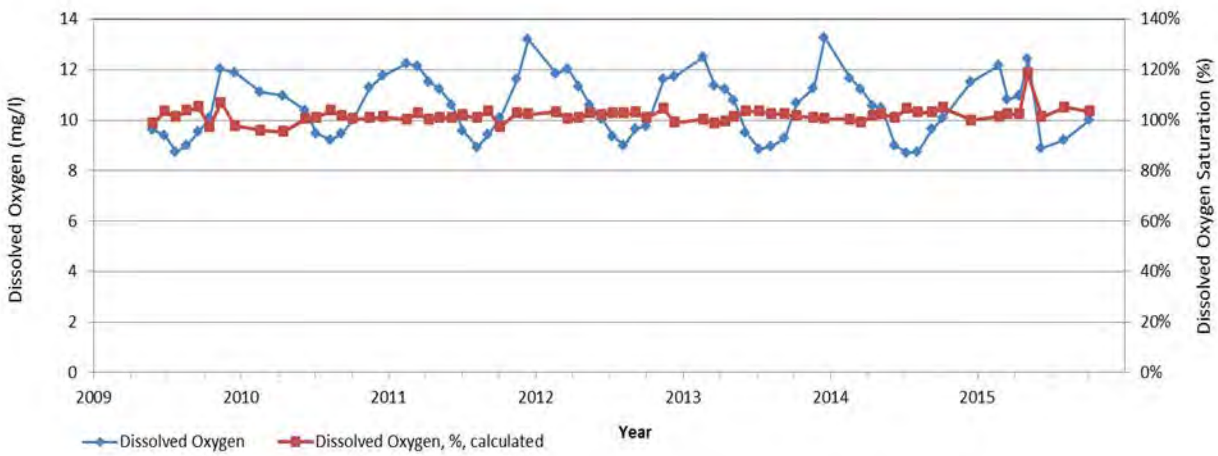
Beneficial Use Designation	Minimum Dissolved Oxygen Limit (mg/l)
WARM, MAR, or SAL	5.0
COLD	6.0
SPWN	7.0
SPWN – during critical spawning and egg incubation periods	9.0
Klamath River Water Column[1] SPWN-designated waters:[2] COLD-designated waters:	 11.0 mg/l[3] 8.0 mg/l[3]
Klamath River Inter Gravel[1] SPWN-designated waters:[2]	 8.0 mg/l[3]

Source: NCRWQCB 2011
Key:
COLD = Cold Freshwater Habitat
MAR = Marine Habitat
mg/l[3] = milligram per cubic liter
SAL = Inland Saline Water Habitat
SPWN = Spawning, Reproduction, and/or Early Development
WARM = Warm Freshwater Habitat

The 2010 *Klamath River TMDLs Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California* provide numerical targets for DO and other constituents (NCRWQCB 2010). Site specific objectives for DO were proposed in this TMDL and adopted into the North Coast Basin Plan. The DO objectives are the primary targets associated with nutrient and organic matter, with additional DO-related TMDLs prescribed for TP, TN and organic matter (CBOD) loading, and numerical targets provided for benthic algae biomass, suspended algae chlorophylla, microcystis aeruginosa, and microcystin toxin discussed in their corresponding sections.

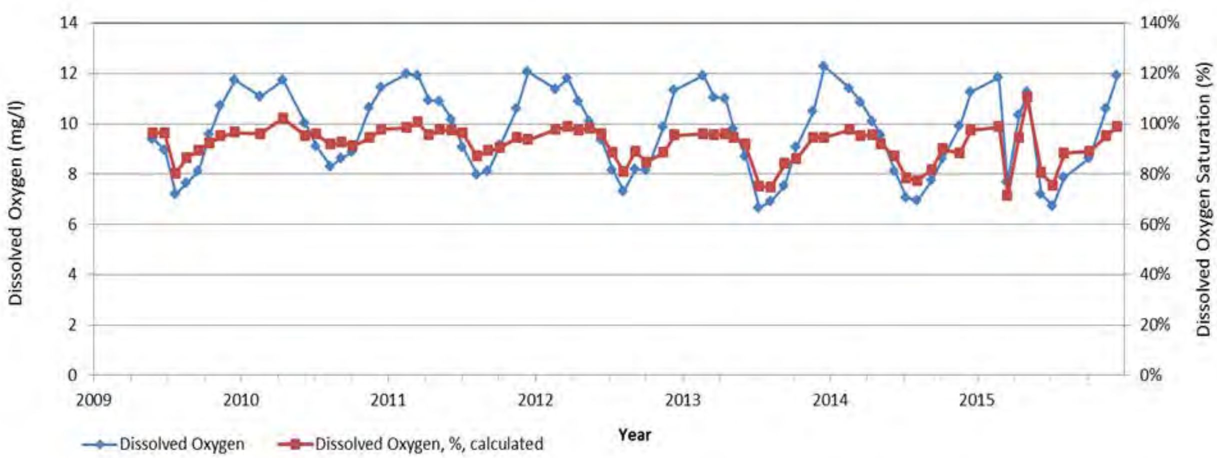
Plans to monitor DO and other constituents in the Klamath River (below Trinity River, near Turwar) and the Klamath River Estuary were established in Chapter 7 of the Klamath River TMDLs, to further protect the beneficial uses of the Trinity and lower Klamath Rivers (NCRWQCB 2010). The TMDL also includes a proposal to revise Site Specific Objectives for DO in the Klamath River.

Available field observations from the IM 15 program for DO concentration and percent saturation for the Trinity River above the Klamath River and Klamath River near Klamath are shown in Figure 5-6 and Figure 5-7.



Key:
% = percent
mg/l = milligrams per liter

Figure 5-6. Dissolved Oxygen Concentration and Percent Saturation for the Trinity River Above the Klamath River for 2009-2015



Key:
% = percent
mg/l = milligrams per liter

Figure 5-7. Dissolved Oxygen Concentration and Percent Saturation for the Klamath River Near Klamath for 2009-2015

Central Valley and Bay-Delta Region

The Central Valley and Bay-Delta Region includes the major rivers and waterways downstream of CVP and SWP dams and reservoirs.

Sacramento Valley

Major watersheds within the Sacramento Valley that could be affected by CVP and SWP operations include the Sacramento River, Feather River, and the lower American River watersheds.

Beneficial uses of surface waters for the Sacramento Valley (as defined in the Central Valley Basin Plan) are summarized in Table 5-1. The constituents of concern that are currently not in compliance with existing water quality standards, and for which TMDLs are adopted or are in development in this region.

Sacramento River from Shasta Lake to Verona Water quality in the upper Sacramento River is influenced by releases from Shasta Lake and diversions from Trinity Lake. Annual and seasonal flows in the Sacramento River watershed are highly variable from year to year, as described in Chapter 4, "Surface Water Supply and Management." These variations in flow are a source of variability in water quality in the Sacramento River drainage.

The water quality constituents that are currently not in compliance with existing water quality standards, and for which TMDLs are adopted or are in development in this region, are: mercury, polychlorinated biphenyls, unknown toxicity, and multiple pesticides. Chlorpyrifos and diazinon have been addressed by changes to the Basin Plan; cadmium, copper, and zinc have been addressed by a TMDL, and temperature is also closely monitored.

Water Temperature The Sacramento River was not placed on the 303(d) list approved by the USEPA in 2010 as impaired by water temperature (SWRCB 2011a). However, water bodies in the upper Sacramento River watershed support the beneficial uses of both warm and cold freshwater habitat, which require that the water bodies maintain water temperatures suitable for multiple fish species (CVRWQCB 2011). Water quality objectives have been established by the SWRCB for the Sacramento River, as summarized in Table 5-12. Performance measures to meet these temperature requirements from May 15-Oct 31 are included in the 2009 NMFS BO (NMFS 2009), and are shown in Table 5-13. An additional objective in the 2009 NMFS BO, not shown in Table 5-13, is that temperatures must be maintained at <56 ºF during April 15-May 15 from Balls Ferry to Bend Bridge. All of these objectives are for winter- and spring-run Chinook Salmon spawning and egg incubation. Finally, there is a temperature objective at Bend Bridge of <63 ºF for Green Sturgeon spawning, incubation and rearing (Reclamation 2015). Temperature conditions on the Sacramento River are managed through operation of the temperature control device at Shasta Dam, and are also affected by imports from the Trinity Basin. Compliance locations in the upper Sacramento River Basin are shown in Figure 5-8.

Table 5-12. Water Quality Objectives for Temperature in the Sacramento River

Applicable Water Bodies	Objective
Sacramento River at Hamilton City	< 56ºF
Sacramento River from Hamilton City to the I Street Bridge (during periods when temperature increases will be detrimental to the fishery)	< 68ºF

Source: CVRWQCB 2011
Key:
ºF = degrees Fahrenheit

Table 5-13. Sacramento River Temperature Performance Measures Under 2009 National Marine Fisheries Services Biological Opinion Reasonable and Prudent Alternative I.2.1

Compliance Location	Compliance Percentage (percent of days from May 15-Oct 31 with Temperatures < 56ºF)[1]
At Clear Creek	95%
Balls Ferry	85%
Jellys Ferry	40%
Bend Bridge	15%

Note:
[1] Percentage is calculated as a 10-year running average excluding years of extended droughts.
Key:
% = percent
ºF = degrees Fahrenheit

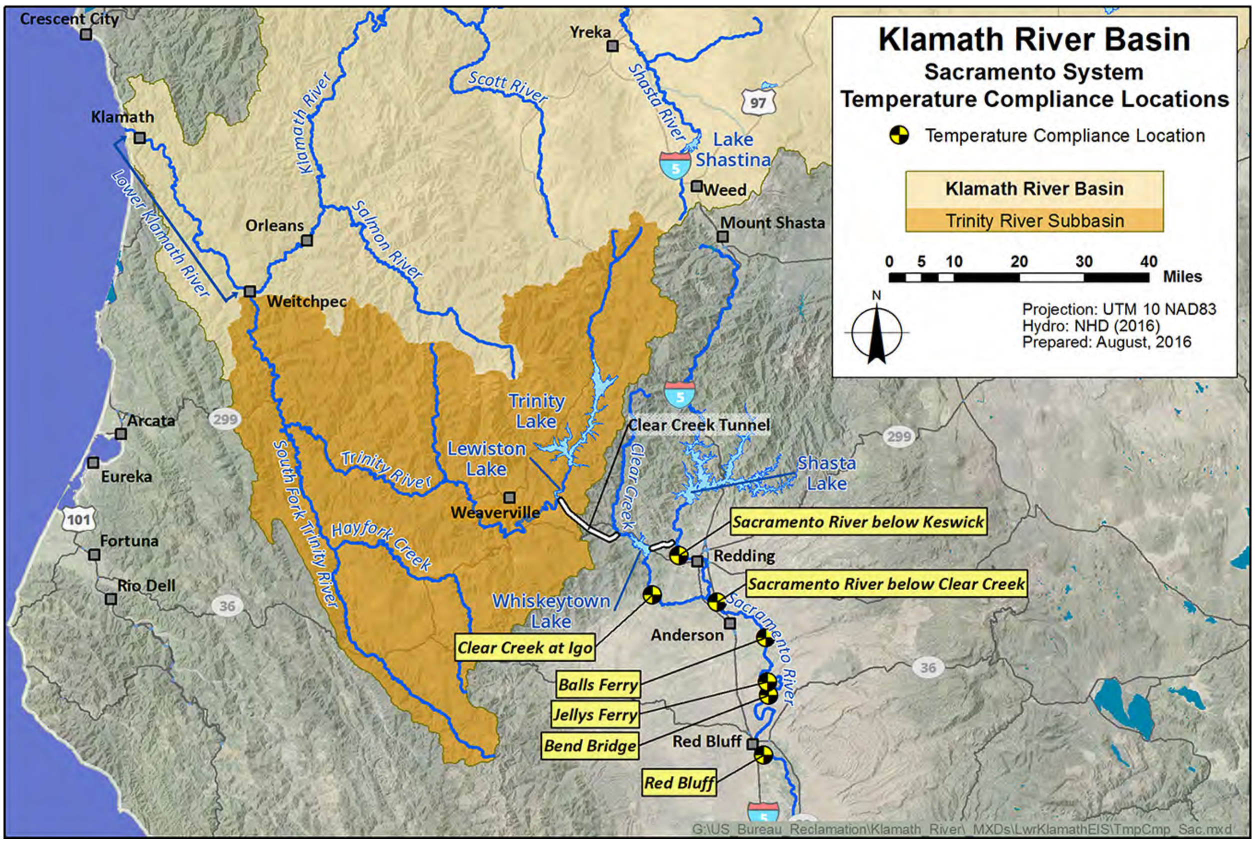


Figure 5-8. Temperature Compliance Stations in the Upper Sacramento River Basin

Table 5-14 and Figure 5-9 depict monthly water temperature data at selected compliance locations in the Sacramento River between 2001 and 2015.

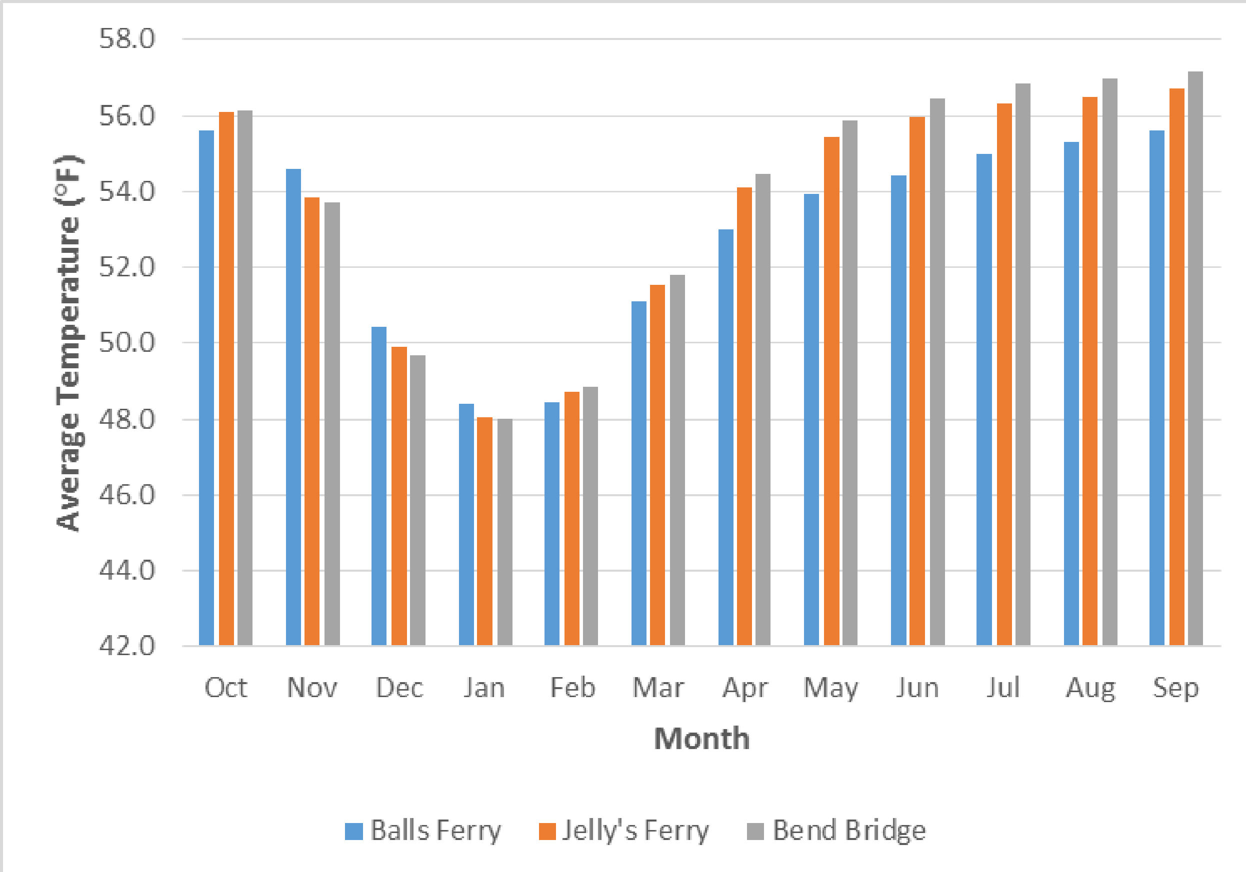
Table 5-14. Monthly Average of Water Temperatures Recorded at Sacramento River Compliance Locations in °F

WY	WYT	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Balls Ferry													
2001	D	55.0	53.2	51.4	47.9	47.0	51.5	52.5	52.9	53.6	54.5	54.3	55.3
2002	D	56.1	54.3	50.0	49.4	48.8	50.5	53.9	53.7	53.7	54.4	54.4	54.0
2003	AN	54.4	54.2	50.0	49.6	49.3	51.7	53.2	53.3	53.5	53.6	54.9	55.4
2004	BN	54.7	52.6	50.2	48.3	47.6	50.9	52.5	53.0	53.7	54.5	54.6	56.7
2005	AN	56.5	54.9	50.6	48.8	50.0	52.1	54.1	54.2	53.5	54.0	55.4	55.6
2006	W	56.2	54.5	50.5	ND	47.8	47.7	49.7	52.7	52.8	53.6	53.8	53.5
2007	D	53.4	52.4	49.7	47.7	48.4	52.0	54.0	52.9	53.8	55.2	55.1	55.7
2008	C	55.9	55.3	50.1	45.7	46.8	49.8	50.9	52.9	55.6	56.0	56.4	57.0
2009	D	58.1	55.8	50.1	47.5	47.8	50.6	51.6	53.8	55.0	56.0	56.0	56.5
2010	BN	56.5	55.1	49.4	48.3	49.6	50.9	52.5	54.0	53.5	53.9	54.2	54.2
2011	W	54.0	51.3	51.2	49.2	48.0	48.8	51.8	54.1	53.6	53.6	54.3	54.0
2012	BN	53.1	51.2	49.6	48.1	48.6	49.6	53.6	54.5	53.4	53.6	54.0	54.1
2013	D	53.6	53.2	49.5	46.6	48.2	50.9	54.8	54.7	54.7	56.0	55.6	54.5
2014	C	55.5	52.8	49.0	48.9	50.1	53.4	55.0	55.7	56.8	57.0	57.9	59.7
2015	C	61.2	68.0	55.1	51.8	ND	56.0	55.2	56.7	59.0	59.0	58.5	57.8
Jellys Ferry													
2001	D	55.5	52.9	51.1	47.5	47.0	52.3	53.6	54.5	54.7	55.6	55.6	56.3
2002	D	56.7	54.4	49.1	47.9	48.6	51.0	55.4	55.1	55.1	55.6	55.5	55.1
2003	AN	54.9	54.1	50.3	50.0	49.0	52.4	53.4	54.5	55.4	55.0	56.0	56.6
2004	BN	55.3	52.5	50.0	47.9	48.1	52.0	54.0	54.7	55.1	55.5	55.8	57.5
2005	AN	56.8	54.6	50.2	48.4	50.3	52.8	55.3	55.6	55.3	55.6	56.7	56.5
2006	W	56.5	54.3	49.9	49.1	48.3	47.9	50.7	54.6	54.8	55.1	55.0	54.6
2007	D	54.2	52.6	49.0	47.1	48.7	52.8	55.0	54.2	54.9	56.6	56.6	56.6
2008	C	56.3	55.4	49.6	45.4	47.0	50.5	52.2	54.5	56.6	56.9	57.3	58.0
2009	D	58.0	55.8	49.8	47.4	47.9	51.2	53.3	55.7	56.4	57.1	57.0	57.8
2010	BN	57.1	54.9	48.9	48.0	49.7	51.7	53.3	55.2	55.4	55.6	55.3	55.2
2011	W	54.6	51.3	50.9	48.9	47.8	48.7	52.2	55.3	55.2	55.0	55.4	55.2
2012	BN	53.7	51.2	49.1	48.1	48.8	49.9	54.4	56.0	54.8	54.6	55.1	55.3
2013	D	54.4	53.3	48.8	46.1	48.1	51.5	55.7	55.7	55.8	57.1	56.8	56.7
2014	C	55.7	52.9	49.1	48.8	49.9	53.3	56.8	57.6	58.8	58.7	59.1	60.7
2015	C	61.4	57.5	52.5	50.0	51.8	54.8	56.5	58.2	61.1	60.9	60.0	58.8
Bend Bridge													
2001	D	55.7	52.8	50.8	47.3	47.0	52.6	54.1	55.0	55.1	56.0	56.0	56.8
2002	D	56.9	54.4	49.0	48.1	48.9	51.2	55.8	55.6	55.6	56.0	56.2	55.6
2003	AN	55.1	53.9	50.2	50.0	49.0	52.6	53.8	54.7	55.9	55.4	56.7	57.0
2004	BN	55.5	52.3	49.4	48.0	48.2	52.2	54.2	55.5	55.6	56.1	56.2	57.9
2005	AN	57.0	54.4	50.0	48.3	50.4	53.1	55.7	55.9	55.5	56.0	57.2	56.9
2006	W	56.6	54.2	50.0	49.2	48.4	48.0	50.7	54.9	55.1	55.6	55.4	54.9
2007	D	54.4	52.3	49.1	46.9	48.8	52.9	55.1	54.9	55.5	56.6	56.6	57.0
2008	C	56.1	55.1	49.3	45.6	47.1	51.0	52.6	55.0	57.4	57.5	57.9	58.5
2009	D	57.4	55.8	49.4	47.3	48.1	52.0	53.6	56.1	56.9	57.7	57.2	58.0
2010	BN	57.0	54.8	48.6	47.9	49.6	51.6	53.3	55.4	55.5	56.2	56.2	55.8
2011	W	54.4	51.0	50.7	49.0	48.0	49.0	52.5	55.7	55.6	55.8	56.2	55.6
2012	BN	53.9	51.3	48.8	47.9	48.9	49.9	54.8	56.5	55.4	55.1	55.5	55.8
2013	D	54.7	53.3	48.6	46.0	48.3	52.1	56.0	55.9	56.3	57.4	57.1	57.2
2014	C	55.8	53.0	48.7	48.6	50.1	53.7	57.5	58.2	59.3	59.3	59.7	61.1
2015	C	61.4	57.1	52.5	49.9	52.1	55.2	57.1	58.8	61.9	61.8	60.7	59.4

Sources: Reclamation 2013 and DWR 2016

Note: WYT is Sacramento 40-30-30 Index.

Key:
AN = Above Normal
BN = Below Normal
C = Critically Dry
D = Dry
W = Wet
WY = Water year
WYT = Water Year Type



Key:
°F = degrees Fahrenheit

Figure 5-9. Monthly Average of Water Temperatures Recorded at Sacramento River Compliance Locations (2001-2015)

Clear Creek from Whiskeytown Dam to the Confluence with the Sacramento River Lower Clear Creek (below Whiskeytown Dam) is 303(d) listed as impaired for mercury, due to mine tailings from gold mining during the 1800s. Otherwise, water quality is considered very good and supportive of all aquatic life and recreational uses (SRWP 2016).

Water Temperature Water temperatures in Lower Clear Creek are influenced by operations of Whiskeytown Dam (including the Spring Creek Temperature Control Curtain) and transfer of water from Trinity Lake to Whiskeytown Lake via the Clear Creek Tunnel. Temperature objectives for Clear Creek below Whiskeytown Dam were originally established in the 2004 CVP/SWP Operations Criteria and Plan (OCAP) (Reclamation 2004) and re-affirmed in the 2009 NMFS BO (NMFS 2009). The standards for daily water temperatures are:

- 60°F at the Igo gage June 1-Sept 15
- 56°F at the Igo gage Sept 15-Oct 31

Table 5-15 and Figure 5-10 depict monthly water temperature data at the Igo gage on Clear Creek from 2001 to 2015.

Table 5-15. Monthly Average of Water Temperatures Recorded at Clear Creek at Igo (2001-2015)

WY	WYT	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Clear Creek at Igo													
2001	D	55.0	53.2	51.4	47.9	47.0	51.5	52.5	52.9	53.6	54.5	54.3	55.3
2002	D	56.1	54.3	50.0	49.4	48.8	50.5	53.9	53.7	53.7	54.4	54.4	54.0
2003	AN	54.4	54.2	50.0	49.6	49.3	51.7	53.2	53.3	53.5	53.6	54.9	55.4
2004	BN	54.7	52.6	50.2	48.3	47.6	50.9	52.5	53.0	53.7	54.5	54.6	56.7
2005	AN	56.5	54.9	50.6	48.8	50.0	52.1	54.1	54.2	53.5	54.0	55.4	55.6
2006	W	56.2	54.5	50.5	ND	47.8	47.7	49.7	52.7	52.8	53.6	53.8	53.5
2007	D	53.4	52.4	49.7	47.7	48.4	52.0	54.0	52.9	53.8	55.2	55.1	55.7
2008	C	55.9	55.3	50.1	45.7	46.8	49.8	50.9	52.9	55.6	56.0	56.4	57.0
2009	D	58.1	55.8	50.1	47.5	47.8	50.6	51.6	53.8	55.0	56.0	56.0	56.5
2010	BN	56.5	55.1	49.4	48.3	49.6	50.9	52.5	54.0	53.5	53.9	54.2	54.2
2011	W	54.0	51.3	51.2	49.2	48.0	48.8	51.8	54.1	53.6	53.6	54.3	54.0
2012	BN	53.1	51.2	49.6	48.1	48.6	49.6	53.6	54.5	53.4	53.6	54.0	54.1
2013	D	53.6	53.2	49.5	46.6	48.2	50.9	54.8	54.7	54.7	56.0	55.6	54.5
2014	C	55.5	52.8	49.0	48.9	50.1	53.4	55.0	55.7	56.8	57.0	57.9	59.7
2015	C	61.2	68.0	55.1	51.8	ND	56.0	55.2	56.7	59.0	59.0	58.5	57.8

Source: DWR 2016

Note:

WYT is Sacramento 40-30-30 Index

Key:

AN = Above Normal
BN = Below Normal
C = Critically Dry
D = Dry
W = Wet
WY = Water year
WYT = Water Year Type

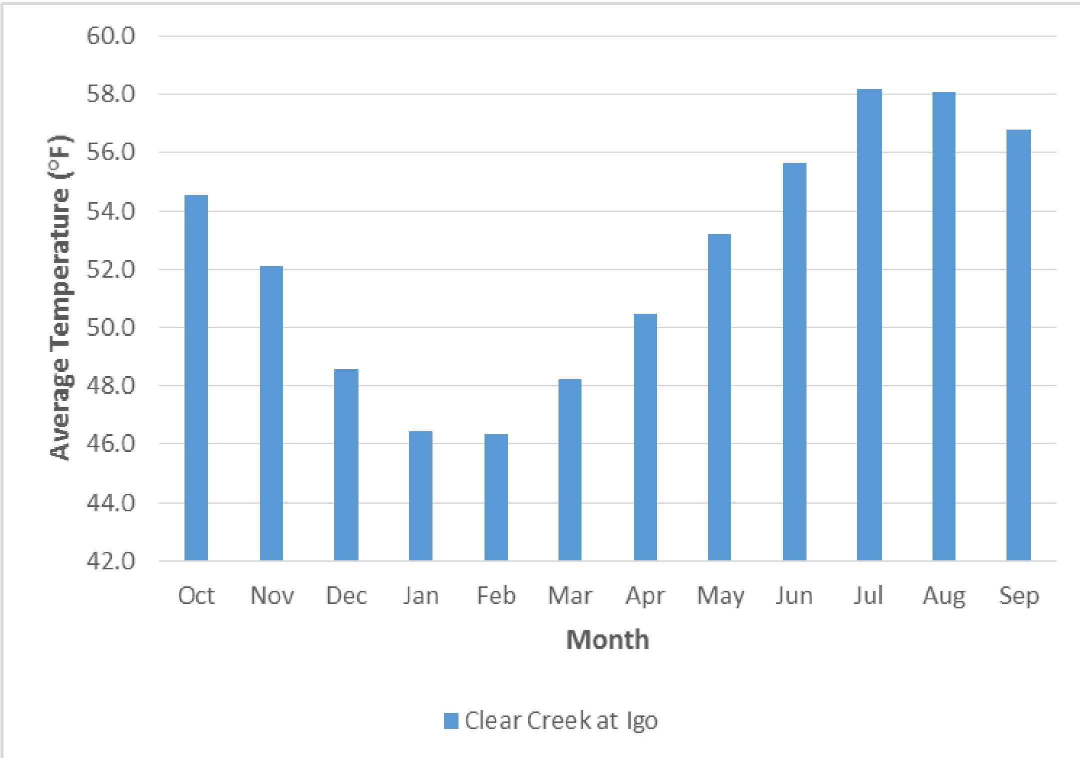


Figure 5-10. Monthly Average of Water Temperatures Recorded on Clear Creek at Igo (2001-2015)

Sacramento River from Verona to Freeport The water quality of the lower Sacramento River is influenced by the upstream sources discussed above, as well as by inflows from the American River and surrounding urban and agricultural runoff. Water temperature is not a major concern in this lower reach of the Sacramento River because the vitality of aquatic species in this reach are not dependent upon temperature.

Feather River from Lake Oroville to the Confluence with the Sacramento River Water quality constituents of concern in the lower Feather River have the potential to affect several supported beneficial uses, including municipal and agricultural water supply, contact and non-contact water recreation, and fish habitat and migration uses for cold and warm water.

Water Temperature The lower Feather River (downstream of Lake Oroville) is not listed on the 303(d) list as impaired by water temperature (SWRCB 2011a). However, water temperature in the lower Feather River is crucial to maintaining freshwater habitat for both warm and cold freshwater fish species in downstream habitats (DWR 2007). The SWP operates Lake Oroville and the Thermalito Reservoir Complex to meet temperature objectives—established through a 1983 agreement with California Department of Fish and Wildlife and BOs issued by NMFS. When necessary, Oroville will release water at different depths through shutters at the intake structures (DWR 2007). Temperature standards are in place for the low flow channel and the high flow channel. The low flow channel is the reach of the river between the Fish Barrier Dam and the confluence with the Thermalito Afterbay Outlet, and it is managed to protect cold water fish species. The high flow channel is the downstream reach of the river, from the Thermalito Afterbay Outlet to the confluence with the Sacramento River.

American River Below Lake Natoma The lower American River flows for 23 miles from Nimbus Dam to its confluence with the Sacramento River. Water quality in this reach of the river is influenced by releases from upstream reservoirs, including Lake Natoma and Folsom Lake. In general, the runoff that flows into Folsom Reservoir and Lake Natoma, upstream of the lower American River, is of high quality (Wallace, Roberts, and Todd et al. 2003). Water quality parameters measured in Folsom Reservoir, upstream of the lower American River, include pH, turbidity, DO total organic carbon, nutrients (nitrogen and phosphorus), electrical conductivity (EC), total dissolved solids, and fecal coliform.

Water Temperature The lower American River is not listed on the 303(d) list as impaired by water temperature (SWRCB 2011a). The lower American River supports warm and cold freshwater habitat beneficial uses, as well as migration and spawning uses. In particular, in-stream rearing of juvenile steelhead requires certain water temperatures which are targeted through water temperature objectives (CVRWQCB 2011, NMFS 2009). Temperature objectives on the American River are defined in NMFS BO Reasonable and Prudent Alternative II.2. The objective is to meet a daily average water temperature of 65°F or lower at Watt Avenue Bridge, from May 15 through October 31. If the 65°F temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then on consultation with NMFS, the target daily average water temperature at Watt Avenue may be increased to as high as 68°F. The CVP operates Folsom Reservoir to meet the temperature objective by using the dam's selective withdrawal structure (shutters), which allows for release elevations to be adjusted based on temperature requirements.

Sacramento-San Joaquin River Delta

Water quality conditions in the Sacramento and San Joaquin Rivers in the Delta are described in this subsection against criteria to protect the beneficial uses as summarized in Table 5-1. The constituents of concern that are currently not in compliance with existing water quality standards, and for which TMDLs are adopted or are in development in this region.

Salinity Delta waterways were placed on the Section 303(d) List approved by the USEPA in 2010 as impaired by EC (SWRCB 2011a). EC is linked to salinity and salinity is of particular concern in the tidally-influenced Delta (CVRWQCB 2011, CALFED 2007).

EC in Delta waterways (i.e., export area, northwestern portion, southern portion, and western portion) can be attributed to runoff from agricultural practices (SWRCB 2011h-k). Salinity in the Delta can vary significantly depending on several factors including hydrology, water operations, and Delta hydrodynamics (Jassby et al. 1995). Hydrology and upstream water operations influence the Delta inflows, which in turn influences the balance with the highly saline seawater intrusion. Various upstream watershed sources determine the quality of the Delta inflows, in addition to the in-Delta sources such as agricultural returns, natural leaching, and M&I discharges that influence the Delta salinity conditions. Operation of various Delta gates and barriers, pumping rates of various diversions, and volume of the open water bodies are the other key factors that influence the Delta hydrodynamics and salinity transport in the Delta.

The CVP and SWP are operated to achieve salinity objectives in the Delta under SWRCB D-1641. The requirements in SWRCB D-1641 define water quality objectives to protect agricultural, M&I, and fishery uses, and they vary throughout the year and sometimes by water year type. Objectives are specific to the western Delta, interior Delta, southern Delta and export area, as well as for inflows and outflows to the Delta from other water bodies. Compliance locations that will be analyzed here are Rock Slough and Banks Pumping Plants (M&I); Emmaton, Jersey Point, and C.W. Jones Pumping Plant (Jones Pumping Plant) (agriculture); and Collinsville (fish and wildlife).

The patterns of EC and salinity in the Delta, over time and space, follow predictable patterns—under the strong influence of higher saline water from the San Joaquin, and less saline water from the Sacramento and Eastside streams—in an ever-changing balance with tidal influence upstream from Suisun Bay, and the losses from south Delta pumping. The highest salinity occurs in the late summer months when the flows from the Sacramento and San Joaquin Rivers are the lowest, and sea water intrusion occurs. The lower Sacramento River at Collinsville experiences strong tidal influence during dry periods (EC above 8000 µmhos/cm), but is flushed with freshwater during winter flows.

For fish and wildlife protection, the SWRCB D-1641 also includes spring X2 criteria. The criteria require CVP and SWP operations to include upstream reservoir releases, from February through June, to maintain freshwater and estuarine conditions in the western Delta to protect aquatic life. In addition, the 2008 USFWS BO also includes an additional Delta salinity requirement in September and October in wet and above normal water years (Fall X2). X2 requirements are set in terms of maintaining X2 at, or westward of, three locations (Chipps Island, Roe Island and Collinsville). The number of days required at each location change, depending on the month and hydrologic condition.

Impact Analysis

Potential Mechanisms for Change and Analytical Methods

As described in Chapter 3, "Considerations for Describing Affected Environment and Environmental Consequences," the impact analysis considers changes in surface water quality conditions related to changes in CVP and SWP operations under the alternatives, as compared to the No Action Alternative.

Changes in CVP and SWP operations (under the alternatives as compared to the No Action Alternative) could result in changes to surface water quality, due to changes in reservoir storage levels and river flows. Based on the discussion above, the following water quality changes are further analyzed in the *Evaluation of Alternatives* section.

As described in the section on *Affected Environment*, there are numerous constituents of concern that have been identified in the study area. These components are not all critical in each region, and they may not all be affected by changes in CVP and SWP operations considered in the EIS alternatives. The groups of constituents that could be affected by implementation of the alternatives have been identified through consideration of constituents of concern, described in the section on *Affected Environment*, and the anticipated implementation of TMDLs by 2030.

These constituents were grouped into major categories, as shown in Table 5-16. The constituents that already have approved TMDLs in certain regions are not further analyzed for those regions, as it is expected that the TMDL will be implemented by 2030. A complete list of TMDLs, and their anticipated completion dates.

Table 5-16. List of Surface Water Quality Constituents Considered for this Analysis

Constituent/Parameter Group	Individual Constituents/Parameters
Water Temperature	Water Temperature (Fahrenheit)
Salinity Indicators	Electrical Conductivity, Chloride, Delta X2
Nutrients (Klamath River Region Only)	Nitrate, Phosphorous
Dissolved Oxygen (Klamath River Region Only)	Dissolved Oxygen

Changes in Water Temperature

Changes in CVP and SWP operations would change water temperatures in rivers downstream of CVP and SWP reservoirs. Changes in water temperature are analyzed in comparison to the relevant temperature standards. Further analysis of the impacts of temperature changes on fisheries and aquatic habitat is presented Chapter 7, “Biological Resources – Fisheries.”

Temperature conditions on the Sacramento River, Clear Creek, and Trinity River at Lewiston were analyzed using the Trinity-Sacramento River HEC-5Q model. The HEC-5Q model simulates daily temperatures for the Trinity River (downstream of Lewiston Dam), Clear Creek (from Whiskeytown Dam to the Sacramento River confluence), and the Sacramento River (from Keswick Dam to the Feather River confluence). CalSim outputs were used to provide flow and storage inputs for HEC-5Q. Additional description of the HEC-5Q is provided in the Analytical Tools Technical Appendix.

Temperature conditions on the Trinity River (below Lewiston and on the lower Klamath River) were analyzed using the RBM10 model. RBM10 is a one-dimensional (laterally and depth averaged) water temperature model producing longitudinal temperature conditions in a river system (Yearsley et al. 2001, Yearsley 2009). RBM10 simulates daily temperatures and flows for locations along the Trinity River and Klamath Rivers. Upstream boundary conditions for RBM10 at Lewiston Dam are provided by HEC-5Q model outputs. Specific details of the Trinity River and Klamath River RBM10 models are provided in Jones et al. (2016) and Perry et al. (2011), respectively. For further description of RBM10 see the Analytical Tools Technical Appendix.

The analysis uses average water monthly temperatures to provide a comparison of the ability of the operations considered (under alternatives) to meet water temperature objectives. Monthly averages of temperatures do not allow a direct comparison to the temperature objectives, and the effects of daily (or hourly) temperature swings are likely masked by the averaging process. Nonetheless, the average monthly water temperatures provide the basis for a coarse evaluation of the likelihood that temperature objectives would be exceeded, on a more or less frequent basis, in one alternative versus another.

In addition, for the Trinity and lower Klamath Rivers, the number of days when temperature objectives are exceeded is also analyzed. Daily results for the Sacramento River and Clear Creek are not analyzed because flows in HEC-5Q in the Sacramento Basin (based on CalSim II outputs) are monthly averages only. While meteorological conditions are modeled in HEC-5Q on a sub-daily basis, the lack of daily flow patterning means that daily temperature model results will not be meaningful for assessing the frequency with which temperature objectives are met. Releases from Lewiston are patterned on a daily basis, so RBM10 results can be used to evaluate the number of days when temperature objectives are exceeded. The Analytical Tools Technical Appendix provides additional information on the RBM10 model, including the daily patterning of monthly CalSim II Lewiston releases prior to input into RBM10.

Changes in Salinity

Changes in salinity due to changes in CVP and SWP operations would be focused in the Delta. Salinity indicators generally considered in this analysis include EC, chloride, and X2.

The *DSM2*, a one-dimensional hydrodynamic and water quality simulation model, is used to evaluate changes in salinity (as represented by EC) in the Delta and at the CVP/SWP export locations. CalSim II outputs are used to evaluate changes in location of X2 in the Delta. For further description of DSM2 and CalSim II see the Analytical Tools Technical Appendix.

Changes in Nutrients, Organic Matter, and Dissolved Oxygen

Analysis of changes in nutrients, organic matter, and DO—due to changes in CVP operations—is qualitative and focused in the Lower Klamath and Trinity River Region.

Evaluation of Alternatives

As described in Chapter 3, "Considerations for Describing Affected Environment and Environmental Consequences," the action alternatives have been compared to the No Action Alternative.

No Action Alternative

Under the No Action Alternative, surface water quality would be comparable to the conditions described in the *Affected Environment* section of this chapter. Conditions in 2030 would be different than existing conditions—primarily due to climate change and sea-level rise, general plan development throughout California, and implementation of reasonable and foreseeable water resource management projects to provide water supplies. It is anticipated that climate change will result in a shift in winter precipitation from snow to rain, which will lead to larger runoff events in the winter and less snowmelt in the spring. Reservoir storage in turn will be reduced, because of the need to maintain flood space in the winter versus being able to store more predictable snowmelt-driven flows in the spring. Lower reservoir storages, combined with increases in ambient air temperatures, are expected to causes increases in water temperatures downstream of CVP and SWP reservoirs, compared to recent historical conditions. Sea-level rise is also likely to cause increased salinities in the Delta—and more eastward locations for X2—compared to recent historical conditions.

Proposed Action (Alternative 1)

Lower Klamath and Trinity River Region

Changes in Water Temperature

Trinity River: Lewiston Dam to the Klamath River Temperature impacts on the Trinity River (below Lewiston Dam) are evaluated by (1) comparing temperatures for the No Action Alternative with Alternative 1 at Trinity River below Lewiston Dam; Trinity River at Douglas City; Trinity River below North Fork Trinity River; Trinity River below South Fork Trinity

River; and Trinity River near mouth (Weitchpec); and (2) comparing the numbers of days (in the No Action Alternative and Alternative 1) that water temperatures exceeded water temperature objectives in the Trinity River identified in Table 5-3, above.

Temperatures below Lewiston Dam under Alternative 1 are similar to the No Action Alternative in most year types, and in most months, as shown in Table 5-17. In extremely wet, wet, and dry years, the monthly average water temperatures for Alternative 1 were within +/-0.5°F (less than 1 percent) of No Action conditions. In normal years, the maximum deviation is 1.3°F warmer (2 percent) in October, and for the remainder of the year changes in temperatures were less than +/-1.0°F (less than 2 percent). For the critically dry years, temperatures were up to 2.7°F (5 percent) warmer in July, and 1.0°F (-2 percent) and 1.7°F (-3 percent) cooler in August and September, respectively.

Table 5-17. Changes in Trinity River Temperature Below Lewiston Dam Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	52.4	50.9	47.8	45.4	45.3	45.8	47.7	46.2	47.8	51.0	53.1	50.4
Wet	52.3	51.8	49.3	48.1	47.3	49.7	51.2	46.6	49.5	52.3	52.2	51.8
Normal	54.8	54.2	49.2	47.4	48.5	51.9	54.6	46.7	51.3	51.9	53.3	53.3
Dry	53.1	51.7	50.5	49.5	49.7	52.0	53.3	49.4	53.2	52.8	53.3	54.0
Critically Dry	55.0	50.2	50.4	51.1	51.9	51.3	52.9	52.0	54.9	54.9	57.5	57.5
Average All Years	53.0	51.7	49.5	48.2	48.2	50.0	51.7	47.8	50.9	52.4	53.2	52.9
Alternative 1 (°F)												
Extremely Wet	52.7	50.9	47.8	45.3	45.3	45.8	47.7	46.2	47.8	51.0	52.8	50.6
Wet	52.6	52.3	49.3	48.1	47.3	49.6	51.1	46.5	49.5	52.3	52.2	52.0
Normal	56.1	54.7	50.1	48.1	48.5	51.8	54.5	46.6	51.3	52.4	52.9	52.7
Dry	53.3	51.7	50.1	49.5	49.7	52.0	53.2	49.4	53.1	52.6	53.4	54.1
Critically Dry	55.1	50.2	50.7	51.2	52.0	51.7	52.9	52.1	54.9	57.6	56.5	55.8
Average All Years	53.3	51.9	49.5	48.3	48.2	50.0	51.6	47.8	50.9	52.7	53.1	52.8
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.3	0.1	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.0	-0.4	0.2
Wet	0.3	0.5	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.2
Normal	1.3	0.5	0.9	0.7	0.0	0.0	0.0	0.0	0.0	0.4	-0.4	-0.6
Dry	0.2	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.1	0.0
Critically Dry	0.2	0.1	0.3	0.2	0.1	0.4	0.0	0.0	0.0	2.7	-1.0	-1.7
Average All Years	0.3	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	-0.1	-0.1
No Action compared to Alternative 1 (%)												
Extremely Wet	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Wet	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	2%	1%	2%	1%	0%	0%	0%	0%	0%	1%	-1%	-1%
Dry	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critically Dry	0%	0%	1%	0%	0%	1%	0%	0%	0%	5%	-2%	-3%
Average All Years	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Temperatures at Douglas City under Alternative 1 are similar to under the No Action Alternative, in most year types and in most months, as shown in Table 5-18. In extremely wet, wet, and dry years, the monthly average water temperatures for Alternative 1 were within +/-0.5°F (less than 1 percent) of No Action conditions. In normal years, the maximum deviation was 1.1°F warmer (2 percent) in October, and for the remainder of the year changes in temperature were less than +/-1.0°F (less than 2 percent). For the critically dry years temperatures were 2.4°F (4 percent) warmer in July, and 1.0°F (-2 percent) and 1.7°F (-3 percent) cooler in August and September, respectively.

Table 5-18. Changes in Trinity River Temperature at Douglas City Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	52.2	49.3	46.0	43.2	44.3	44.9	46.8	47.1	48.6	52.5	54.8	51.4
Wet	52.1	50.2	47.0	45.1	45.3	47.8	49.5	47.2	50.3	53.5	53.5	52.3
Normal	54.4	51.5	45.9	43.9	45.3	47.1	52.7	47.1	52.0	52.9	54.1	53.7
Dry	52.8	50.2	47.8	46.4	46.4	48.8	51.9	49.8	54.1	54.2	54.1	54.2
Critically Dry	54.5	49.3	48.4	48.3	48.7	48.5	51.3	52.2	55.4	56.0	57.7	57.4
Average All Years	52.7	50.1	47.1	45.3	45.7	47.6	50.2	48.4	51.8	53.7	54.3	53.3
Alternative 1 (°F)												
Extremely Wet	52.4	49.3	45.9	43.2	44.3	44.9	46.8	47.1	48.6	52.5	54.5	51.6
Wet	52.4	50.6	47.0	45.1	45.2	47.8	49.5	47.1	50.3	53.6	53.5	52.5
Normal	55.5	51.7	46.3	44.1	45.3	47.1	52.7	47.1	51.9	53.3	53.6	52.9
Dry	52.9	50.2	47.5	46.5	46.5	48.8	51.9	49.8	54.1	54.0	54.1	54.1
Critically Dry	54.6	49.4	48.7	48.4	48.7	48.7	51.3	52.3	55.4	58.3	56.8	55.8
Average All Years	53.0	50.3	47.1	45.4	45.8	47.6	50.2	48.4	51.8	53.9	54.1	53.1
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.3	0.2
Wet	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Normal	1.1	0.3	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.4	-0.5	-0.8
Dry	0.1	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1
Critically Dry	0.1	0.1	0.2	0.1	0.1	0.2	0.0	0.0	0.0	2.4	-1.0	-1.7
Average All Years	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.2	-0.2
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Wet	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	2%	1%	1%	0%	0%	0%	0%	0%	0%	1%	-1%	-2%
Dry	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	-2%	-3%
Average All Years	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

At the North Fork Trinity River, South Fork Trinity River and Weitchpec (Table 5-19 through Table 5-21, respectively), differences in temperature for all year types (for all months) were less than +/-1°F (1 percent) with the exception of normal, dry, and critically dry year types in August and September. Temperatures were consistently cooler than No Action conditions in these two months, by up to 6.6°F (-2 percent to -9 percent). Decreases in temperature in August and September were due to flow increases (associated with augmentation releases from Lewiston Dam that were drawn from cool, deep water releases from Trinity Reservoir), while minor increases or decreases in the other months of the year were due to changes in Trinity Lake operations, impacting storage in Trinity Lake storage or release rate and residence time in Lewiston Reservoir.

Table 5-19. Changes in Trinity River Temperature at North Fork Trinity River Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	53.9	47.3	43.6	41.9	43.9	45.0	47.6	50.1	52.5	59.7	64.5	58.4
Wet	54.4	48.5	44.3	43.2	44.2	47.7	50.5	50.2	55.2	61.9	63.6	58.9
Normal	56.9	49.0	43.0	41.8	43.8	46.3	54.3	50.2	57.3	61.8	64.1	60.0
Dry	54.7	48.5	44.6	43.8	44.8	48.5	53.8	53.4	61.7	65.4	63.9	60.2
Critically Dry	56.0	47.7	44.3	45.0	46.8	48.0	53.1	55.9	62.4	67.2	66.8	63.5
Average All Years	54.8	48.3	44.2	43.2	44.5	47.4	51.6	51.6	57.5	63.0	64.2	59.7
Alternative 1 (°F)												
Extremely Wet	54.0	47.4	43.6	41.9	43.9	45.0	47.6	50.1	52.5	59.7	64.3	58.5
Wet	54.6	48.7	44.3	43.2	44.2	47.7	50.5	50.2	55.2	61.9	63.3	58.8
Normal	57.7	49.1	43.1	41.9	43.8	46.3	54.3	50.2	57.2	62.1	62.5	56.8
Dry	54.8	48.5	44.4	43.8	44.9	48.5	53.8	53.4	61.7	65.2	63.0	58.5
Critically Dry	56.1	47.7	44.5	45.1	46.8	48.1	53.1	55.9	62.4	68.9	64.6	59.5
Average All Years	55.0	48.4	44.1	43.2	44.5	47.4	51.6	51.6	57.5	63.2	63.4	58.6
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.1
Wet	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1
Normal	0.8	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.3	-1.6	-3.3
Dry	0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-1.7
Critically Dry	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	1.7	-2.2	-4.0
Average All Years	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.7	-1.2
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-5%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-3%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	-3%	-6%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-20. Changes in Trinity River Temperature at South Fork Trinity River Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.7	49.0	44.7	43.3	46.2	47.5	49.6	54.2	57.9	66.6	72.2	66.0
Wet	57.7	50.0	44.9	44.4	45.9	49.7	52.7	53.8	60.4	68.4	72.0	65.4
Normal	59.3	50.9	44.2	42.7	44.5	47.6	57.3	54.0	62.6	68.9	72.1	66.1
Dry	58.0	49.7	44.8	44.0	45.8	50.0	55.9	57.3	67.2	74.0	72.5	66.1
Critically Dry	58.8	47.8	42.9	44.3	46.9	48.8	54.5	58.8	66.5	75.2	74.1	69.1
Average All Years	57.9	49.6	44.6	43.9	45.9	49.1	53.7	55.4	62.8	70.4	72.4	66.1
Alternative 1 (°F)												
Extremely Wet	56.8	49.0	44.7	43.3	46.2	47.5	49.6	54.2	57.9	66.6	72.1	66.0
Wet	57.7	50.1	44.9	44.4	45.9	49.7	52.7	53.8	60.4	68.4	71.6	65.0
Normal	59.7	50.9	44.2	42.7	44.5	47.6	57.3	54.0	62.5	69.0	69.8	60.7
Dry	58.1	49.7	44.7	44.0	45.8	50.0	55.9	57.3	67.2	74.0	70.9	62.8
Critically Dry	58.8	47.8	43.0	44.3	46.9	48.9	54.5	58.8	66.5	76.0	71.2	62.7
Average All Years	57.9	49.6	44.6	43.9	45.9	49.1	53.7	55.4	62.8	70.5	71.3	63.9
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Wet	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.3
Normal	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-2.3	-5.4
Dry	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.7	-3.3
Critically Dry	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-3.0	-6.4
Average All Years	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-1.1	-2.1
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%
Normal	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-8%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-5%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	-4%	-9%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-3%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-21. Changes in Trinity River Temperature at Mouth of Trinity River (Weitchpec) Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.7	48.8	44.7	43.4	46.3	47.6	49.8	54.6	58.3	67.1	72.4	66.3
Wet	57.7	49.6	44.9	44.5	46.1	49.8	52.9	54.3	61.1	69.0	72.7	65.9
Normal	59.5	50.7	44.2	42.8	44.6	47.7	57.4	54.6	63.5	69.7	73.0	67.0
Dry	58.0	49.4	44.6	44.0	45.9	50.1	56.2	57.9	67.8	75.0	73.7	66.8
Critically Dry	58.6	47.7	42.6	44.1	47.0	49.0	54.9	59.5	67.3	76.2	75.2	69.9
Average All Years	57.9	49.3	44.5	44.0	46.0	49.3	53.9	55.9	63.4	71.2	73.2	66.7
Alternative 1 (°F)												
Extremely Wet	56.8	48.9	44.7	43.4	46.3	47.6	49.8	54.6	58.3	67.1	72.3	66.3
Wet	57.7	49.7	44.9	44.5	46.1	49.8	52.9	54.3	61.1	69.0	72.4	65.5
Normal	59.8	50.7	44.3	42.8	44.6	47.7	57.4	54.6	63.4	69.8	70.9	61.3
Dry	58.1	49.4	44.6	44.0	46.0	50.1	56.2	57.9	67.8	74.9	72.1	63.4
Critically Dry	58.7	47.7	42.7	44.2	47.0	49.0	54.9	59.5	67.3	76.8	72.4	63.3
Average All Years	57.9	49.4	44.5	44.0	46.0	49.3	53.9	55.9	63.4	71.2	72.2	64.4
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Wet	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4
Normal	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-2.1	-5.7
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.6	-3.5
Critically Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-2.8	-6.6
Average All Years	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-2.3
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%
Normal	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-9%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-5%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	-4%	-9%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-3%

Key:
% = percent
ºF = degrees Fahrenheit

Potential impacts on existing temperature objectives in the Trinity River (Table 5-) were assessed for the specific periods when objectives were applicable. A comparison of No Action versus Alternative 1 for the 1980 to 2003 RBM10 simulation period was completed to assess the frequency (number of days) of meeting temperature objectives based on daily average water temperature. In most years, temperature objectives were met throughout the designated temperature management period. However, there were periods objectives were not met, including:

- Increased frequency of meeting objectives under Alternative 1 compared to the No Action
- Decreased frequency of meeting objectives under Alternative 1 compared to the No Action than Alternative 1
- Equal frequency of meeting objectives for both No Action and Alternative 1.

The number of days that the objectives were not achieved is summarized in tabular form for the stipulated temperature objectives (i.e., temperature for each location and time period).

Noncompliance days for the Trinity River (at Douglas City between July 1 and September 30) are shown in Table 5-22. Temperature objectives at this location were largely met except in drier year types. Noncompliance for No Action and Alternative 1 occurred 40 and 46 days, respectively, between July 1 and September 15. Noncompliance for No Action and Alternative 1 occurred 27 and 31 days, respectively, between September 15 and September 30. The difference in non-compliance, between No Action and Alternative 1 at Douglas City, was 1 percent or less.

Noncompliance days for the Trinity River below North Fork Trinity River (between October 1 and December 31) are shown in Table 5-24. Temperature objectives at this location were not met as often as at Douglas City, being further downstream and influenced by atmospheric heating and tributary inputs. Noncompliance for No Action and Alternative 1 occurred 244 and 274 days, respectively, between October 1 and December 31. The difference in non-compliance, between No Action and Alternative 1 at North Fork Trinity River, was 1 percent.

The spring time objectives from the Record of Decision (ROD) for the Trinity River Trinity River Mainstem Fishery Restoration EIS/Environmental Impact Report (EIR) were also assessed (USFWS et al. 2000; DOI and Hoopa Valley Tribe 2000). These daily average water temperature objectives are applicable to the Trinity River, from Lewiston Dam to the confluence with the Klamath River. For this analysis, the number of non-compliance days for No Action and Alternative 1 were compared for all years in the RBM10 simulation period (1980-2003). Five locations were assessed: Trinity River below Lewiston Dam, Trinity River at Douglas City, Trinity River below North Fork Trinity River, Trinity River below South Fork Trinity River, and Trinity River near Weitchpec (Table 5-24 through Table 5-28, respectively). For the Trinity River (below Lewiston Dam and at Douglas City) there were few incidences of temperatures exceeding objectives—only a few days between April 15 and May 22. At the North Fork Trinity River the number of days increased slightly, but at the South Fork Trinity River and mouth locations, there was a high prevalence of non-compliance—with percentage of time exceeding objectives ranging from 18 percent to over 90 percent—with dry and critically dry years experiencing the highest percentages in June. However, the difference between the No Action and Alternative 1 was less than 1 percent in all cases, indicating that these two alternatives were nearly identical in temperature response.

Table 5-22. Number of Days that No Action Alternative and Alternative 1 Temperatures at Douglas City Exceeded Basin Plan Temperature Objectives

Basin Plan Temperature Objective: Lewiston to Douglas City (RM 111 to RM 92)		**7/1 to 9/15 ≤ 60°F**		**9/15 to 9/30 ≤ 56°F**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	0	0	0	0
1981	D	0	0	0	0
1982	EW	0	0	0	0
1983	EW	0	0	0	0
1984	W	0	0	0	0
1985	D	0	0	0	0
1986	W	0	0	0	0
1987	D	0	0	0	0
1988	D	0	0	0	0
1989	N	0	0	0	0
1990	D	0	0	7	**2**
1991	CD	33	<u>**37**</u>	15	15
1992	D	0	0	5	<u>**14**</u>
1993	W	1	<u>**2**</u>	0	0
1994	CD	0	0	0	0
1995	EW	6	6	0	0
1996	W	0	0	0	0
1997	W	0	0	0	0
1998	EW	0	0	0	0
1999	W	0	<u>**1**</u>	0	0
2000	W	0	0	0	0
2001	D	0	0	0	0
2002	N	0	0	0	0
2003	EW	0	0	0	0
# of Days of Non-compliance		40	46	27	31
Total # of Days		1,848	1,848	384	384
%		2%	2%	7%	8%

Note:
Bold values denote less days of non-compliance and <u>**bold underline**</u> days denote more days of non-compliance
Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-23. Number of Days that No Action Alternative and Alternative 1 Temperatures at Trinity River Below North Fork Trinity River Exceeded Basin Plan Temperature Objectives

Basin Plan Temperature Objective: **Lewiston to North Fork Trinity River Confluence** **(RM 111 to RM 72)**		**10/1 to 12/31** **≤ 56°F**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**
1980	W	10	10
1981	D	1	**<u>4</u>**
1982	EW	1	1
1983	EW	7	7
1984	W	1	1
1985	D	9	9
1986	W	2	2
1987	D	23	**<u>28</u>**
1988	D	22	**<u>24</u>**
1989	N	20	20
1990	D	11	11
1991	CD	22	22
1992	D	26	26
1993	W	10	**<u>14</u>**
1994	CD	14	**<u>18</u>**
1995	EW	0	0
1996	W	11	11
1997	W	1	1
1998	EW	1	1
1999	W	8	8
2000	W	9	9
2001	D	19	**<u>22</u>**
2002	N	6	**<u>15</u>**
2003	EW	10	10
# of Days of Non-compliance		244	274
Total # of Days		2,208	2,208
%		11%	12%

Note:
Bold values denote less days of non-compliance and **<u>bold underline</u>** days denote more days of non-compliance
Key:
% = percent
ºF = degrees Fahrenheit CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-24. Number of Days that No Action Alternative and Alternative 1 Average Daily Water Temperatures at Trinity River Below Lewiston Dam Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4°F (for N, W & EW years) ≤ 59.0°F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0°F (for N, W & EW years) ≤ 62.6°F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6°F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0°F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	6	6	0	0	0	0
1981	D	0	0	0	0	0	0
1982	EW	0	0	0	0	0	0
1983	EW	0	0	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	0
1986	W	0	0	0	0	0	0
1987	D	0	0	0	0	0	0
1988	D	0	0	0	0	0	0
1989	N	8	8	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	0	0	0	0
1993	W	0	0	0	0	0	0
1994	CD	0	0	0	0	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	5	5	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	0	0	0	0	0	0
2002	N	0	0	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		19	19	0	0	0	0
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		2%	2%	0%	0%	0%/0%	0%/0%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-25. Number of Days that No Action Alternative and Alternative 1 Temperatures at Trinity River near Douglas City Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22** **≤ 55.4°F (for N, W & EW years)** **≤ 59.0°F (for D & CD years)**		**5/23 to 6/4** **≤ 59.0°F (for N, W & EW years)** **≤ 62.6°F (for D & CD years)**		**6/5 to 7/9** **≤ 62.6°F (for N, W & EW years)** **6/5 to 6/15** **≤ 68.0°F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	0	0	0	0	0	0
1981	D	0	0	0	0	0	0
1982	EW	0	0	0	0	0	0
1983	EW	0	0	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	0
1986	W	0	0	0	0	0	0
1987	D	0	0	0	0	0	0
1988	D	0	0	0	0	0	0
1989	N	7	7	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	0	0	0	0
1993	W	0	0	0	0	0	0
1994	CD	0	0	0	0	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	0	0	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	0	0	0	0	0	0
2002	N	0	0	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		7	7	0	0	0	0
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		1%	1%	0%	0%	0%/0%	0%/0%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-26. Number of Days that No Action Alternative and Alternative 1 Temperatures at Trinity River at the North Fork Trinity River Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		4/15 to 5/22 ≤ 55.4°F (for N, W & EW years) ≤ 59.0°F (for D & CD years)		5/23 to 6/4 ≤ 59.0°F (for N, W & EW years) ≤ 62.6°F (for D & CD years)		6/5 to 7/9 ≤ 62.6°F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0°F (for D & CD years)	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	2	2	0	0	0	0
1981	D	0	0	0	0	1	1
1982	EW	0	0	0	0	0	0
1983	EW	1	1	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	0
1986	W	0	0	0	0	0	0
1987	D	1	1	0	0	0	0
1988	D	0	0	0	0	2	2
1989	N	7	7	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	1	1	3	3
1993	W	0	0	0	0	0	0
1994	CD	7	7	0	0	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	3	3	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	3	3	0	0	0	0
2002	N	3	3	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		27	27	1	1	0/6	0/6
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		3%	3%	0%	0%	0%/6%	0%/6%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-27. Number of Days that No Action Alternative and Alternative 1 Temperatures at Trinity River Below South Fork Trinity River Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4°F (for N, W & EW years) ≤ 59.0°F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0°F (for N, W & EW years) ≤ 62.6°F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6°F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0°F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	24	24	0	0	0	0
1981	D	4	4	8	8	0	0
1982	EW	22	22	0	0	0	0
1983	EW	6	6	7	7	2	2
1984	W	3	3	0	0	21	21
1985	D	4	4	0	0	5	5
1986	W	6	6	3	3	14	14
1987	D	16	16	2	2	3	3
1988	D	2	2	0	0	0	0
1989	N	15	15	3	3	24	25
1990	D	9	9	0	0	0	0
1991	CD	0	0	0	1	3	3
1992	D	4	4	11	11	5	5
1993	W	7	7	0	0	23	23
1994	CD	16	16	11	11	2	2
1995	EW	4	4	0	0	14	14
1996	W	13	13	1	1	17	16
1997	W	23	23	0	0	9	9
1998	EW	18	18	0	0	4	4
1999	W	10	10	0	0	17	17
2000	W	6	6	0	0	19	19
2001	D	11	11	11	11	0	0
2002	N	10	10	6	6	18	18
2003	EW	0	0	0	0	5	4
# of days of Non-compliance		233	233	63	64	187/18	186/18
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		26%	26%	18%	18%	22%/18%	22%/18%

Key:
% = percent
°F = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-28. Number of Days that No Action Alternative and Alternative 1 Temperatures at Trinity River Near Weitchpec Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4°F (for N, W & EW years) ≤ 59.0°F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0°F (for N, W & EW years) ≤ 62.6°F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6°F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0°F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**	**No Action**	**Alt. 1**
1980	W	24	24	0	0	10	10
1981	D	4	4	8	8	0	0
1982	EW	23	23	0	0	1	1
1983	EW	7	7	8	7	3	3
1984	W	4	4	0	0	24	24
1985	D	4	4	0	0	5	5
1986	W	7	7	4	4	20	20
1987	D	18	18	3	3	4	4
1988	D	3	3	2	2	0	0
1989	N	19	19	3	3	30	32
1990	D	9	9	0	0	0	0
1991	CD	1	1	2	2	4	5
1992	D	10	10	12	12	7	7
1993	W	10	10	0	0	23	23
1994	CD	18	18	12	12	4	4
1995	EW	5	5	0	0	14	14
1996	W	14	14	1	1	20	20
1997	W	28	29	1	0	16	16
1998	EW	18	18	0	0	5	5
1999	W	10	10	2	2	20	20
2000	W	8	8	0	0	20	20
2001	D	13	13	13	13	0	0
2002	N	12	12	6	6	30	30
2003	EW	0	0	0	0	12	12
# of days of Non-compliance		269	270	77	75	248/24	250/25
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		30%	30%	21%	21%	30%/24%	30%/25%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Klamath River: Below Trinity River The temperature impacts associated with Alternative 1 for Klamath River temperatures (near Klamath) were evaluated by comparing the simulated temperatures of the No Action Alternative and Alternative 1. A comparison of daily water temperature (averaged by month for Alternative 1 and No Action temperatures) is presented for each location, and tabular monthly averages are presented in Table 5-29. The alternatives identified herein do not increase the water temperature by 5°F (NCRWQCB 2011). Unlike the Trinity River, there are no site and location specific temperature objectives for the lower Klamath River.

Water temperatures at Klamath River (near Klamath) under Alternative 1 were similar to the No Action Alternative in most year types, and in most months, except August and September. In extremely wet and wet years, the monthly average water temperatures for Alternative 1 were within +/-0.5°F (less than 1 percent) of No Action conditions. For the normal, dry, and critically dry years, temperatures were 1.8°F (3 percent) to 4.0°F (6 percent) cooler. Temperatures in the Klamath River (at Klamath) did not exhibit the same magnitude of cooling, due to water comingling and heating from the confluence of the Trinity River through to the Klamath River Estuary.

Table 5-29. Changes in Klamath River near Klamath Water Temperature Under Alternative 1 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.6	48.6	43.7	42.7	45.6	47.6	49.9	56.2	61.4	69.3	72.5	67.1
Wet	57.6	49.5	43.7	43.3	45.2	49.4	52.7	56.3	63.9	71.2	73.0	66.6
Normal	59.9	50.4	43.4	42.0	43.6	47.5	56.7	56.9	66.2	72.0	73.1	67.7
Dry	58.0	49.4	43.6	43.2	45.4	50.4	56.4	60.2	69.1	75.5	73.8	67.2
Critically Dry	58.5	48.6	42.2	43.1	46.7	49.8	55.5	60.6	68.3	76.9	74.4	69.7
Average All Years	57.8	49.3	43.5	43.0	45.3	49.3	53.9	57.9	65.6	72.7	73.3	67.2
Alternative 1 (°F)												
Extremely Wet	56.7	48.6	43.7	42.7	45.6	47.6	49.9	56.2	61.4	69.3	72.5	67.1
Wet	57.6	49.5	43.7	43.3	45.2	49.4	52.7	56.3	63.9	71.2	72.8	66.4
Normal	60.0	50.4	43.4	42.0	43.6	47.5	56.7	56.9	66.2	72.1	72.0	64.2
Dry	58.1	49.4	43.6	43.2	45.4	50.4	56.4	60.2	69.1	75.4	73.0	65.4
Critically Dry	58.5	48.6	42.2	43.1	46.7	49.9	55.5	60.6	68.3	77.2	72.8	65.7
Average All Years	57.9	49.3	43.5	43.0	45.3	49.3	53.9	57.9	65.6	72.8	72.7	66.0
No Action Compared to Alternative 1 (°F)												
Extremely Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
Normal	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-1.1	-3.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-1.8
Critically Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-1.5	-4.0
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-1.3
No Action compared to Alternative 1 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-5%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-3%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-6%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%

Key:
% = percent
ºF = degrees Fahrenheit

Changes in Nutrients, Organic Matter, and Dissolved Oxygen

Trinity River: Lewiston Dam to Klamath River For the Trinity River under Alternative 1, nutrient concentrations, organic matter and DO would be similar to the No Action Alternative because all releases from Trinity Reservoir would be of similar quality.

Klamath River: Below Trinity River For the lower Klamath River, under Alternative 1, lower nutrient and organic matter concentrations would be anticipated during August and September in comparison to the No Action Alternative. The Trinity River typically experiences lower nutrient and organic matter conditions than the Klamath River. Thus, during periods when augmentation flows occur, contributions from the Trinity River will result in lower nutrient and organic matter concentrations in the Klamath River below the Trinity River confluence due to dilution effects. Concentration of blue-green algae is expected to be similar or lower in comparison to the No Action Alternative because high temperature and nutrient conditions that contribute to algal blooms would not increase in frequency or magnitude.

For the lower Klamath River, under Alternative 1, similar DO concentrations would be anticipated during August and September in comparison to the No Action Alternative. This is because mechanical reaeration maintains DO at or near saturation concentration. Because DO saturation concentration is a function of water temperature, the lower Klamath River may experience slightly lower DO concentrations during augmentation due to slightly cooler water temperatures.

Central Valley and Bay-Delta Region

Changes in Water Temperature

Sacramento River Below Keswick Dam Water temperatures on the Sacramento River are summarized in Table 5-30 through Table 5-33. Water temperatures on the Sacramento River below Clear Creek, and at Balls Ferry, Jellys Ferry, and Bend Bridge (under Alternative 1),would be similar to the No Action Alternative with all months—of all year types—changing less than, or equal to, 1 percent.

Table 5-30. Changes in Water Temperature on Sacramento River Below Clear Creek Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	55.1	54.8	50.7	47.0	45.9	46.6	48.5	50.1	51.0	51.9	53.2	52.0
Above Normal	55.9	54.8	50.8	47.4	46.2	47.4	49.0	50.5	50.7	51.3	52.8	52.6
Below Normal	55.1	55.0	51.5	48.1	47.3	48.9	49.9	50.8	51.3	52.3	53.6	54.9
Dry	55.8	55.0	51.2	48.3	47.8	49.0	50.3	51.1	51.5	52.9	54.9	55.9
Critical	58.4	56.1	51.7	47.9	47.6	49.4	50.3	52.6	54.1	56.0	59.1	62.3
Average All Years	55.9	55.1	51.1	47.7	46.9	48.1	49.5	50.9	51.6	52.7	54.5	55.0
Alternative 1 (°F)												
Wet	55.1	54.8	50.7	47.0	45.9	46.6	48.5	50.1	51.0	51.9	53.2	52.0
Above Normal	55.9	54.9	50.9	47.4	46.2	47.4	49.0	50.5	50.7	51.3	52.8	52.6
Below Normal	55.0	55.0	51.5	48.1	47.3	48.9	49.9	50.8	51.3	52.3	53.6	54.9
Dry	55.7	55.0	51.2	48.3	47.8	49.0	50.3	51.1	51.5	52.9	54.9	55.8
Critical	58.5	56.1	51.7	47.8	47.6	49.4	50.3	52.7	54.2	56.0	59.0	62.9
Average All Years	55.9	55.1	51.1	47.7	46.9	48.1	49.5	50.9	51.6	52.7	54.5	55.1
No Action Compared to Alternative 1 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	0.6
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-31. Changes in Water Temperature on Sacramento River at Balls Ferry Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	55.6	54.3	49.7	46.7	46.2	47.3	50.1	52.4	53.0	53.3	54.5	52.8
Above Normal	56.4	54.4	50.0	47.0	46.4	48.2	50.7	52.5	52.3	52.4	54.0	53.6
Below Normal	55.5	54.5	50.6	47.5	47.5	49.7	51.4	52.5	52.8	53.4	54.7	56.2
Dry	56.2	54.6	50.4	47.8	47.9	49.8	51.9	53.0	52.9	54.1	56.1	57.3
Critical	58.8	55.9	51.0	47.6	48.0	50.4	51.5	54.2	55.5	57.1	60.2	63.3
Average All Years	56.3	54.7	50.2	47.3	47.1	48.8	51.0	52.8	53.2	54.0	55.7	56.1
Alternative 1 (°F)												
Wet	55.6	54.3	49.7	46.7	46.2	47.3	50.0	52.4	53.0	53.3	54.5	52.8
Above Normal	56.4	54.5	50.0	47.0	46.4	48.2	50.6	52.5	52.3	52.4	54.0	53.6
Below Normal	55.5	54.5	50.6	47.5	47.5	49.7	51.4	52.5	52.8	53.5	54.7	56.2
Dry	56.2	54.6	50.4	47.8	47.9	49.8	51.9	53.0	52.9	54.1	56.1	57.2
Critical	58.9	55.9	51.0	47.6	48.0	50.4	51.5	54.2	55.5	57.1	60.1	63.8
Average All Years	56.3	54.7	50.2	47.2	47.1	48.8	51.0	52.8	53.2	54.0	55.7	56.1
No Action Compared to Alternative 1 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Above Normal	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.5
Average All Years	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-32. Changes in Water Temperature on Sacramento River at Jellys Ferry Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	56.0	53.8	48.9	46.4	46.4	48.1	51.6	54.7	55.4	55.1	56.1	53.8
Above Normal	56.9	54.0	49.2	46.6	46.6	49.0	52.2	54.9	54.3	53.8	55.4	54.8
Below Normal	56.0	54.0	49.6	46.9	47.6	50.4	53.0	54.4	54.5	54.8	56.0	57.7
Dry	56.6	54.2	49.6	47.3	47.9	50.4	53.4	55.0	54.5	55.4	57.5	58.9
Critical	59.0	55.5	50.2	47.2	48.3	51.2	52.8	55.9	57.0	58.4	61.3	64.2
Average All Years	56.7	54.2	49.4	46.8	47.2	49.6	52.5	54.9	55.1	55.4	57.1	57.3
Alternative 1 (°F)												
Wet	56.1	53.9	48.9	46.4	46.4	48.1	51.6	54.7	55.4	55.1	56.1	53.8
Above Normal	56.8	54.1	49.2	46.6	46.6	49.0	52.2	54.9	54.3	53.9	55.4	54.8
Below Normal	55.9	54.0	49.6	46.9	47.6	50.4	53.0	54.4	54.5	54.8	56.0	57.7
Dry	56.6	54.2	49.6	47.3	47.9	50.4	53.4	55.0	54.5	55.4	57.5	58.8
Critical	59.2	55.5	50.2	47.2	48.3	51.2	52.8	56.0	57.1	58.4	61.3	64.7
Average All Years	56.8	54.2	49.4	46.8	47.2	49.6	52.5	54.9	55.1	55.4	57.1	57.4
No Action Compared to Alternative 1 (°F)												
Wet	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Below Normal	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.5
Average All Years	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-33. Changes in Water Temperature on Sacramento River at Bend Bridge Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	56.3	53.5	48.5	46.4	46.6	48.6	52.3	55.6	56.4	56.2	57.3	54.6
Above Normal	57.2	53.7	48.8	46.5	46.8	49.7	53.2	55.9	55.4	54.9	56.6	55.7
Below Normal	56.2	53.7	49.1	46.7	47.7	51.0	53.7	55.4	55.6	55.8	57.1	58.8
Dry	56.9	53.8	49.1	47.0	47.9	51.0	54.2	56.1	55.7	56.6	58.7	60.0
Critical	59.3	55.2	49.7	47.0	48.5	51.7	53.6	56.9	58.1	59.5	62.2	64.8
Average All Years	57.0	53.9	49.0	46.7	47.4	50.1	53.3	55.9	56.2	56.5	58.2	58.2
Alternative 1 (°F)												
Wet	56.3	53.5	48.5	46.4	46.6	48.6	52.3	55.6	56.4	56.2	57.3	54.6
Above Normal	57.1	53.8	48.8	46.5	46.8	49.6	53.2	55.9	55.4	54.9	56.6	55.7
Below Normal	56.2	53.7	49.1	46.7	47.7	51.0	53.7	55.4	55.6	55.9	57.1	58.8
Dry	56.9	53.8	49.2	47.0	47.9	51.0	54.2	56.1	55.7	56.6	58.8	60.0
Critical	59.4	55.2	49.7	47.0	48.4	51.7	53.6	56.9	58.1	59.5	62.2	65.2
Average All Years	57.0	53.9	49.0	46.7	47.4	50.1	53.3	55.9	56.2	56.5	58.2	58.2
No Action Compared to Alternative 1 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	-0.1	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Dry	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Critical	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Clear Creek below Whiskeytown Dam Water temperatures on Clear Creek at Igo are summarized in Table 5-34. Water temperatures on Clear Creek (under Alternative 1) would be similar to the No Action Alternative with all months—of all year types—changing less than, or equal to, 1 percent.

Table 5-34. Changes in Water Temperature on Clear Creek at Igo Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	52.2	50.4	46.6	44.5	44.5	45.5	47.2	48.7	50.8	54.8	55.0	52.7
Above Normal	53.4	50.9	46.7	44.7	44.6	45.6	47.3	48.7	50.9	54.8	54.8	52.9
Below Normal	52.4	50.3	46.6	44.3	44.7	46.2	47.9	48.8	51.2	55.1	55.3	53.9
Dry	53.5	50.9	47.1	45.0	45.1	46.4	48.0	49.0	51.4	55.3	56.0	54.5
Critical	55.7	52.9	48.3	45.9	46.1	47.3	49.1	50.8	54.4	56.3	56.9	57.6
Average All Years	53.3	51.0	47.0	44.8	44.9	46.1	47.8	49.1	51.5	55.2	55.5	54.1
Alternative 1 (°F)												
Wet	52.2	50.4	46.6	44.5	44.5	45.5	47.2	48.7	50.8	54.7	55.0	52.7
Above Normal	53.5	51.0	46.8	44.7	44.6	45.6	47.3	48.7	50.9	54.8	54.9	52.9
Below Normal	52.4	50.3	46.6	44.3	44.7	46.2	47.9	48.8	51.1	55.1	55.3	53.9
Dry	53.5	51.0	47.1	45.0	45.1	46.4	48.0	49.0	51.4	55.3	56.0	54.4
Critical	55.7	53.0	48.4	46.0	46.1	47.3	49.1	50.8	54.4	56.2	56.8	57.3
Average All Years	53.3	51.0	47.0	44.8	45.0	46.1	47.8	49.1	51.6	55.1	55.5	54.0
No Action Compared to Alternative 1 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Above Normal	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
Dry	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.3
Average All Years	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Feather River Below Thermalito/Oroville Dam Temperatures on the Feather River were not modelled, but because Oroville storage and releases change by 1 percent or less (in Alternative 1 as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar. See Tables 4-11 and 4-13 in Chapter 4, "Surface Water Supply and Management," for changes in Oroville storage and flows on the Feather River.

American River Below Nimbus Dam Temperatures on the American River were not modelled, but because Folsom storage and releases change by 1 percent or less (in Alternative 1 as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar. See Tables 4-15 and 4-17 in Chapter 4, "Surface Water Supply and Management," for changes in Folsom storage and flows on the American River.

Changes in Salinity

Delta Salinity Salinities in the Delta at Rock Slough, Emmaton, Jersey Point, Collinsville, and at Banks and Jones Pumping Plants are summarized in Table 5-35 through Table 5-40. Salinities at these six locations under Alternative 1 would be similar to the No Action Alternative—with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-35. Changes in Salinity (EC) at Rock Slough Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	569	538	520	586	588	533	455	392	280	278	338	575
Above Normal	783	870	741	596	543	524	402	416	289	282	362	563
Below Normal	579	551	565	663	529	427	409	419	307	346	467	696
Dry	695	727	748	756	510	426	384	378	306	414	647	735
Critical	909	997	1,043	977	627	487	418	417	423	539	749	887
Average All Years	685	706	693	696	560	484	417	400	312	359	495	674
Alternative 1 (umhos/cm)												
Wet	568	539	520	586	588	533	455	392	280	278	338	575
Above Normal	782	872	738	595	543	523	402	416	289	282	362	562
Below Normal	580	552	565	664	530	427	409	418	307	345	466	695
Dry	696	727	747	756	510	425	384	378	306	412	644	732
Critical	912	1,003	1,049	981	627	487	418	417	422	538	747	890
Average All Years	685	707	694	697	560	484	417	400	312	359	493	674
No Action Compared to Alternative 1 (umhos/cm)												
Wet	-1	1	0	0	0	0	0	0	0	0	0	0
Above Normal	-1	2	-3	-1	0	-1	0	0	0	0	0	-1
Below Normal	1	1	0	1	1	0	0	-1	0	-1	-1	-1
Dry	1	0	-1	0	0	-1	0	0	0	-2	-3	-3
Critical	3	6	6	4	0	0	0	0	-1	-1	-2	3
Average All Years	0	1	1	1	0	0	0	0	0	0	-2	0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Critical	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-36. Changes in Salinity (EC) on Sacramento River at Emmaton Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	1,323	774	312	214	184	183	187	192	276	297	838	328
Above Normal	2,713	1,735	720	271	193	184	193	209	384	347	855	557
Below Normal	1,386	1,079	869	463	248	223	244	292	551	501	1,113	2,228
Dry	2,242	1,822	1,298	599	286	222	248	327	607	986	2,119	2,866
Critical	3,430	3,346	2,163	1,017	437	358	436	815	1,503	2,134	3,007	3,860
Average All Years	2,084	1,599	963	468	256	224	247	332	591	769	1,508	1,755
Alternative 1 (umhos/cm)												
Wet	1,324	775	312	214	184	183	187	192	276	297	838	328
Above Normal	2,719	1,720	720	271	193	184	192	209	384	347	856	558
Below Normal	1,386	1,077	869	463	248	223	244	292	551	503	1,118	2,233
Dry	2,243	1,819	1,295	598	285	222	248	327	607	991	2,127	2,861
Critical	3,445	3,357	2,168	1,016	436	358	436	815	1,498	2,146	3,031	3,886
Average All Years	2,088	1,598	963	467	256	224	247	332	590	773	1,514	1,758
No Action Compared to Alternative 1 (umhos/cm)												
Wet	1	1	0	0	0	0	0	0	0	0	0	0
Above Normal	6	-15	0	0	0	0	-1	0	0	0	1	1
Below Normal	0	-2	0	0	0	0	0	0	0	2	5	5
Dry	1	-3	-3	-1	-1	0	0	0	0	5	8	-5
Critical	15	11	5	-1	-1	0	0	0	-5	12	24	26
Average All Years	4	-1	0	-1	0	0	0	0	-1	4	6	3
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-37. Changes in Salinity (EC) on San Joaquin River at Jersey Point Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	1,114	958	503	284	238	221	222	214	239	345	1,063	936
Above Normal	2,148	1,759	1,088	465	252	218	229	239	305	468	1,178	1,007
Below Normal	1,107	1,151	1,168	692	325	243	248	276	378	816	1,458	2,431
Dry	1,693	1,689	1,590	952	389	255	248	288	416	1,298	1,704	2,466
Critical	2,459	2,509	2,134	1,309	536	330	352	542	904	1,613	2,115	2,718
Average All Years	1,615	1,516	1,189	680	332	248	252	292	409	846	1,445	1,782
Alternative 1 (umhos/cm)												
Wet	1,116	959	503	284	238	221	222	214	239	345	1,063	936
Above Normal	2,149	1,741	1,086	465	252	218	229	239	305	468	1,177	1,007
Below Normal	1,107	1,151	1,169	692	326	243	248	276	378	815	1,455	2,431
Dry	1,693	1,685	1,590	951	388	255	248	288	416	1,290	1,692	2,461
Critical	2,468	2,521	2,142	1,309	535	330	352	542	906	1,606	2,116	2,726
Average All Years	1,617	1,514	1,190	680	332	248	252	292	409	842	1,441	1,781
No Action Compared to Alternative 1 (umhos/cm)												
Wet	2	1	0	0	0	0	0	0	0	0	0	0
Above Normal	1	-18	-2	0	0	0	0	0	0	0	-1	0
Below Normal	0	0	1	0	1	0	0	0	0	-1	-3	0
Dry	0	-4	0	-1	-1	0	0	0	0	-8	-12	-5
Critical	9	12	8	0	-1	0	0	0	2	-7	1	8
Average All Years	2	-2	1	0	0	0	0	0	0	-4	-4	-1
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-38. Changes in Salinity (EC) on Sacramento River at Collinsville Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	4,127	2,900	1,039	403	200	198	218	291	916	1,422	3,821	1,226
Above Normal	7,539	5,358	2,987	778	261	220	249	421	1,716	1,869	3,925	2,880
Below Normal	4,255	3,826	3,579	2,046	752	599	725	1,154	2,518	2,746	4,747	7,305
Dry	6,541	6,049	5,129	2,772	956	540	778	1,409	2,765	4,487	6,762	8,422
Critical	9,144	9,192	7,249	4,254	1,845	1,454	2,011	3,327	5,037	6,844	8,416	9,739
Average All Years	6,008	5,103	3,595	1,824	709	523	690	1,145	2,312	3,212	5,351	5,305
Alternative 1 (umhos/cm)												
Wet	4,130	2,900	1,040	403	200	198	218	291	916	1,423	3,821	1,226
Above Normal	7,542	5,316	2,987	778	261	220	249	421	1,715	1,869	3,926	2,882
Below Normal	4,256	3,825	3,579	2,047	752	599	725	1,154	2,518	2,756	4,758	7,315
Dry	6,543	6,044	5,121	2,766	952	540	778	1,409	2,765	4,496	6,766	8,415
Critical	9,162	9,206	7,257	4,251	1,842	1,454	2,010	3,328	5,032	6,855	8,446	9,767
Average All Years	6,013	5,097	3,594	1,822	707	523	690	1,145	2,311	3,217	5,359	5,309
No Action Compared to Alternative 1 (umhos/cm)												
Wet	3	0	1	0	0	0	0	0	0	1	0	0
Above Normal	3	-42	0	0	0	0	0	0	-1	0	1	2
Below Normal	1	-1	0	1	0	0	0	0	0	10	11	10
Dry	2	-5	-8	-6	-4	0	0	0	0	9	4	-7
Critical	18	14	8	-3	-3	0	-1	1	-5	11	30	28
Average All Years	5	-6	-1	-2	-2	0	0	0	-1	5	8	4
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-39. Changes in Salinity (EC) at Banks Pumping Plant Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	473	443	428	470	389	329	250	276	301	281	307	458
Above Normal	667	662	571	591	517	407	331	362	324	274	317	414
Below Normal	478	460	494	584	558	476	380	424	356	306	392	615
Dry	570	588	600	663	592	549	452	453	352	364	515	632
Critical	742	780	788	768	708	690	569	535	452	490	605	740
Average All Years	568	565	554	595	528	467	376	391	347	334	414	556
Alternative 1 (umhos/cm)												
Wet	473	443	428	470	389	329	250	276	301	281	307	458
Above Normal	668	661	570	592	517	407	331	362	324	274	317	414
Below Normal	479	460	495	584	558	476	380	424	356	306	391	615
Dry	571	588	599	664	592	549	452	453	352	363	511	631
Critical	745	785	792	769	709	690	569	535	450	489	603	741
Average All Years	568	565	554	596	528	467	376	391	346	334	413	556
No Action Compared to Alternative 1 (umhos/cm)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	1	-1	-1	1	0	0	0	0	0	0	0	0
Below Normal	1	0	1	0	0	0	0	0	0	0	-1	0
Dry	1	0	-1	1	0	0	0	0	0	-1	-4	-1
Critical	3	5	4	1	1	0	0	0	-2	-1	-2	1
Average All Years	0	0	0	1	0	0	0	0	-1	0	-1	0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Critical	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-40. Changes in Salinity (EC) at Jones Pumping Plant Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	473	455	496	517	406	336	265	288	345	345	331	449
Above Normal	624	627	608	631	572	449	353	375	373	332	343	426
Below Normal	478	469	564	627	618	531	405	433	392	334	407	581
Dry	550	570	633	687	664	619	483	480	388	383	512	602
Critical	684	721	761	774	784	787	621	569	472	492	588	696
Average All Years	547	551	595	629	579	515	403	409	385	372	425	536
Alternative 1 (umhos/cm)												
Wet	473	455	496	517	406	336	265	288	345	345	331	449
Above Normal	624	627	608	631	572	449	353	375	373	332	343	426
Below Normal	479	469	564	627	619	531	405	433	392	335	407	580
Dry	550	570	632	688	664	619	483	480	388	383	510	600
Critical	686	725	764	773	783	787	621	569	470	491	586	697
Average All Years	548	552	595	629	579	515	403	409	385	372	424	536
No Action Compared to Alternative 1 (umhos/cm)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	0	0	0	0	0	0	0	0	0	0	0	0
Below Normal	1	0	0	0	1	0	0	0	0	1	0	-1
Dry	0	0	-1	1	0	0	0	0	0	0	-2	-2
Critical	2	4	3	-1	-1	0	0	0	-2	-1	-2	1
Average All Years	1	1	0	0	0	0	0	0	0	0	-1	0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

X2 Position X2 positions are summarized in Table 5-41. X2 positions in Alternative 1 would be similar to the No Action Alternative—with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-41. Changes in X2 Position Under Alternative 1 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (km)												
Wet	80.6	76.8	63.7	54.8	51.2	53.1	55.1	58.4	67.3	74.9	82.8	73.9
Above Normal	86.8	82.6	75.2	60.9	54.9	55.3	59.1	65.2	75.3	77.8	83.1	74.7
Below Normal	80.4	80.3	80.4	74.6	64.3	66.9	69.0	72.9	79.1	81.1	85.1	89.4
Dry	85.7	85.5	84.5	77.7	67.7	65.4	68.8	74.5	80.1	84.5	87.6	90.6
Critical	90.5	90.7	88.3	82.1	75.3	74.6	77.7	82.3	85.2	87.9	90.3	92.2
Average All Years	84.2	82.4	76.4	68.0	61.1	61.4	64.2	68.9	75.9	80.4	85.4	82.9
Alternative 1 (km)												
Wet	80.6	76.8	63.7	54.8	51.2	53.1	55.1	58.4	67.3	74.9	82.8	73.9
Above Normal	86.8	82.6	75.2	60.9	54.9	55.3	59.1	65.2	75.3	77.8	83.1	74.7
Below Normal	80.4	80.3	80.4	74.6	64.3	66.9	69.1	72.9	79.1	81.1	85.1	89.4
Dry	85.7	85.5	84.5	77.7	67.7	65.4	68.8	74.5	80.1	84.5	87.6	90.5
Critical	90.5	90.7	88.3	82.1	75.3	74.6	77.7	82.3	85.2	87.9	90.3	92.2
Average All Years	84.2	82.4	76.4	68.0	61.1	61.4	64.2	68.9	75.9	80.4	85.4	82.9
No Action Compared to Alternative 1 (km)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 1 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
km = kilometer

Trinity River Record of Decision Flow Rescheduling Alternative (Alternative 2)

Lower Klamath and Trinity River Region

Changes in Water Temperature

Trinity River: Lewiston Dam to Klamath River Temperature impacts on the Trinity River (below Lewiston Dam) are evaluated by (1) comparing temperatures for the No Action Alternative with Alternative 2 at Trinity River below Lewiston Dam; Trinity River at Douglas City; Trinity River below North Fork Trinity River; Trinity River below South Fork Trinity River; and Trinity River near its mouth (Weitchpec); and (2) comparing the numbers of days (in the No Action Alternative and Alternative 2) that water temperatures exceeded water temperature objectives in the Trinity River, as identified in Table 5-3.

Temperatures below Lewiston Dam under Alternative 2 are similar to under the No Action Alternative, in most year types, and in most months, as shown in Table 5-42. In extremely wet, wet, normal, and dry years, the monthly average water temperatures for Alternative 2 were within +/-1.0°F (less than 2 percent) of No Action conditions. For the critically dry years, temperatures were 1.7°F (3 percent) cooler in September.

Table 5-42. Changes in Trinity River Water Temperature Below Lewiston Dam Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	52.4	50.9	47.8	45.4	45.3	45.8	47.7	46.2	47.8	51.0	53.1	50.4
Wet	52.3	51.8	49.3	48.1	47.3	49.7	51.2	46.6	49.5	52.3	52.2	51.8
Normal	54.8	54.2	49.2	47.4	48.5	51.9	54.6	46.7	51.3	51.9	53.3	53.3
Dry	53.1	51.7	50.5	49.5	49.7	52.0	53.3	49.4	53.2	52.8	53.3	54.0
Critically Dry	55.0	50.2	50.4	51.1	51.9	51.3	52.9	52.0	54.9	54.9	57.5	57.5
Average All Years	53.0	51.7	49.5	48.2	48.2	50.0	51.7	47.8	50.9	52.4	53.2	52.9
Alternative 2 (°F)												
Extremely Wet	52.6	50.9	47.8	45.4	45.3	45.8	47.7	46.2	47.7	51.0	52.8	50.6
Wet	52.4	52.2	49.4	48.1	47.3	49.7	51.1	46.5	49.5	52.2	52.3	51.7
Normal	55.6	54.6	50.1	47.8	48.5	51.9	54.6	46.7	51.3	52.3	52.9	52.6
Dry	53.2	51.7	50.1	49.6	49.7	52.0	53.3	49.8	53.3	52.6	53.1	53.7
Critically Dry	55.2	50.2	50.4	51.0	51.8	51.6	52.8	52.6	55.7	54.5	56.6	55.7
Average All Years	53.2	51.8	49.5	48.3	48.2	50.1	51.6	48.0	51.0	52.3	53.0	52.6
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.4	0.2
Wet	0.0	0.4	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	-0.2	0.1	0.0
Normal	0.8	0.3	0.9	0.4	0.0	0.0	0.0	0.1	0.0	0.4	-0.4	-0.7
Dry	0.1	0.0	-0.4	0.1	0.1	0.0	0.0	0.4	0.1	-0.2	-0.2	-0.4
Critically Dry	0.3	0.1	-0.1	-0.1	-0.1	0.4	0.0	0.6	0.8	-0.3	-0.9	-1.7
Average All Years	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.2	0.1	-0.1	-0.2	-0.3
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Wet	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	1%	1%	2%	1%	0%	0%	0%	0%	0%	1%	-1%	-1%
Dry	0%	0%	-1%	0%	0%	0%	0%	1%	0%	0%	0%	-1%
Critically Dry	0%	0%	0%	0%	0%	1%	0%	1%	1%	-1%	-2%	-3%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%

Key:
% = percent
ºF = degrees Fahrenheit

Temperatures at Douglas City under Alternative 2 are similar to under the No Action Alternative, in most year types and in most months, as shown in Table 5-43. In extremely wet, wet, normal, and dry years, the monthly average water temperatures for Alternative 2 were within +/-1.0°F (less than 2 percent) of No Action conditions. For the critically dry years, temperatures were 1.7°F (3 percent) cooler in September.

Table 5-43. Changes in Trinity River Water Temperature at Douglas City Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	52.2	49.3	46.0	43.2	44.3	44.9	46.8	47.1	48.6	52.5	54.8	51.4
Wet	52.1	50.2	47.0	45.1	45.3	47.8	49.5	47.2	50.3	53.5	53.5	52.3
Normal	54.4	51.5	45.9	43.9	45.3	47.1	52.7	47.1	52.0	52.9	54.1	53.7
Dry	52.8	50.2	47.8	46.4	46.4	48.8	51.9	49.8	54.1	54.2	54.1	54.2
Critically Dry	54.5	49.3	48.4	48.3	48.7	48.5	51.3	52.2	55.4	56.0	57.7	57.4
Average All Years	52.7	50.1	47.1	45.3	45.7	47.6	50.2	48.4	51.8	53.7	54.3	53.3
Alternative 2 (°F)												
Extremely Wet	52.3	49.3	46.0	43.2	44.3	44.9	46.8	47.1	48.5	52.5	54.5	51.6
Wet	52.2	50.5	47.0	45.1	45.3	47.8	49.5	47.2	50.4	53.4	53.5	52.3
Normal	55.1	51.6	46.2	44.0	45.3	47.1	52.7	47.2	52.0	53.2	53.6	52.8
Dry	52.8	50.2	47.5	46.5	46.5	48.8	51.9	50.2	54.3	54.0	53.8	53.8
Critically Dry	54.7	49.4	48.4	48.2	48.6	48.7	51.3	52.8	56.2	55.7	56.8	55.7
Average All Years	52.9	50.2	47.0	45.4	45.7	47.6	50.2	48.6	51.9	53.6	54.1	52.9
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.3	0.2
Wet	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1
Normal	0.7	0.2	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.4	-0.5	-0.9
Dry	0.1	0.0	-0.3	0.1	0.0	0.0	0.0	0.4	0.2	-0.1	-0.3	-0.4
Critically Dry	0.2	0.1	-0.1	-0.1	-0.1	0.2	0.0	0.6	0.8	-0.3	-0.9	-1.7
Average All Years	0.1	0.1	-0.1	0.0	0.0	0.0	0.0	0.2	0.1	-0.1	-0.3	-0.3
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
Wet	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	1%	0%	1%	0%	0%	0%	0%	0%	0%	1%	-1%	-2%
Dry	0%	0%	-1%	0%	0%	0%	0%	1%	0%	0%	-1%	-1%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	1%	2%	-1%	-2%	-3%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%

Key:
% = percent
ºF = degrees Fahrenheit

At the North Fork Trinity River, South Fork Trinity River and the Trinity River's mouth at Weitchpec (Table 5-44 and Table 5-46, respectively), differences in temperature for all year types, for all months, were less than +/-1°F (1 percent), with the exception of normal, dry, and critically dry year types in August and September, when temperatures were up to 4°F (6 percent), 6.3ºF (9 percent), and 6.6°F (9 percent) cooler for North Fork Trinity River, South Fork Trinity River and mouth locations, respectively. Alternative 2 daily average water temperatures were consistently cooler than No Action conditions. Decreased temperatures in August and September were because of increased flows (due to augmentation releases from Lewiston Dam that were drawn from cool, deep water releases from Trinity Reservoir), while minor increases or decreases in the other months of the year were due to changes in Trinity Lake operations, impacting storage in Trinity Lake storage or release rate and residence time in Lewiston Reservoir. An exception is June, in critically dry years, when water temperatures were warmer by 1.6°F (3 percent), 1.4°F (2 percent), and 1.3°F (2 percent) for North Fork Trinity River, South Fork Trinity River and Weitchpec, respectively. These increases in water temperature were due to reduced June flows under this alternative.

Table 5-44. Changes in Trinity River Water Temperature at North Fork Trinity River Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	53.9	47.3	43.6	41.9	43.9	45.0	47.6	50.1	52.5	59.7	64.5	58.4
Wet	54.4	48.5	44.3	43.2	44.2	47.7	50.5	50.2	55.2	61.9	63.6	58.9
Normal	56.9	49.0	43.0	41.8	43.8	46.3	54.3	50.2	57.3	61.8	64.1	60.0
Dry	54.7	48.5	44.6	43.8	44.8	48.5	53.8	53.4	61.7	65.4	63.9	60.2
Critically Dry	56.0	47.7	44.3	45.0	46.8	48.0	53.1	55.9	62.4	67.2	66.8	63.5
Average All Years	54.8	48.3	44.2	43.2	44.5	47.4	51.6	51.6	57.5	63.0	64.2	59.7
Alternative 2 (°F)												
Extremely Wet	54.0	47.3	43.6	41.9	43.9	45.0	47.6	50.1	52.5	59.7	64.3	58.5
Wet	54.5	48.7	44.3	43.2	44.2	47.7	50.5	50.2	55.3	61.8	63.3	58.6
Normal	57.4	49.1	43.1	41.9	43.8	46.3	54.3	50.3	57.3	62.0	62.4	56.7
Dry	54.7	48.5	44.4	43.8	44.9	48.5	53.8	54.0	62.1	65.2	62.7	58.2
Critically Dry	56.2	47.7	44.3	45.0	46.8	48.1	53.1	56.7	64.0	67.0	64.6	59.4
Average All Years	54.9	48.3	44.1	43.2	44.5	47.4	51.6	51.9	57.8	63.0	63.4	58.4
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2	0.1
Wet	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	-0.2	-0.2
Normal	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.3	-1.7	-3.4
Dry	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.6	0.4	-0.1	-1.2	-2.0
Critically Dry	0.2	0.1	-0.1	-0.1	0.0	0.1	0.0	0.8	1.6	-0.2	-2.1	-4.0
Average All Years	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.3	-0.1	-0.8	-1.3
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-6%
Dry	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	-2%	-3%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	1%	3%	0%	-3%	-6%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	-1%	-2%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-45. Changes in Trinity River Water Temperature at South Fork Trinity River Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.7	49.0	44.7	43.3	46.2	47.5	49.6	54.2	57.9	66.6	72.2	66.0
Wet	57.7	50.0	44.9	44.4	45.9	49.7	52.7	53.8	60.4	68.4	72.0	65.4
Normal	59.3	50.9	44.2	42.7	44.5	47.6	57.3	54.0	62.6	68.9	72.1	66.1
Dry	58.0	49.7	44.8	44.0	45.8	50.0	55.9	57.3	67.2	74.0	72.5	66.1
Critically Dry	58.8	47.8	42.9	44.3	46.9	48.8	54.5	58.8	66.5	75.2	74.1	69.1
Average All Years	57.9	49.6	44.6	43.9	45.9	49.1	53.7	55.4	62.8	70.4	72.4	66.1
Alternative 2 (°F)												
Extremely Wet	56.8	49.0	44.7	43.3	46.2	47.5	49.6	54.2	57.9	66.6	72.1	66.0
Wet	57.7	50.1	44.9	44.4	45.9	49.7	52.7	53.8	60.6	68.4	71.6	65.0
Normal	59.6	50.9	44.2	42.7	44.5	47.6	57.3	54.2	62.6	69.0	69.8	60.7
Dry	58.0	49.7	44.7	44.0	45.8	50.0	55.9	57.9	67.7	74.0	70.7	62.6
Critically Dry	58.9	47.8	42.9	44.3	46.9	48.9	54.5	59.4	67.9	75.2	71.2	62.7
Average All Years	57.9	49.6	44.6	43.9	45.9	49.1	53.7	55.7	63.1	70.4	71.2	63.8
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Wet	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.4	-0.4
Normal	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-2.4	-5.5
Dry	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.6	0.4	0.0	-1.8	-3.5
Critically Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	-0.1	-3.0	-6.3
Average All Years	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	-1.2	-2.2
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-8%
Dry	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	-2%	-5%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	-4%	-9%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-3%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-46. Changes in Trinity River Water Temperature at Mouth of Trinity River (Weitchpec) Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.7	48.8	44.7	43.4	46.3	47.6	49.8	54.6	58.3	67.1	72.4	66.3
Wet	57.7	49.6	44.9	44.5	46.1	49.8	52.9	54.3	61.1	69.0	72.7	65.9
Normal	59.5	50.7	44.2	42.8	44.6	47.7	57.4	54.6	63.5	69.7	73.0	67.0
Dry	58.0	49.4	44.6	44.0	45.9	50.1	56.2	57.9	67.8	75.0	73.7	66.8
Critically Dry	58.6	47.7	42.6	44.1	47.0	49.0	54.9	59.5	67.3	76.2	75.2	69.9
Average All Years	57.9	49.3	44.5	44.0	46.0	49.3	53.9	55.9	63.4	71.2	73.2	66.7
Alternative 2 (°F)												
Extremely Wet	56.7	48.8	44.7	43.4	46.3	47.6	49.8	54.6	58.3	67.1	72.3	66.3
Wet	57.7	49.7	44.9	44.5	46.1	49.8	52.9	54.3	61.2	69.0	72.4	65.5
Normal	59.7	50.7	44.3	42.8	44.6	47.7	57.4	54.8	63.5	69.8	70.9	61.2
Dry	58.1	49.4	44.6	44.0	46.0	50.1	56.2	58.5	68.3	74.9	72.0	63.2
Critically Dry	58.7	47.7	42.6	44.1	46.9	49.0	54.9	60.0	68.6	76.1	72.3	63.3
Average All Years	57.9	49.4	44.5	44.0	46.0	49.3	53.9	56.2	63.7	71.2	72.1	64.4
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Wet	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.4	-0.4
Normal	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	-2.1	-5.7
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4	0.0	-1.7	-3.7
Critically Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.3	-0.1	-2.8	-6.6
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	-1.1	-2.3
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-9%
Dry	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	-2%	-5%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	-4%	-9%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-4%

Key:
% = percent
ºF = degrees Fahrenheit

Potential impacts on existing temperature objectives in the Trinity River (Table 5-3) were assessed for the specific periods when objectives were applicable. A comparison of No Action versus Alternative 2 for the 1980 to 2003 RBM10 simulation period was completed to assess the frequency (number of days) of meeting temperature objectives based on daily average water temperature.

However, there were periods objectives were not met, including:

- Increased frequency of meeting objectives under Alternative 2 compared to the No Action
- Decreased frequency of meeting objectives under Alternative 2 compared to the No Action than Alternative 1
- Equal frequency of meeting objectives for both No Action and Alternative2.

The number of days that the objectives were not achieved is summarized in tabular form for the stipulated temperature objectives (i.e., temperature for each location and time period).

Non-compliance days for the Trinity River at Douglas City (between July 1 and September 30) are shown in Table 5-47. Temperature objectives at this location were largely met, except in drier year types. Non-compliance for No Action and Alternative 2 occurred 40 and 46 days, respectively, between July 1 and September 15. Non-compliance for No Action and Alternative 2 occurred 27 and 31 days, respectively, between September 15 and September 30. The difference in non-compliance, between No Action and Alternative 2 at Douglas City, was 1 percent or less.

Table 5-47. Number of Days that No Action Alternative and Alternative 2 Temperatures at Douglas City Exceeded Basin Plan Temperature Objectives

Basin Plan Temperature Objective: Lewiston to Douglas City (RM 111 to RM 92)		**7/1 to 9/15 ≤ 60 °F**		**9/15 to 9/30 ≤ 56 °F**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	0	0	0	0
1981	D	0	0	0	0
1982	EW	0	0	0	0
1983	EW	0	0	0	0
1984	W	0	0	0	0
1985	D	0	0	0	0
1986	W	0	0	0	0
1987	D	0	0	0	0
1988	D	0	0	0	0
1989	N	0	0	0	0
1990	D	0	0	7	**6**
1991	CD	33	**12**	15	15
1992	D	0	0	5	**1**
1993	W	1	**<u>2</u>**	0	0
1994	CD	0	0	0	0
1995	EW	6	6	0	0
1996	W	0	0	0	0
1997	W	0	0	0	0
1998	EW	0	0	0	0
1999	W	0	0	0	0
2000	W	0	0	0	0
2001	D	0	0	0	0
2002	N	0	0	0	0
2003	EW	0	0	0	0
# of Days of Non-compliance		40	20	27	22
Total # of Days		1,848	1,848	384	384
%		2%	1%	7%	6%

Note:
Bold values denote less days of non-compliance and **<u>bold underline</u>** values denote more days of non-compliance
Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Non-compliance days for the Trinity River below North Fork Trinity River (between October 1 and December 31) are shown in Table 5-48. Temperature objectives at this location were not met as often as at Douglas City. Non-compliance for No Action and Alternative 2 occurred 244 and 260 days, respectively, between October 1 and December 31. The difference in non-compliance, between No Action and Alternative 2 at North Fork Trinity River, was 1 percent.

Table 5-48. Number of Days that No Action Alternative and Alternative 2 Temperatures at Trinity River Below North Fork Trinity River Exceeded Basin Plan Temperature Objectives

Basin Plan Temperature Objective: Lewiston to North Fork Trinity River Confluence (RM 111 to RM 72)		**10/1 to 12/31 ≤ 56 °F**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**
1980	W	10	10
1981	D	1	**3**
1982	EW	1	1
1983	EW	7	7
1984	W	1	1
1985	D	9	9
1986	W	2	2
1987	D	23	**27**
1988	D	22	**24**
1989	N	20	20
1990	D	11	**12**
1991	CD	22	22
1992	D	26	**<u>19</u>**
1993	W	10	**12**
1994	CD	14	**15**
1995	EW	0	0
1996	W	11	11
1997	W	1	1
1998	EW	1	1
1999	W	8	8
2000	W	9	9
2001	D	19	**21**
2002	N	6	**15**
2003	EW	10	10
# of Days of Non-compliance		244	260
Total # of Days		2,208	2,208
%		11%	12%

Note:
Bold values denote less days of non-compliance and **<u>bold underline</u>** values denote more days of non-compliance
Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

The springtime objectives from the ROD for the Trinity River Trinity River Mainstem Fishery Restoration EIS/EIR (DOI and Hoopa Valley 2000) were also assessed. These daily average water temperature objectives are applicable to the Trinity River, from Lewiston Dam to its confluence with the Klamath River. For this analysis, the number of non-compliance days for No Action and Alternative 2 were compared for all years in the RBM10 simulation. Five locations were assessed: Trinity River below Lewiston Dam, Trinity River at Douglas City, Trinity River below North Fork Trinity River, Trinity River below North Fork Trinity River, and Trinity River near Weitchpec (Table 5-49 through Table 5-53, respectively). For the Trinity River (below Lewiston Dam and at Douglas City) there were few incidences of temperatures exceeding objectives—only a few days between April 15 and May 22. At the North Fork Trinity River the number of days increased slightly, but at the South Fork Trinity River and mouth locations, there was a high prevalence of non-compliance—with percentage of time exceeding objectives ranging from 18 percent to 99 percent—with dry and critically dry years experiencing the highest percentages in June. There was no difference between the No Action and Alternative 2 below Lewiston Dam and Douglas City. At the North Fork Trinity River, dry and critically dry year types increased in non-compliance from 6 to 10 days in June—less than 1 percent of all days—for Alternative 2 versus No Action. At the South Fork Trinity and mouth locations, Alternative 2 indicated more days of non-compliance during all three temperature compliance periods (4/15 to 5/22, 5/23 to 6/4, and 6/5 to 6/15 (critically dry and dry) and 6/5 to 7/9 (normal, wet, extremely wet)). For all periods except 6/5 to 6/15 in dry and critically dry years, increases ranged from approximately 1 percent to 4 percent. For the 6/5 to 6/15 period in dry and critically dry years, increased in non-compliance increased approximately 5 percent to 7 percent. These results indicate that these two alternatives were similar in temperature response, with the exception of critically dry and dry years in early June.

Table 5-49. Number of Days that No Action Alternative and Alternative 2 Average Daily Water Temperatures at Trinity River Below Lewiston Dam Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4 °F (for N, W & EW years) ≤ 59.0 °F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0 °F (for N, W & EW years) ≤ 62.6 °F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6 °F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0 °F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	6	6	0	0	0	0
1981	D	0	0	0	0	0	0
1982	EW	0	0	0	0	0	0
1983	EW	0	0	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	0
1986	W	0	0	0	0	0	0
1987	D	0	0	0	0	0	0
1988	D	0	0	0	0	0	0
1989	N	8	8	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	0	0	0	0
1993	W	0	0	0	0	0	0
1994	CD	0	0	0	0	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	5	5	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	0	0	0	0	0	0
2002	N	0	0	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		19	19	0	0	0	0
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		2%	2%	0%	0%	0%/0%	0%/0%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-50. Number of Days that No Action Alternative and Alternative 2 Temperatures at Trinity River near Douglas City Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4 °F (for N, W & EW years) ≤ 59.0 °F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0 °F (for N, W & EW years) ≤ 62.6 °F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6 °F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0 °F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	0	0	0	0	0	0
1981	D	0	0	0	0	0	0
1982	EW	0	0	0	0	0	0
1983	EW	0	0	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	0
1986	W	0	0	0	0	0	0
1987	D	0	0	0	0	0	0
1988	D	0	0	0	0	0	0
1989	N	7	7	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	0	0	0	0
1993	W	0	0	0	0	0	0
1994	CD	0	0	0	0	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	0	0	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	0	0	0	0	0	0
2002	N	0	0	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		7	7	0	0	0	0
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		1%	1%	0%	0%	0%/0%	0%/0%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-51. Number of Days that No Action Alternative and Alternative 2 Temperatures at Trinity River at the North Fork Trinity River Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		4/15 to 5/22 ≤ 55.4 °F (for N, W & EW years) ≤ 59.0 °F (for D & CD years)		5/23 to 6/4 ≤ 59.0 °F (for N, W & EW years) ≤ 62.6 °F (for D & CD years)		6/5 to 7/9 ≤ 62.6 °F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0 °F (for D & CD years)	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	2	2	0	0	0	0
1981	D	0	0	0	0	1	1
1982	EW	0	0	0	0	0	0
1983	EW	1	1	0	0	0	0
1984	W	0	0	0	0	0	0
1985	D	0	0	0	0	0	1
1986	W	0	0	0	0	0	0
1987	D	1	1	0	0	0	0
1988	D	0	0	0	0	2	3
1989	N	7	7	0	0	0	0
1990	D	0	0	0	0	0	0
1991	CD	0	0	0	0	0	0
1992	D	0	0	1	2	3	5
1993	W	0	0	0	0	0	0
1994	CD	7	7	0	5	0	0
1995	EW	0	0	0	0	0	0
1996	W	0	0	0	0	0	0
1997	W	0	0	0	0	0	0
1998	EW	0	0	0	0	0	0
1999	W	3	3	0	0	0	0
2000	W	0	0	0	0	0	0
2001	D	3	3	0	1	0	0
2002	N	3	3	0	0	0	0
2003	EW	0	0	0	0	0	0
# of days of Non-compliance		27	27	1	8	0/6	0/10
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		3%	3%	0%	2%	0%/6%	0%/10%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-52. Number of Days that No Action Alternative and Alternative 2 Temperatures at Trinity River Below South Fork Trinity River Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22 ≤ 55.4 °F (for N, W & EW years) ≤ 59.0 °F (for D & CD years)**		**5/23 to 6/4 ≤ 59.0 °F (for N, W & EW years) ≤ 62.6 °F (for D & CD years)**		**6/5 to 7/9 ≤ 62.6 °F (for N, W & EW years) 6/5 to 6/15 ≤ 68.0 °F (for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	24	24	0	0	0	0
1981	D	4	4	8	8	0	0
1982	EW	22	22	0	0	0	1
1983	EW	6	6	7	7	2	2
1984	W	3	3	0	0	21	21
1985	D	4	6	0	1	5	5
1986	W	6	6	3	3	14	16
1987	D	16	19	2	2	3	3
1988	D	2	3	0	3	0	0
1989	N	15	15	3	3	24	25
1990	D	9	9	0	0	0	0
1991	CD	0	1	0	5	3	6
1992	D	4	11	11	12	5	6
1993	W	7	7	0	0	23	23
1994	CD	16	17	11	12	2	6
1995	EW	4	4	0	0	14	14
1996	W	13	13	1	1	17	17
1997	W	23	23	0	1	9	9
1998	EW	18	18	0	0	4	4
1999	W	10	10	0	0	17	18
2000	W	6	6	0	0	19	19
2001	D	11	14	11	12	0	0
2002	N	10	10	6	6	18	18
2003	EW	0	0	0	0	5	5
# of days of Non-compliance		233	251	63	76	187/18	192/26
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		26%	28%	18%	21%	22%/18%	23%/26%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Table 5-53. Number of Days that No Action Alternative and Alternative 2 Temperatures at Trinity River near Mouth (Weitchpec) Exceeded Spring-Time Temperature Objectives

Spring-Time Temperature Objective: Lewiston to Weitchpec (RM 111 to RM 0.1)		**4/15 to 5/22** **≤ 55.4 °F** **(for N, W & EW years)** **≤ 59.0 °F** **(for D & CD years)**		**5/23 to 6/4** **≤ 59.0 °F** **(for N, W & EW years)** **≤ 62.6 °F** **(for D & CD years)**		**6/5 to 7/9** **≤ 62.6 °F** **(for N, W & EW years)** **6/5 to 6/15** **≤ 68.0 °F** **(for D & CD years)**	
Year	**Trinity Water Year Type**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**	**No Action**	**Alt. 2**
1980	W	24	24	0	0	10	10
1981	D	4	4	8	9	0	0
1982	EW	23	23	0	0	1	1
1983	EW	7	7	8	8	3	3
1984	W	4	4	0	1	24	24
1985	D	4	6	0	5	5	5
1986	W	7	7	4	5	20	20
1987	D	18	19	3	3	4	6
1988	D	3	3	2	5	0	0
1989	N	19	19	3	3	30	32
1990	D	9	9	0	0	0	0
1991	CD	1	1	2	3	4	7
1992	D	10	17	12	12	7	7
1993	W	10	10	0	0	23	23
1994	CD	18	19	12	12	4	7
1995	EW	5	5	0	0	14	14
1996	W	14	14	1	1	20	20
1997	W	28	28	1	1	16	16
1998	EW	18	18	0	0	5	6
1999	W	10	10	2	3	20	23
2000	W	8	8	0	0	20	20
2001	D	13	15	13	13	0	0
2002	N	12	12	6	6	30	32
2003	EW	0	0	0	0	12	13
# of days of Non-compliance		269	282	77	90	248/24	257/32
Total # of Days		888	888	360	360	840 (N/W/EW) 99 (D/CD)	840 (N/W/EW) 99 (D/CD)
%		30%	32%	21%	25%	30%/24%	31%/32%

Key:
% = percent
ºF = degrees Fahrenheit
CD = critically dry
D = dry
EW = extremely wet
N = normal
RM = River Mile
W = wet

Klamath River Below Trinity River The temperature impacts associated with Alternative 2 for Klamath River temperatures (near Klamath) were evaluated by comparing the simulated temperatures of the No Action Alternative and Alternative 2. A comparison of daily water temperature (averaged by month for Alternative 2 and No Action temperatures) is presented for each location, and tabular monthly averages are presented in Table 5-54. The alternatives identified herein do not increase the water temperature by 5ºF (NCRWQCB 2011). There are no temperature objectives for the lower Klamath River.

Water temperatures at Klamath River (near Klamath) under Alternative 2 were similar to the No Action Alternative in most all year types, and in most months, except August and September. In extremely wet and wet years, the monthly average water temperatures for Alternative 1 were within +/-0.5ºF (less than 1 percent) of No Action conditions. For the normal, dry, and critically dry years temperatures were 1.9ºF (3 percent) to 4.0ºF (6 percent) cooler. Temperatures in the Klamath River (at Klamath) did not exhibit the same magnitude of cooling due to water comingling and heating from the confluence of the Trinity River through to the Klamath River Estuary.

Table 5-54. Changes in Klamath River near Klamath Water Temperature Under Alternative 2 as Compared to the No Action Alternative, by Trinity Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Extremely Wet	56.6	48.6	43.7	42.7	45.6	47.6	49.9	56.2	61.4	69.3	72.5	67.1
Wet	57.6	49.5	43.7	43.3	45.2	49.4	52.7	56.3	63.9	71.2	73.0	66.6
Normal	59.9	50.4	43.4	42.0	43.6	47.5	56.7	56.9	66.2	72.0	73.1	67.7
Dry	58.0	49.4	43.6	43.2	45.4	50.4	56.4	60.2	69.1	75.5	73.8	67.2
Critically Dry	58.5	48.6	42.2	43.1	46.7	49.8	55.5	60.6	68.3	76.9	74.4	69.7
Average All Years	57.8	49.3	43.5	43.0	45.3	49.3	53.9	57.9	65.6	72.7	73.3	67.2
Alternative 2 (°F)												
Extremely Wet	56.7	48.6	43.7	42.7	45.6	47.6	49.9	56.2	61.5	69.3	72.5	67.1
Wet	57.6	49.5	43.7	43.3	45.2	49.4	52.7	56.3	64.0	71.2	72.8	66.4
Normal	59.9	50.4	43.4	42.0	43.6	47.5	56.7	57.0	66.3	72.1	72.0	64.2
Dry	58.0	49.4	43.6	43.2	45.4	50.4	56.4	60.6	69.3	75.4	72.9	65.3
Critically Dry	58.5	48.6	42.2	43.1	46.7	49.9	55.5	60.9	69.0	76.9	72.8	65.7
Average All Years	57.9	49.3	43.5	43.0	45.3	49.3	53.9	58.1	65.8	72.7	72.7	65.9
No Action Compared to Alternative 2 (°F)												
Extremely Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.2	-0.2
Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-1.1	-3.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.0	-0.9	-1.9
Critically Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	-1.6	-4.0
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	-0.6	-1.3
No Action Compared to Alternative 2 (%)												
Extremely Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-5%
Dry	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	-1%	-3%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	-2%	-6%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%

Key:
% = percent
ºF = degrees Fahrenheit

Changes in Nutrients, Organic Matter, and Dissolved Oxygen

Trinity River: Lewiston Dam to Klamath River For the Trinity River under Alternative 2, nutrient concentrations, organic matter and DO would be similar to the No Action Alternative because all releases from Trinity Reservoir would be of similar quality. During the spring period when releases from Trinity Reservoir to the Trinity River would be lower than Alternative 2 than under No Action, flows are typically still high in response to snowmelt runoff from adjacent watershed areas in both the Klamath and Trinity Rivers (i.e., several 1,000 cubic feet per second (cfs)). Thus, reduced flows from Trinity Reservoir would have a modest impact on Trinity River nutrients and organic matter. DO conditions would be similar under Alternative 2 and No Action due to mechanical reaeration throughout much of this reach.

Klamath River: Below Trinity River For the lower Klamath River, under Alternative 2, lower nutrient and organic matter concentrations would be anticipated during August and September in comparison to the No Action Alternative. The Trinity River typically experiences lower nutrients and organic matter conditions than the Klamath River. Thus, during periods when augmentation flows occur, contributions from the Trinity River will result in lower nutrient and organic matter concentrations in the Klamath River below the Trinity River confluence due to dilution effects. During the spring period flows are typically still high in response to snowmelt runoff from adjacent watershed areas in both the Klamath and Trinity Rivers (i.e., several 1,000 cfs), minimizing any impacts on nutrients and organic matter concentrations. Concentration of blue-green algae is expected to be similar or lower in comparison to the No Action Alternative because high temperature and nutrient conditions that contribute to algal blooms would not increase in frequency or magnitude.

For the lower Klamath River, under Alternative 2, similar DO concentrations would be anticipated during August and September in comparison to the No Action Alternative. This is because mechanical reaeration maintains both rivers at or near saturation concentration. Because DO saturation concentration is a function of water temperature, the lower Klamath River may experience slightly lower DO concentrations during augmentation due to slightly cooler water temperatures.

Central Valley and Bay-Delta Region

Changes in Water Temperature

Sacramento River Below Keswick Dam Water temperatures on the Sacramento River are summarized in Table 5-55 through Table 5-58. Water temperatures on the Sacramento River, below Clear Creek and at Balls Ferry, Jellys Ferry, and Bend Bridge under Alternative 2, would be similar to the No Action Alternative with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-55. Changes in Water Temperature on Sacramento River Below Clear Creek Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	55.1	54.8	50.7	47.0	45.9	46.6	48.5	50.1	51.0	51.9	53.2	52.0
Above Normal	55.9	54.8	50.8	47.4	46.2	47.4	49.0	50.5	50.7	51.3	52.8	52.6
Below Normal	55.1	55.0	51.5	48.1	47.3	48.9	49.9	50.8	51.3	52.3	53.6	54.9
Dry	55.8	55.0	51.2	48.3	47.8	49.0	50.3	51.1	51.5	52.9	54.9	55.9
Critical	58.4	56.1	51.7	47.9	47.6	49.4	50.3	52.6	54.1	56.0	59.1	62.3
Average All Years	55.9	55.1	51.1	47.7	46.9	48.1	49.5	50.9	51.6	52.7	54.5	55.0
Alternative 2 (°F)												
Wet	55.1	54.8	50.7	47.0	45.9	46.6	48.5	50.1	51.0	51.9	53.1	52.0
Above Normal	55.9	54.9	50.9	47.4	46.2	47.4	49.0	50.5	50.7	51.3	52.8	52.6
Below Normal	55.0	55.0	51.5	48.1	47.3	48.9	49.9	50.8	51.4	52.3	53.6	54.9
Dry	55.7	54.9	51.2	48.3	47.8	49.0	50.3	51.1	51.5	52.9	54.8	55.8
Critical	58.5	56.1	51.7	47.8	47.6	49.4	50.3	52.6	54.2	56.0	59.0	62.5
Average All Years	55.9	55.1	51.1	47.7	46.9	48.1	49.5	50.9	51.6	52.7	54.4	55.0
No Action Compared to Alternative 2 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Above Normal	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Dry	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.2
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-56. Changes in Water Temperature on Sacramento River at Balls Ferry Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	55.6	54.3	49.7	46.7	46.2	47.3	50.1	52.4	53.0	53.3	54.5	52.8
Above Normal	56.4	54.4	50.0	47.0	46.4	48.2	50.7	52.5	52.3	52.4	54.0	53.6
Below Normal	55.5	54.5	50.6	47.5	47.5	49.7	51.4	52.5	52.8	53.4	54.7	56.2
Dry	56.2	54.6	50.4	47.8	47.9	49.8	51.9	53.0	52.9	54.1	56.1	57.3
Critical	58.8	55.9	51.0	47.6	48.0	50.4	51.5	54.2	55.5	57.1	60.2	63.3
Average All Years	56.3	54.7	50.2	47.3	47.1	48.8	51.0	52.8	53.2	54.0	55.7	56.1
Alternative 2 (°F)												
Wet	55.6	54.3	49.7	46.7	46.2	47.3	50.0	52.4	53.0	53.4	54.5	52.8
Above Normal	56.4	54.4	50.0	47.0	46.4	48.2	50.7	52.5	52.3	52.4	54.0	53.6
Below Normal	55.5	54.5	50.6	47.5	47.5	49.7	51.4	52.5	52.9	53.4	54.7	56.2
Dry	56.2	54.6	50.4	47.8	47.9	49.8	51.9	53.0	52.9	54.1	56.0	57.2
Critical	58.8	55.9	51.0	47.6	48.0	50.4	51.5	54.2	55.5	57.1	60.0	63.5
Average All Years	56.3	54.7	50.2	47.2	47.1	48.8	51.0	52.8	53.2	54.0	55.6	56.1
No Action Compared to Alternative 2 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.0	0.0
Above Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.2
Average All Years	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-57. Changes in Water Temperature on Sacramento River at Jellys Ferry Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	56.0	53.8	48.9	46.4	46.4	48.1	51.6	54.7	55.4	55.1	56.1	53.8
Above Normal	56.9	54.0	49.2	46.6	46.6	49.0	52.2	54.9	54.3	53.8	55.4	54.8
Below Normal	56.0	54.0	49.6	46.9	47.6	50.4	53.0	54.4	54.5	54.8	56.0	57.7
Dry	56.6	54.2	49.6	47.3	47.9	50.4	53.4	55.0	54.5	55.4	57.5	58.9
Critical	59.0	55.5	50.2	47.2	48.3	51.2	52.8	55.9	57.0	58.4	61.3	64.2
Average All Years	56.7	54.2	49.4	46.8	47.2	49.6	52.5	54.9	55.1	55.4	57.1	57.3
Alternative 2 (°F)												
Wet	56.0	53.9	48.9	46.4	46.4	48.1	51.6	54.7	55.4	55.1	56.1	53.8
Above Normal	56.8	54.1	49.2	46.6	46.6	49.0	52.2	54.9	54.3	53.9	55.4	54.8
Below Normal	55.9	54.0	49.6	46.9	47.6	50.4	53.0	54.4	54.6	54.8	56.0	57.8
Dry	56.6	54.2	49.6	47.3	47.9	50.4	53.4	55.0	54.5	55.4	57.5	58.8
Critical	59.1	55.5	50.2	47.2	48.3	51.2	52.8	56.0	57.1	58.4	61.2	64.4
Average All Years	56.7	54.2	49.4	46.8	47.2	49.6	52.5	54.9	55.1	55.4	57.1	57.3
No Action Compared to Alternative 2 (°F)												
Wet	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Below Normal	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Critical	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	0.2
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Table 5-58. Changes in Water Temperature on Sacramento River at Bend Bridge Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	56.3	53.5	48.5	46.4	46.6	48.6	52.3	55.6	56.4	56.2	57.3	54.6
Above Normal	57.2	53.7	48.8	46.5	46.8	49.7	53.2	55.9	55.4	54.9	56.6	55.7
Below Normal	56.2	53.7	49.1	46.7	47.7	51.0	53.7	55.4	55.6	55.8	57.1	58.8
Dry	56.9	53.8	49.1	47.0	47.9	51.0	54.2	56.1	55.7	56.6	58.7	60.0
Critical	59.3	55.2	49.7	47.0	48.5	51.7	53.6	56.9	58.1	59.5	62.2	64.8
Average All Years	57.0	53.9	49.0	46.7	47.4	50.1	53.3	55.9	56.2	56.5	58.2	58.2
Alternative 2 (°F)												
Wet	56.3	53.5	48.5	46.4	46.6	48.6	52.3	55.6	56.4	56.3	57.2	54.6
Above Normal	57.1	53.7	48.8	46.5	46.8	49.6	53.2	55.9	55.4	54.9	56.6	55.7
Below Normal	56.2	53.7	49.1	46.7	47.7	51.0	53.7	55.5	55.6	55.8	57.1	58.8
Dry	56.9	53.8	49.2	47.0	47.9	51.0	54.2	56.1	55.7	56.6	58.7	60.0
Critical	59.3	55.2	49.7	47.0	48.4	51.7	53.6	56.9	58.1	59.5	62.1	64.9
Average All Years	57.0	53.9	49.0	46.7	47.4	50.1	53.3	55.9	56.2	56.5	58.2	58.2
No Action Compared to Alternative 2 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0
Above Normal	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.1
Average All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Clear Creek Below Whiskeytown Dam Water temperatures on Clear Creek at Igo are summarized in Table 5-59. Water temperatures on Clear Creek under Alternative 2 would be similar to the No Action Alternative, with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-59. Changes in Water Temperature on Clear Creek at Igo Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (°F)												
Wet	52.2	50.4	46.6	44.5	44.5	45.5	47.2	48.7	50.8	54.8	55.0	52.7
Above Normal	53.4	50.9	46.7	44.7	44.6	45.6	47.3	48.7	50.9	54.8	54.8	52.9
Below Normal	52.4	50.3	46.6	44.3	44.7	46.2	47.9	48.8	51.2	55.1	55.3	53.9
Dry	53.5	50.9	47.1	45.0	45.1	46.4	48.0	49.0	51.4	55.3	56.0	54.5
Critical	55.7	52.9	48.3	45.9	46.1	47.3	49.1	50.8	54.4	56.3	56.9	57.6
Average All Years	53.3	51.0	47.0	44.8	44.9	46.1	47.8	49.1	51.5	55.2	55.5	54.1
Alternative 2 (°F)												
Wet	52.2	50.4	46.6	44.5	44.5	45.5	47.2	48.7	50.8	54.8	55.0	52.7
Above Normal	53.4	51.0	46.7	44.7	44.6	45.6	47.3	48.7	50.9	54.8	54.8	52.8
Below Normal	52.3	50.2	46.6	44.3	44.7	46.2	48.0	49.2	51.4	55.2	55.3	53.9
Dry	53.5	50.9	47.1	45.0	45.1	46.4	48.0	49.0	51.5	55.3	56.0	54.3
Critical	55.6	52.8	48.3	45.9	46.1	47.3	49.0	50.8	54.4	56.2	56.8	57.3
Average All Years	53.2	51.0	47.0	44.8	44.9	46.1	47.8	49.2	51.6	55.2	55.5	54.0
No Action Compared to Alternative 2 (°F)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Below Normal	-0.1	-0.1	0.0	0.0	0.0	0.0	0.1	0.4	0.2	0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.2
Critical	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.3
Average All Years	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.1
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
ºF = degrees Fahrenheit

Feather River Below Thermalito/Oroville Dam Temperatures on the Feather River were not modelled, but because Oroville storage and releases change by 1 percent or less in Alternative 2 (as compared to the No Action Alternative) changes in downstream water temperatures are assumed to be similar. See Tables 4-44 and 4-46 in Chapter 4, “Surface Water Supply and Management,” for changes in Oroville storage and flows on the Feather River.

American River Below Nimbus Dam Temperatures on the American River were not modelled, but because Folsom storage and releases change by 1 percent or less in Alternative 2 (as compared to the No Action Alternative) changes in downstream water temperatures are assumed to be similar. See Tables 4-48 and 4-50 in Chapter 4, “Surface Water Supply and Management,” for changes in Folsom storage and flows on the American River.

Changes in Salinity

Delta Salinity Salinities in the Delta at Rock Slough, Emmaton, Jersey Point, Collinsville, and at Banks and Jones Pumping Plants, are summarized in Table 5-60 through Table 5-65. Salinities at these six locations under Alternative 2 would be similar to the No Action Alternative—with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-60. Changes in Salinity (EC) at Rock Slough Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	569	538	520	586	588	533	455	392	280	278	338	575
Above Normal	783	870	741	596	543	524	402	416	289	282	362	563
Below Normal	579	551	565	663	529	427	409	419	307	346	467	696
Dry	695	727	748	756	510	426	384	378	306	414	647	735
Critical	909	997	1,043	977	627	487	418	417	423	539	749	887
Average All Years	685	706	693	696	560	484	417	400	312	359	495	674
Alternative 2 (umhos/cm)												
Wet	569	538	520	586	588	533	455	392	280	278	338	575
Above Normal	784	871	738	595	543	524	402	416	289	282	363	564
Below Normal	579	551	565	663	529	427	409	419	307	346	466	696
Dry	695	727	748	756	510	426	384	378	306	414	649	736
Critical	909	998	1,045	978	626	487	417	418	422	539	748	888
Average All Years	685	706	693	697	560	484	417	400	312	359	495	674
No Action Compared to Alternative 2 (umhos/cm)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	1	1	-3	-1	0	0	0	0	0	0	1	1
Below Normal	0	0	0	0	0	0	0	0	0	0	-1	0
Dry	0	0	0	0	0	0	0	0	0	0	2	1
Critical	0	1	2	1	-1	0	-1	1	-1	0	-1	1
Average All Years	0	0	0	1	0	0	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-61. Changes in Salinity (EC) on Sacramento River at Emmaton Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	1,323	774	312	214	184	183	187	192	276	297	838	328
Above Normal	2,713	1,735	720	271	193	184	193	209	384	347	855	557
Below Normal	1,386	1,079	869	463	248	223	244	292	551	501	1,113	2,228
Dry	2,242	1,822	1,298	599	286	222	248	327	607	986	2,119	2,866
Critical	3,430	3,346	2,163	1,017	437	358	436	815	1,503	2,134	3,007	3,860
Average All Years	2,084	1,599	963	468	256	224	247	332	591	769	1,508	1,755
Alternative 2 (umhos/cm)												
Wet	1,323	774	312	214	184	183	187	192	276	297	838	328
Above Normal	2,721	1,717	720	271	193	184	193	209	384	347	854	558
Below Normal	1,386	1,078	869	463	248	223	244	292	551	500	1,113	2,229
Dry	2,241	1,818	1,298	599	286	222	248	327	607	985	2,120	2,867
Critical	3,438	3,344	2,163	1,016	436	358	436	815	1,498	2,143	3,012	3,874
Average All Years	2,087	1,595	963	468	256	224	247	332	590	770	1,508	1,757
No Action Compared to Alternative 2 (umhos/cm)												
Wet	0	0	0	0	0	0	0	0	0	0	0	0
Above Normal	8	-18	0	0	0	0	0	0	0	0	-1	1
Below Normal	0	-1	0	0	0	0	0	0	0	-1	0	1
Dry	-1	-4	0	0	0	0	0	0	0	-1	1	1
Critical	8	-2	0	-1	-1	0	0	0	-5	9	5	14
Average All Years	3	-4	0	0	0	0	0	0	-1	1	0	2
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-62. Changes in Salinity (EC) on San Joaquin River at Jersey Point Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	1,114	958	503	284	238	221	222	214	239	345	1,063	936
Above Normal	2,148	1,759	1,088	465	252	218	229	239	305	468	1,178	1,007
Below Normal	1,107	1,151	1,168	692	325	243	248	276	378	816	1,458	2,431
Dry	1,693	1,689	1,590	952	389	255	248	288	416	1,298	1,704	2,466
Critical	2,459	2,509	2,134	1,309	536	330	352	542	904	1,613	2,115	2,718
Average All Years	1,615	1,516	1,189	680	332	248	252	292	409	846	1,445	1,782
Alternative 2 (umhos/cm)												
Wet	1,115	957	503	284	238	221	222	214	239	345	1,063	936
Above Normal	2,148	1,741	1,086	465	252	218	229	239	305	468	1,180	1,008
Below Normal	1,107	1,151	1,168	692	325	243	248	276	378	816	1,458	2,432
Dry	1,693	1,689	1,591	952	388	255	248	288	416	1,300	1,705	2,467
Critical	2,463	2,514	2,136	1,307	535	330	352	542	906	1,610	2,117	2,718
Average All Years	1,616	1,514	1,189	680	332	248	252	292	409	846	1,445	1,782
No Action Compared to Alternative 2 (umhos/cm)												
Wet	1	-1	0	0	0	0	0	0	0	0	0	0
Above Normal	0	-18	-2	0	0	0	0	0	0	0	2	1
Below Normal	0	0	0	0	0	0	0	0	0	0	0	1
Dry	0	0	1	0	-1	0	0	0	0	2	1	1
Critical	4	5	2	-2	-1	0	0	0	2	-3	2	0
Average All Years	1	-2	0	0	0	0	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-63. Changes in Salinity (EC) on Sacramento River at Collinsville Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	4,127	2,900	1,039	403	200	198	218	291	916	1,422	3,821	1,226
Above Normal	7,539	5,358	2,987	778	261	220	249	421	1,716	1,869	3,925	2,880
Below Normal	4,255	3,826	3,579	2,046	752	599	725	1,154	2,518	2,746	4,747	7,305
Dry	6,541	6,049	5,129	2,772	956	540	778	1,409	2,765	4,487	6,762	8,422
Critical	9,144	9,192	7,249	4,254	1,845	1,454	2,011	3,327	5,037	6,844	8,416	9,739
Average All Years	6,008	5,103	3,595	1,824	709	523	690	1,145	2,312	3,212	5,351	5,305
Alternative 2 (umhos/cm)												
Wet	4,128	2,895	1,038	403	200	198	218	291	916	1,422	3,820	1,226
Above Normal	7,548	5,313	2,986	777	261	220	249	421	1,715	1,869	3,923	2,879
Below Normal	4,255	3,826	3,579	2,047	752	599	725	1,154	2,518	2,745	4,746	7,306
Dry	6,540	6,044	5,128	2,771	955	540	778	1,409	2,766	4,485	6,763	8,424
Critical	9,155	9,194	7,248	4,250	1,843	1,455	2,012	3,328	5,032	6,852	8,426	9,749
Average All Years	6,011	5,093	3,594	1,823	708	523	690	1,145	2,311	3,212	5,353	5,307
No Action Compared to Alternative 2 (umhos/cm)												
Wet	1	-5	-1	0	0	0	0	0	0	0	-1	0
Above Normal	9	-45	-1	-1	0	0	0	0	-1	0	-2	-1
Below Normal	0	0	0	1	0	0	0	0	0	-1	-1	1
Dry	-1	-5	-1	-1	-1	0	0	0	1	-2	1	2
Critical	11	2	-1	-4	-2	1	1	1	-5	8	10	10
Average All Years	3	-10	-1	-1	-1	0	0	0	-1	0	2	2
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-64. Changes in Salinity (EC) at Banks Pumping Plant Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	473	443	428	470	389	329	250	276	301	281	307	458
Above Normal	667	662	571	591	517	407	331	362	324	274	317	414
Below Normal	478	460	494	584	558	476	380	424	356	306	392	615
Dry	570	588	600	663	592	549	452	453	352	364	515	632
Critical	742	780	788	768	708	690	569	535	452	490	605	740
Average All Years	568	565	554	595	528	467	376	391	347	334	414	556
Alternative 2 (umhos/cm)												
Wet	473	442	427	470	389	329	250	276	301	281	307	458
Above Normal	668	660	570	591	517	407	331	362	324	274	317	415
Below Normal	478	460	494	584	558	476	380	424	356	306	392	615
Dry	570	588	600	664	592	549	452	453	352	364	515	633
Critical	743	782	790	768	708	689	569	535	451	489	604	739
Average All Years	568	564	554	595	528	467	376	391	346	334	414	556
No Action Compared to Alternative 2 (umhos/cm)												
Wet	0	-1	-1	0	0	0	0	0	0	0	0	0
Above Normal	1	-2	-1	0	0	0	0	0	0	0	0	1
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	1	0	0	0	0	0	0	0	1
Critical	1	2	2	0	0	-1	0	0	-1	-1	-1	-1
Average All Years	0	-1	0	0	0	0	0	0	-1	0	0	0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

Table 5-65. Changes in Salinity (EC) at Jones Pumping Plant Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (umhos/cm)												
Wet	473	455	496	517	406	336	265	288	345	345	331	449
Above Normal	624	627	608	631	572	449	353	375	373	332	343	426
Below Normal	478	469	564	627	618	531	405	433	392	334	407	581
Dry	550	570	633	687	664	619	483	480	388	383	512	602
Critical	684	721	761	774	784	787	621	569	472	492	588	696
Average All Years	547	551	595	629	579	515	403	409	385	372	425	536
Alternative 2 (umhos/cm)												
Wet	473	454	496	517	406	336	265	288	345	345	331	449
Above Normal	624	626	608	630	572	449	353	375	373	332	343	426
Below Normal	478	469	564	627	618	531	405	433	392	334	407	581
Dry	550	570	633	688	664	619	483	480	388	383	513	602
Critical	685	722	764	774	782	786	621	569	470	491	587	695
Average All Years	547	551	595	629	579	515	403	409	385	372	425	536
No Action Compared to Alternative 2 (umhos/cm)												
Wet	0	-1	0	0	0	0	0	0	0	0	0	0
Above Normal	0	-1	0	-1	0	0	0	0	0	0	0	0
Below Normal	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	1	0	0	0	0	0	0	1	0
Critical	1	1	3	0	-2	-1	0	0	-2	-1	-1	-1
Average All Years	0	0	0	0	0	0	0	0	0	0	0	0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
EC = electrical conductivity
umhos/cm = micromhos per centimeter

X2 Position X2 positions are summarized in Table 5-66. X2 positions in Alternative 2 would be similar to the No Action Alternative—with all months, of all year types, changing less than, or equal to, 1 percent.

Table 5-66. Changes in X2 Positions Under Alternative 2 as Compared to the No Action Alternative, by Sacramento Water Year Type

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Action (km)												
Wet	80.6	76.8	63.7	54.8	51.2	53.1	55.1	58.4	67.3	74.9	82.8	73.9
Above Normal	86.8	82.6	75.2	60.9	54.9	55.3	59.1	65.2	75.3	77.8	83.1	74.7
Below Normal	80.4	80.3	80.4	74.6	64.3	66.9	69.0	72.9	79.1	81.1	85.1	89.4
Dry	85.7	85.5	84.5	77.7	67.7	65.4	68.8	74.5	80.1	84.5	87.6	90.6
Critical	90.5	90.7	88.3	82.1	75.3	74.6	77.7	82.3	85.2	87.9	90.3	92.2
Average All Years	84.2	82.4	76.4	68.0	61.1	61.4	64.2	68.9	75.9	80.4	85.4	82.9
Alternative 2 (km)												
Wet	80.6	76.8	63.7	54.8	51.2	53.1	55.1	58.4	67.3	74.9	82.8	73.9
Above Normal	86.9	82.6	75.2	60.9	54.9	55.3	59.1	65.2	75.3	77.8	83.1	74.7
Below Normal	80.4	80.3	80.4	74.6	64.3	66.9	69.0	72.9	79.1	81.1	85.1	89.4
Dry	85.7	85.5	84.5	77.7	67.7	65.4	68.8	74.5	80.1	84.5	87.6	90.6
Critical	90.5	90.7	88.3	82.1	75.3	74.6	77.7	82.3	85.2	87.9	90.3	92.2
Average All Years	84.2	82.3	76.4	68.0	61.1	61.4	64.2	68.9	75.9	80.4	85.4	82.9
No Action Compared to Alternative 2 (km)												
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Normal	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average All Years	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Action Compared to Alternative 2 (%)												
Wet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Above Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Critical	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average All Years	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key:
% = percent
km = kilometer

Summary of Environmental Consequences

Table 5-67 presents the results of the environmental consequences analysis for implementing the action alternatives compared to the No Action Alternative.

It should be noted that since concentrations of water quality constituents not covered in the impact analysis would be managed through regulatory processes by 2030, it is assumed that concentrations of these constituents would be similar under the No Action Alternative and the action alternatives.

Environmental effects associated with changes in water temperatures are related to impacts on biological resources (as described in Chapter 7, “Biological Resources – Fisheries”). Therefore, the potential impacts of the action alternatives related to changes in water temperature, including changes resulting from including reasonably and foreseeable actions, are presented in Chapter 7.

Table 5-67. Comparison of Action Alternatives to No Action Alternative

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1	*Trinity River: Lewiston Dam to the Klamath River*	
	Water temperatures on the Trinity River, below Lewiston Dam, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are increases of 2% in October and December of normal years, increases of 5% in July in critically dry years, and reductions of 2% and 3% in August and September respectively. Days of non-compliance with temperature objectives changed by 1% or less in the spring compared to the No Action Alternative. Water temperatures on the Trinity River at Douglas City would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in normal years, with reductions of 2% in September and 2% increases in October, and in critically dry years, with increases of 4% in July and reductions of 2% and 3% in August and September. Days of non-compliance with temperature objectives changed by 1% or less in the fall and spring compared to the No Action Alternative. Water temperatures on the Trinity River, below the North Fork Trinity River, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in July of critically dry years (2% increase), August of normal and critically dry years (3% decrease), and September of critically dry, dry, and normal years, with reductions of 2% to 6%. Days of non-compliance with temperature objectives changed by 1% or less in the fall and spring compared to the No Action Alternative. Water temperatures on the Trinity River, below the South Fork Trinity River, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in critically dry, dry, and normal years, in August (reductions of 2% to 4%) and in September (reductions of 5% to 9%). Days of non-compliance with temperature objectives changed by 1% or less in the spring compared to the No Action Alternative. Water temperatures on the Trinity River near Weitchpec would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in critically dry, dry, and normal years, in August (reductions of 2% to 4% change) and in September (reductions of 5% to 9%). Days of non-compliance with temperature objectives changed by 1% or less in the spring compared to the No Action Alternative.	Environmental effects associated with changes in water temperature may affect fish habitat and are related to impacts on fisheries (as described in Chapter 7, “Biological Resources – Fisheries”). Mitigation measures, if needed, related to environmental changes caused by changes in surface water quality conditions are presented in Chapter 7.
	Nutrient concentrations, organic matter concentrations, and DO in the Trinity River would be similar to the No Action Alternative during all months and year types.	None needed

Table 5-67. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1 (contd.)	*Klamath River: Below Trinity River* Water temperatures on the lower Klamath River would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in critically dry and normal years, in August (reductions of 2%) and in September (reductions of 3% to 6%). Nutrient concentrations, organic matter concentrations, and DO in the lower Klamath River would be similar to the No Action Alternative during most months and year types. Lower nutrient and organic matter concentrations are anticipated in August and September during flow augmentation actions, particularly in drier years.	None needed
	Sacramento River Below Keswick Dam Water temperatures on the Sacramento River below Clear Creek, and at Balls Ferry, Jellys Ferry, and Bend Bridge, would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%. *Clear Creek Below Whiskeytown Dam* Water temperatures on Clear Creek at Igo would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%. *Feather River Below Thermalito/Oroville Dam* Water temperatures on the Feather River were not modelled, but because Oroville storage and releases change by 1% or less in Alternative 1 (as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar. *American River Below Nimbus Dam* Water temperatures on the American River were not modelled, but because Folsom storage and releases change by 1% or less in Alternative 1 (as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar.	None needed
	Delta Salinity Salinities in the Delta at Rock Slough, Emmaton, Jersey Point, Collinsville, and at Banks and Jones Pumping Plants would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	None needed
	X2 Position X2 Position would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	None Needed

Table 5-67. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 2	*Trinity River: Lewiston Dam to the Klamath River* Water temperatures on the Trinity River, below Lewiston Dam, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are increases of 2% in December of normal years, and in critically dry years, reductions of 2% in August and 3% in September. Days of non-compliance with temperature objectives changed by 1% or less in the spring compared to the No Action Alternative. Water temperatures on the Trinity River at Douglas City would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in normal years, with reductions of 2% in September, and in critically dry years, with increases of 2% in June and reductions of 2% and 3% in August and September. Days of non-compliance with temperature objectives changed by 1% or less in the fall and spring compared to the No Action Alternative. Water temperatures on the Trinity River, below the North Fork Trinity River, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in June of critically dry years (3% increase), August of normal, dry and critically dry years (reductions of 2% to 3%), and September of critically dry, dry, and normal years, with reductions of 3% to 6%. Days of non-compliance with temperature objectives changed by 1% or less in the fall and spring compared to the No Action Alternative. Water temperatures on the Trinity River, below the South Fork Trinity River, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in June of critically dry years (2% increase), and in critically dry, dry, and normal years, in August (reductions of 2% to 4%) and in September (reductions of 5% to 9%). The percent of days out of compliance with spring temperature objectives increased by 2% compared to the No Action Alternative. Water temperatures on the Trinity River near Weitchpec would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in June of critically dry years (2%), and in critically, dry, and normal years in August (reductions of 2% to 4%) and in September (reductions of 5% to 9%). The percent of days out of compliance with spring temperature objectives increased by 2% compared to the No Action Alternative.	Environmental effects associated with changes in water temperature may affect fish habitat and are related to impacts on fisheries (as described in Chapter 7, "Biological Resources – Fisheries"). Mitigation measures, if needed, related to environmental changes caused by changes in surface water quality conditions are presented in Chapter 7.
	Nutrient concentrations, organic matter concentrations, and DO in the Trinity River would be similar to the No Action Alternative during all months and year types.	None needed

Table 5-67. Comparison of Action Alternatives to No Action Alternative (contd.)

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 2 (contd.)	*Klamath River: Below Trinity River* Water temperatures on the Klamath River, below the Trinity River, would be similar to the No Action Alternative, with most months of the year changing 1% or less. Exceptions are in critically dry and normal years in August (reductions of 2%) and in critically dry, dry, and normal years in September (reductions of 3% to 6%). Nutrient concentrations, organic matter concentrations, and DO in the lower Klamath River would be similar to the No Action Alternative during most months and year types. Lower nutrient and organic matter concentrations are anticipated in August and September during flow augmentation actions, particularly in drier years.	None needed
	Sacramento River Below Keswick Dam Water temperatures on the Sacramento River below Clear Creek, and at Balls Ferry, Jellys Ferry, and Bend Bridge, would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%. *Clear Creek Below Whiskeytown Dam* Water temperatures on Clear Creek at Igo would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%. *Feather River Below Thermalito/Oroville Dam* Water temperatures on the Feather River were not modelled, but because Oroville storage and releases change by 1% or less in Alternative 2 (as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar. *American River Below Nimbus Dam* Water temperatures on the American River were not modelled, but because Folsom storage and releases change by 1% or less in Alternative 2 (as compared to the No Action Alternative), changes in downstream water temperatures are assumed to be similar.	None needed
	Delta Salinity Salinities in the Delta at Rock Slough, Emmaton, Jersey Point, Collinsville, and at Banks and Jones Pumping Plants would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	None needed
	X2 Position X2 Position would be similar to the No Action Alternative with all months of all year types changing less than, or equal to, 1%.	None needed

Key:
% = percent
DO = dissolved oxygen

Potential Mitigation Measures

Mitigation measures are identified, as appropriate, to avoid, minimize, rectify, reduce, eliminate, or compensate for adverse environmental effects of action alternatives, as compared to the No Action Alternative.

There are no mitigation measures proposed for direct environmental impacts from changes to water temperature due to CVP and SWP operational changes. Impacts of these changes on other resource areas (i.e., fisheries) and potential mitigation measures, if required, are included in the chapters dealing with the specific resource area.

Cumulative Effects Analysis

The cumulative effects analysis considers projects, programs, and policies that are not speculative; and are based upon known or reasonably foreseeable long-range plans, regulations, operating agreements, or other information that establishes them as reasonably foreseeable. The cumulative effects analysis of the action alternatives for water quality is summarized in Table 5-68. The methodology for this cumulative effects analysis is described in the Cumulative Effects Technical Appendix.

Table 5-68. Summary of Cumulative Effects on Water Quality of Action Alternatives as Compared to the No Action Alternative

Scenarios	**Cumulative Effects of Actions**
No Action Alternative with Associated Cumulative Effects Actions in Year 2030	*Conditions and Actions included in Quantitative Analyses* *(Conditions and actions incorporated into No Action Alternative modeling)* Climate change is anticipated to increase ambient air temperatures, increasing water temperatures in both regulated and unregulated rivers and streams. Climate change is also anticipated to shift winter precipitation from snow to rain, which will lead to larger runoff events in the winter and less snowmelt in the spring. Reservoir storage in turn will be reduced during summer months because of the need to maintain flood capacity in the winter versus being able to store more predictable snowmelt-driven flows in the spring. Lower reservoir storages, combined with increases in ambient air temperatures, are expected to cause further increases in water temperatures downstream of reservoirs, compared to recent historical conditions. Sea-level rise is also likely to cause increased salinities in the Delta—and more eastward locations for X2—compared to recent historical conditions. *Additional Identified Actions* *(Additional projects identified in Cumulative Effects Technical Appendix)* Additional reasonably foreseeable actions related to improved water quality and habitat conditions (e.g., FERC relicensing projects and Klamath River Main-Stem Dam Removal), could influence the timing of stream flows and associated surface water temperatures and other water quality parameters.
Alternative 1 with Associated Cumulative Effects Actions in Year 2030	*Alternative 1 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 1 would result in similar water temperatures in most months and year types in both Klamath and Sacramento basin rivers as compared to the No Action Alternative. Exceptions include improvements (decreases) in water temperatures in the Klamath River below the Trinity River confluence in critically dry and normal years during September. Implementation of Alternative 1 would result in similar changes to water quality conditions for nutrients, DO, and organic matter in Klamath Basin rivers as compared to the No Action Alternative. Implementation of Alternative 1 would result in similar Delta water quality in all months and year types as compared to the No Action Alternative.

Table 5-68. Summary of Cumulative Effects on Water Quality of Action Alternatives as Compared to the No Action Alternative

Scenarios	Cumulative Effects of Actions
Alternative 1 with Associated Cumulative Effects Actions in Year 2030 (contd.)	*Alternative 1 with Additional Identified Actions* Implementation of Alternative 1 with the additional reasonably foreseeable actions would result in similar water temperatures in both Klamath and Sacramento basin rivers as compared to the No Action Alternative with the additional reasonably foreseeable actions. Exceptions include improvements (decreases) in water temperatures in the Klamath River below the Trinity River confluence in critically dry and normal years during September. Alternative 1 with the additional reasonably foreseeable action would result in beneficial effects to water quality, and therefore cumulative effects to water quality are not anticipated. Implementation of Alternative 1 with the additional reasonably foreseeable actions would result in similar Delta water quality in all months and year types as compared to the No Action Alternative with the additional reasonably foreseeable actions.
Alternative 2 with Associated Cumulative Effects Actions in Year 2030	*Alternative 2 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 2 would result in similar water temperatures in most months and year types in both Klamath and Sacramento basin rivers as compared to the No Action Alternative. Exceptions include improvements (decreases) in water temperatures in the Klamath River below the Trinity River confluence in critically dry and normal years during September. Implementation of Alternative 2 would result in similar changes to water quality conditions for nutrients, DO, and organic matter in Klamath Basin rivers as compared to the No Action Alternative. Implementation of Alternative 2 would result in similar Delta water quality in all months and year types as compared to the No Action Alternative. *Alternative 2 with Additional Identified Actions* Implementation of Alternative 2 with the additional reasonably foreseeable actions would result in similar water temperatures in most months and year types in both Klamath and Sacramento basin rivers as compared to the No Action Alternative with the additional reasonably foreseeable actions. Exceptions include improvements (decreases) in water temperatures in the Klamath River below the Trinity River confluence in critically dry and normal years during September. Implementation of Alternative 2 with the additional reasonably foreseeable actions would result in similar changes to water quality conditions for nutrients, DO, and organic matter in Klamath Basin rivers as the No Action Alternative with the additional reasonably foreseeable actions. Implementation of Alternative 2 with the additional reasonably foreseeable actions would result in similar Delta water quality in all months and year types as compared to the No Action Alternative with the additional reasonably foreseeable actions.

Key:
DO = Dissolved Oxygen
FERC = Federal Energy Regulatory Commission

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Chapter 6
Groundwater Resources/Groundwater Quality

Introduction

This chapter describes the groundwater resources/groundwater quality in the study area and the potential changes that could occur as a result of implementing the alternatives evaluated in this Environmental Impact Statement (EIS). Implementation of the alternatives could affect groundwater resources through operational changes at Trinity Dam and other Central Valley Project (CVP) facilities.

Affected Environment

This section describes groundwater resources that could potentially be affected by the implementation of the alternatives considered in this EIS. Groundwater is present throughout the study area. However, the groundwater resources that could be directly or indirectly affected through implementation of the alternatives analyzed in this EIS are located in groundwater basins. These resources are available to users of CVP surface water supplies, who also use groundwater to meet their water demands not met by surface water deliveries. In addition, there are areas along the rivers downstream of CVP reservoirs that also use and rely on groundwater supplies. Therefore, the following description of the affected environment is limited to these areas, and it does not include groundwater basins or subbasins that are not directly or indirectly affected by changes in CVP operations.

Changes in groundwater resources resulting from changes in CVP operations may occur in the Lower Klamath and Trinity River Region, and the Central Valley and Bay-Delta Region. The Lower Klamath and Trinity River Region includes the area in Trinity County along the Trinity River, from Trinity Lake to the river's confluence with the Klamath River; and in Humboldt and Del Norte Counties along the Klamath River, from its confluence with the Trinity River to the Pacific Ocean. The Central Valley and Bay-Delta Region extends from above Shasta Lake, south to the Tehachapi Mountains, and includes the Sacramento Valley, San Joaquin Valley, and the Sacramento-San Joaquin River Delta (Delta).

Overview of California Groundwater Resources

As described in Chapter 4, "Surface Water Supply and Management," groundwater is a vital resource in California. Groundwater supplied about 37 percent of the State's average agricultural, municipal, and industrial water needs between 1998 and 2010, and 40 percent or more during dry and critical water years in that period (DWR 2013). About 20 percent of the nation's groundwater demand is supplied from Central Valley aquifers, making it the second-most-pumped aquifer system in the United States (USGS 2009). The three Central Valley hydrologic regions (Tulare Lake, San Joaquin River, and Sacramento River) account for about 75 percent of California's average annual groundwater use (DWR 2013).

A delineation of the groundwater systems throughout the State has been conducted by the California Department of Water Resources (DWR), with the results presented in Bulletin 118-03 (DWR 2003). Specific groundwater studies have been conducted by regional water agencies or the U.S. Geological Survey (USGS), to update the statewide survey conducted by DWR in 1980 (USGS 2000, 2006, 2008, 2009, 2012). The results of some of those studies are referenced in the following subsections of this chapter.

The overdraft of groundwater basins is of serious concern and scrutiny in California, and is one of the factors for the passage of the Sustainable Groundwater Management Act (SGMA). A comprehensive assessment of overdraft in all of the State's groundwater basins has not been conducted since Bulletin 118-80 was published in 1980, but overdraft is estimated between 1 to 2 million acre-feet annually (DWR 2003). In DWR's Bulletin 118-80 (DWR 1980), an assessment of critically overdrafted basins was conducted, and this assessment identified 11 basins in critical condition of overdraft. Based on SGMA requirements, the State identified basins subject to critical conditions of overdraft in 2015, and provided local agencies and interested parties with the opportunity to provide comments on the draft list. These comments were evaluated by DWR against data submitted, and no revisions were made to the draft list. As described in the *Coordinated Long-Term Operation of the CVP and State Water Project* EIS (Reclamation 2015), the final list will also be included in Bulletin 118, Interim Update 2017, which is expected to be published in late 2016. The update will contain three basins in the EIS study area that are considered in critical conditions of overdraft (DWR 2015). The basins are:

- Merced: Subsidence in El Nido area of 0.6 to 1.0 ft/year
- Delta-Mendota: Significant, on-going and irreversible subsidence
- Westside: Significant, on-going and irreversible subsidence

Lower Klamath and Trinity River Region

The Lower Klamath and Trinity River Region includes the area along the Trinity River from Trinity Lake to the confluence with the Klamath River, and the lower Klamath River includes the area along the Klamath River from its confluence with the Trinity River to the Pacific Ocean. These two basins are the Hoopa Valley and Lower Klamath River Valley groundwater basins (DWR 2003).

Most usable groundwater in the Lower Klamath and Trinity River Region occurs in widely scattered alluvium-filled valleys, such as those immediately adjacent to the Trinity River. These valleys contain only small quantities of recoverable groundwater, and, therefore, are not considered a major source. A number of shallow wells adjacent to the river provide water for domestic purposes (Reclamation et al. 2006; NCRWQCB et al. 2009). Groundwater present in these alluvial valleys is in close hydraulic connection with the Trinity River and its tributaries. Both groundwater discharge to surface streams, as well as leakage of stream flow to underlying aquifers, are expected to occur at various locations.

Bulletin 118-03 (DWR 2003, DWR 2004a, 2004b) identified only two groundwater basins underlying the Lower Klamath and Trinity River Region, which are the Hoopa Valley and Lower Klamath River Valley groundwater basins. These groundwater basins are small, isolated, valley-fill aquifers that provide a very limited quantity of groundwater to satisfy local domestic, municipal, and agricultural needs. Groundwater pumped from these aquifer systems is used strictly for local supply.

Several communities use near-surface groundwater via intake galleries adjacent to the Trinity River (NCRWQCB et al. 2009). The systems using this include the Lewiston Community Services District, Lewiston Valley Water Company, and Lewiston Park Mutual Water Company.

Groundwater within the Hoopa Valley Indian Reservation occurs along alluvial terraces (Hoopa Valley Tribe 2008). The aquifers are approximately 10- to 80-feet deep, with some of the shallow wells being productive only during the winter and early spring months.

The Lower Klamath River Valley Groundwater Basin extends over 7,030 acres in Del Norte and Humboldt Counties, including areas along the lower Klamath River (Reclamation 2010). Groundwater along the lower Klamath River occurs in alluvial fans near the confluences of major tributaries and along terrace and floodplain deposits adjacent to the river (Yurok Tribe 2012). The depth of aquifers here ranges from 10 to 80 feet below ground surface and are used by some members of the community.

The Hoopa Valley and Lower Klamath River Valley groundwater basins were designated by the California Statewide Groundwater Elevation Monitoring Program program as very low and low priorities, respectively.

Groundwater quality is suitable for many beneficial uses in the region. In other locations, the groundwater can include naturally-occurring metals, such as manganese, cadmium, zinc, and barium (Hoopa Valley Tribe 2008). Groundwater quality issues include nitrate contamination (DWR 2013). Contamination of groundwater and surface water is suspected at several former and existing mill sites that historically used wood treatment chemicals. Discharges of pentachlorophenol, polychlorodibenzodioxins, and polychlorodibenzofurans—typically used in historical wood-treatment applications—are likely to have occurred due to poor containment practices. Additional investigation, sampling, monitoring, and enforcement actions have been limited by the insufficient resources that exist to address this historical toxic chemical problem (NCRWQCB 2005).

Central Valley and Bay-Delta Region

The Central Valley Region and Bay-Delta Region extends from above Lake Shasta, south to the Tehachapi Mountains, and includes the Sacramento Valley, San Joaquin Valley, and Sacramento-San Joaquin Rivers Delta (Delta).

Groundwater for the Central Valley and Bay-Delta Region is described in relation to the basins delineated in Bulletin 118-03 (DWR 2003). The overall area includes the Sacramento Valley Basin (which extends through the Sacramento Valley), and the San Joaquin Valley Groundwater Basin (including the Tulare Lake area), which extends through the San Joaquin Valley. The Delta area is located partially in the Sacramento Valley Basin and partially in the San Joaquin

Valley Groundwater Basin. There are separate descriptions for the Delta area because of the distinct characteristics as an estuary, at the confluence of the Sacramento and the San Joaquin rivers.

Sacramento Valley

The Sacramento Valley includes the Redding Groundwater Basin and the Sacramento Valley Groundwater Basin. In terms of size, the Sacramento Valley Groundwater Basin is one of the largest groundwater basins in the State, and extends from Redding in the north to the Delta in the south (USGS 2009). Approximately one-third of the Sacramento Valley's urban and agricultural water needs are met by groundwater (DWR 2003).

Overall, the Sacramento Groundwater Basin is approximately balanced with respect to annual recharge and pumping demand. However, there are several locations showing early signs of persistent drawdown, suggesting that the limits of sustainable groundwater use have been reached. Locations within this area include: Glenn County, areas near Chico in Butte County, northern Sacramento County, and portions of Yolo County.

Groundwater quality in the Sacramento Valley is generally good, as described below for individual basins. Several areas have localized high nitrate, total dissolved solids (TDS) or boron concentrations. High nitrate concentrations frequently occur due to residuals from agricultural activity (including livestock operations) or septic systems. High TDS, a measure of salinity, can be an indicator of brackish or connate water when it occurs in high concentrations. High boron concentration is usually associated with naturally-occurring deposits.

Overview of Groundwater Basins in the Sacramento Valley The Sacramento Valley includes the Redding Groundwater Basin and the Sacramento Valley Groundwater Basin. The Redding Groundwater Basin is situated in the extreme northern end of the Valley and is a separate, isolated groundwater basin, but due to similarities in geology and stratigraphy, it is included as part of the overall Sacramento Valley. It is bordered by the Coast Ranges on the west, and by the Cascade Range and Sierra Nevada mountains on the east.

The Sacramento Valley Groundwater Basin has been divided into 18 subbasins by DWR, based on groundwater characteristics, surface water features, and political boundaries (DWR 2003). From a hydrologic standpoint, these individual groundwater subbasins have a high degree of hydraulic connection, because rivers in the area do not always act as barriers to groundwater flow. Therefore, the Sacramento Valley Groundwater Basin functions primarily as a single laterally-extensive alluvial aquifer, rather than numerous discrete, smaller groundwater subbasins.

General Hydrogeology of the Sacramento Valley Presently, groundwater levels in the Valley are generally in equilibrium, with pumping matched by recharge from the various sources annually. Some locales show the early signs of persistent drawdown, especially in areas where water demands are met primarily, or are satisfied exclusively by groundwater. These areas include portions of the far west side of the Sacramento Valley in Glenn County, portions of Butte County near Chico, in portions of Yolo County, and in the northern Sacramento County area. Areas of prolonged and increasing drawdown may be indicative that the limits of sustainable groundwater use have been reached. Due to the drought that began in 2011, surface water supplies have declined and new wells have been put into service. Between January and October 2014, over 100 water supply wells were drilled in both Shasta and Butte Counties (DWR 2014).

Land subsidence in the Sacramento Valley has resulted from inelastic deformation (non-recoverable changes) of fine-grained sediments related to groundwater withdrawal. Areas of subsidence from groundwater-level declines have been measured at several locations in the Sacramento Valley. Subsidence monitoring was established following several studies in the 1990s that indicated more than four feet of subsidence had occurred since 1954 in some areas, such as in Yolo County (Ikehara 1994). Initial data from the Yolo County extensometers (instruments used to quantify subsidence) indicated subsidence in the Zamora area. This reduction has subsequently been confirmed with a countywide global positioning system (GPS) network installed in 1999 and monitored in 2002 and 2005. Up to 0.4 feet of subsidence has occurred between 1999 and 2005 in that area (Frame Surveying and Mapping 2006). The Zamora area does not currently use CVP water supplies, but this area was designated as part of the CVP Sacramento Valley Irrigation Canals service area in the Reclamation Act of 1950, and as amended in the Reclamation Act of 1980 and Central Valley Project Improvement Act.

San Joaquin Valley

The San Joaquin Valley Groundwater Basin extends from the Delta in the north to the Tehachapi Mountains in the south. Groundwater is estimated to provide over 47 percent of the overall water supply in the San Joaquin Valley, including 70 percent of municipal uses and 43 percent of irrigation supplies from 2005 through 2010 (DWR 2013). Annual precipitation in the San Joaquin Valley averages between 5 to 18 inches. Due to the low amounts of average annual precipitation, limited surface water supply, and extensive agricultural water use, there are areas of significant overdraft that exist in the San Joaquin Valley Groundwater Basin. Eight subbasins in the San Joaquin Valley Groundwater Basin were identified to be in a state of critical overdraft: Chowchilla, Eastern San Joaquin, Madera, Kings, Kaweah, Tule, Tulare Lake, and Kern (DWR 1980). Three of these subbasins are on the eastern side of the San Joaquin River: Eastern San Joaquin, Chowchilla, and Madera. Recent studies have indicated that overdraft continues to exist in these subbasins (DWR 2013). By 1970, over 5,200 square miles of irrigable land had subsided at least one foot. The maximum subsidence, which occurred near Mendota, was recorded at almost 30 feet (9 meters) (Reclamation 2013). Due to the drought that started in 2011, surface water supplies have declined and new wells have been constructed. Between January and October 2014, more than 100 wells were drilled in both Kern and Kings Counties, almost 200 in Stanislaus County, almost 250 in Merced County, and over 350 in both Fresno and Tulare Counties (DWR 2014).

The elevation of the freshwater base in the western and central San Joaquin Valley ranges from 600 to 800 feet below mean sea level (WWD 2013). This area has experienced subsidence of up to 28 feet between 1926 and 1970 (USGS 2009) due to groundwater extraction that exceeds recharge. The water quality of the semi-perched aquifer on the western side of the San Joaquin Valley is impaired due to high salinity, selenium and boron concentrations. These constituents are from both naturally-occurring deposits in the Coast Ranges to the west and agricultural activities in the Valley. The chemicals become trapped in the soil matrix due to the low-permeability clay layers close to the surface. There are also localized areas with high concentrations of naturally-occurring arsenic or selenium.

Portions of the San Joaquin Valley Groundwater Basin in the Cosumnes, Tracy, and Eastern San Joaquin Subbasins were designated by the State Water Resources Control Board in 2000 as Hydrogeologically Vulnerable Areas and Groundwater Protection Areas, based on hydrogeologic permeability. These areas could be more vulnerable to groundwater-quality impairment if applied surface water—including recycled water—contains high concentrations of constituents that are of concern to the beneficial users of the groundwater (CVRWQCB 2014).

Delta

The Delta overlies the western portion of the area where the Sacramento River and San Joaquin River groundwater basins converge. This area also includes the Solano Subbasin and the South American Subbasin in the Sacramento Valley Groundwater Basin; the Tracy Subbasin, the Eastern San Joaquin Subbasin, and the Cosumnes Subbasin in the San Joaquin Valley Groundwater Basin; and the Suisun-Fairfield Valley Basin.

In some areas of the western and central Delta floodplain, the floodplain deposits contain organic material (peat) that ranges in thickness from zero to 150 feet. Below the surficial floodplain deposits, unconsolidated non-marine sediments occur, at depths of a few hundred feet near the Coast Range to nearly 3,000 feet near the eastern margin of the Sacramento Valley Groundwater Basin. These non-marine sediments form the major water-bearing formations in the Delta.

In general, shallow groundwater conditions and extensive groundwater-surface water interaction characterize the Delta. Spring runoff generated by melting snow in the Sierra Nevada increases flows in the Sacramento and San Joaquin Rivers and their tributaries, which causes groundwater levels near the rivers to rise. Because the Delta is a large floodplain, and the shallow groundwater is hydraulically connected to the surface water, changes in river stages affect groundwater levels and vice versa. Groundwater levels in the central Delta are very shallow, and land subsidence on several islands has resulted in groundwater levels close to the ground surface. Maintaining groundwater levels below crop rooting zones is critical for successful agriculture, especially for islands that lie below sea level. Many farmers rely on an intricate network of drainage ditches and pumps to maintain groundwater levels of approximately 3 to 6 feet below ground surface. The accumulated agricultural drainage is discharged into adjoining surface water bodies (USGS 2000). Without this drainage system, many of the islands would be subject to extremely high groundwater, bogs, or localized flooding.

Groundwater generally flows from the Sierra Nevada in the east toward the low-lying lands of the Delta to the west. However, a number of pumping depressions have reversed this trend, and groundwater inflow from the Delta toward these pumping areas has been observed, primarily in the Stockton area.

Subsidence in the Delta is well-documented and a major source of concern for farming operations. The oxidation of peat soils is the primary mechanism of subsidence in the Delta, and some areas are located below sea level. Another mechanism for subsidence is wind erosion. Certain areas in the Delta may continue to subside, 2 to 4 more feet, over the next 35 years (DWR 2013).

San Francisco Bay Area

The San Francisco Bay Area includes portions of Contra Costa, Alameda, Santa Clara, and San Benito Counties that are within the CVP service areas.

There are several groundwater basins in the San Francisco Bay Area, however, only some of the basins are within the CVP service areas evaluated in this EIS. The portions of the San Francisco Bay Area within the CVP service areas include the Pittsburg Plain, Clayton Valley, Ygnacio Valley, Arroyo Del Hambre Valley, San Ramon Valley, Livermore Valley, Castro Valley, and Santa Clara Valley Groundwater Basins within the San Francisco Bay Hydrologic Region; and Gilroy-Hollister Valley Groundwater Basin within the Central Coast Hydrologic Region.

Groundwater represents approximately 21 percent of the agricultural, municipal, and industrial water supplies in the San Francisco Bay Area (DWR 2013). Conjunctive use programs have been implemented by several agencies to optimize the use of groundwater and surface water resources.

The groundwater quality in the San Francisco Bay Area is generally suitable for most agricultural and municipal uses, but concerns exist about groundwater contamination from industrial and agricultural chemical spills, leaky underground and above-ground storage tanks, landfill leachate, and poorer-quality surface water bodies. There have been over 800 groundwater cleanup projects in the San Francisco Bay Area, with the majority of these resulting from leaky fuel tanks (DWR 2013). Portions of the San Francisco Bay Area Region shorelines include aquifers that are susceptible to seawater intrusion.

In the southern San Francisco Bay Area, groundwater and surface water are connected by in-stream and off-stream artificial recharge projects, in which surface water is delivered to water bodies that enable the infiltration (recharge) of water to underlying aquifers. Surface waters recharge aquifers in other regions of the San Francisco Bay Area along streambeds, especially in areas with depressed groundwater levels that have resulted from extensive groundwater pumping.

Impact Analysis

Potential Mechanisms for Change in Groundwater Resources

The impact analysis considers changes in groundwater resource conditions related to changes in CVP operations under the alternatives as compared to the No Action Alternative.

Changes to Groundwater Use and Groundwater Levels

Changes in availability of CVP water supplies could result in changes of groundwater use. For example, if CVP water deliveries are decreased, water users may increase the amount of groundwater withdrawals in response to the shortage in surface water deliveries, so as to make up the deficit in water supplies.

Historically, groundwater resources were the only water resources available to meet the demand for water supply in the Central Valley. The heavy use of groundwater has caused groundwater quality issues, drainage issues, groundwater overdraft, and land subsidence in the Central Valley (Reclamation 2015). Throughout many areas of the San Joaquin Valley, shallow groundwater is characterized by high salinity. Use of this groundwater for irrigation deposited salts, along with agricultural chemicals (nutrients and fertilizers), into the upper soil layer. These constituents leached into the underlying shallow groundwater aquifers and caused them to be unsuitable for irrigation. Surface water delivered by the CVP provides irrigation water of higher quality than was available from local groundwater. The expanded use of surface water for irrigation has resulted in a reduction in groundwater overdraft of local groundwater basins (Reclamation 2015).

Generally, agricultural water users in the San Joaquin Valley prefer to use surface water for irrigation, when available, because the water quality is better than that of groundwater. However, when adequate surface water supplies are not available, the demand is met with the use of groundwater (USGS 2009).

SGMA mandates that most groundwater users in California must develop Groundwater Sustainability Plans (GSP) by 2020 or 2022, and meet the sustainable goal within 20 years of adoption of the GSP. The time frame of this EIS analysis is 2030. Therefore, this EIS analysis assumes that groundwater users have developed the GSPs within the requisite timeframe (by 2020 or 2022), and have begun to plan, design, and possibly construct alternative water supply facilities, or implement water conservation measures and management to achieve full compliance with SGMA by 2040 or 2042. However, this EIS analysis also assumes that the new facilities or conservation measures are not fully implemented by 2030. Therefore, reductions in groundwater use in accordance with the SGMA are not anticipated until after 2030 and are discussed under the section addressing *Cumulative Effects Analysis*.

Changes to groundwater use by users of CVP water supplies could result in changes in groundwater storage and groundwater levels within the study area. For example, if CVP water supplies are decreased and water users increase the amount of groundwater withdrawals, groundwater levels could decline. Changes in groundwater levels resulting in a lowering of the water table (declining groundwater levels) could result in a decrease in well yields.

As described in Chapter 4, “Surface Water Supply and Management,” the CalSim II model was used to estimate changes in the deliveries to CVP water users for each action alternative in this EIS. The change in delivery is then calculated by taking the difference between the alternative under consideration and the No Action Alternative for the respective year type, (e.g., wet, above normal, dry). Based on this approach, the decreases in the water delivered are not considerable enough to warrant a large increase in groundwater demand to meet the shortage of surface water supply created by these alternatives.

Changes in Land Subsidence

Extensive groundwater withdrawals from confined and unconfined aquifers increases the potential for land subsidence. In aquifers with clay and silt lenses, decreased groundwater levels can result in compaction of fine-grained deposits, which could lead to irreversible land subsidence. Subsidence could result in structural damage to roads, railroad tracks, pipelines and associated structures, drainage, buildings, and wells. Subsidence can also result in the permanent loss of groundwater storage potential within an aquifer system.

Land subsidence is a function of the rock (consolidated or unconsolidated) properties, the thickness of the water bearing units, and the change(s) in water level. Based on the premise outlined in the section on *Changes to Groundwater Use and Groundwater Levels* above, there is no indication that groundwater levels will change enough under the alternatives reviewed here, as compared to the No Action Alternative, so that there will be any impact to subsidence.

Changes to Groundwater Quality

Changes to groundwater quality could occur in several ways under implementation of the alternatives as compared to the No Action Alternative. Reductions in groundwater levels could change groundwater flow directions or hydraulic gradients, potentially causing poorer-quality groundwater to migrate into areas with higher-quality groundwater—possibly at different rates—or cause intrusion of poor-water quality (e.g., from aquitards) as water levels decline.

Groundwater quality could also change due to changes in the availability of CVP water supplies used by agricultural water users. For example, if reductions in CVP water supplies result in an increased use of groundwater with higher salinity than CVP water supplies, shallow groundwater could become more saline and soil salinity could increase. In addition, the reduced availability of higher-quality surface water for use in recharge facilities may decrease the overall groundwater quality in those localized areas.

As outlined in the section on *Changes to Groundwater Use and Groundwater Levels*, there is no indication that groundwater levels will be impacted by the alternatives reviewed here as compared to the No Action Alternative.

Evaluation of Alternatives

The impact analysis in this EIS is based upon the comparison of the alternatives to the No Action Alternative in the year 2030. The results of CalSim II modelling were reviewed in order to consider the effects on groundwater demand and withdrawals created by decreased surface water deliveries. Chapter 4, "Surface Water Supply and Management," discusses certain limitations of the CalSim II model, and that there may be minor fluctuations in the model of up to 5 percent, due to the assumptions and approaches. In addition, it notes that quantitative changes of 5 percent or less, between a specific alternative and the No Action Alternative, would be considered similar to conditions under the No Action Alternative, which is the same consideration utilized in this Evaluation of Alternatives.

No Action Alternative

Changes to Groundwater Use and Elevation Under the No Action Alternative, groundwater resources and groundwater quality would be comparable to the conditions described in the *Affected Environment* section of this chapter. Conditions in 2030 would be different than existing conditions, primarily due to expected variability in groundwater conditions, as well as climate change and sea-level rise, general plan development throughout California, and implementation of reasonable and foreseeable water resource management projects to provide water supplies. Climate change and sea-level rise are anticipated to reduce long-term average CVP water supply deliveries by 2030 as compared to recent historical long-term average deliveries. Climate change would also reduce groundwater supplies, due to reduced groundwater recharge potential and increased groundwater overdraft potential, as surface water supplies decline. However, in some locations, sustainable groundwater supplies could remain similar to recent historical conditions, or rise, due to implementation of groundwater management plans to reduce groundwater overdraft, including the completion of ongoing groundwater recharge and recovery programs.

For groundwater basins along the Trinity River and lower Klamath River, groundwater use and elevations are expected to remain similar to recent historical use and water levels. In the Central Valley and Delta, the combination of increased groundwater withdrawals—due to reductions in CVP and State Water Project (SWP) water deliveries—as compared to recent historical long-term deliveries and reduced groundwater recharge (due to climate change) could result in continued reductions in groundwater levels. These reductions could be in the same manner as recent declines of up to 10 feet in the Sacramento Valley, and more than 20 feet in the San Joaquin Valley (Reclamation 2015).

Under the No Action Alternative, groundwater banks and other management programs would continue to be implemented, and possibly expanded, including ongoing groundwater recharge efforts in the Eastern San Joaquin, Kings, Kaweah, and Kern Subbasins in the San Joaquin Valley Groundwater Basin. These programs could result in groundwater levels that are similar or higher comparative to recent groundwater conditions. If local agencies fully implement GSPs in accordance with the State SGMA prior to the regulatory deadline, groundwater levels could remain similar to recent conditions, or they could rise.

Changes to Land Subsidence Land subsidence due to groundwater withdrawals historically occurred in the Yolo Subbasin of the Sacramento Valley Groundwater Basin, the Delta-Mendota and Westside Subbasins of the San Joaquin Valley Groundwater Basin, and the Santa Clara Valley Groundwater Basin. Under the No Action Alternative, it is anticipated that increased groundwater withdrawals—due to reductions in CVP and SWP water supplies—and reduced groundwater recharge (due to climate change) could result in increased irreversible land subsidence in these areas.

Changes to Groundwater Quality In the Central Valley, there are localized areas of high salinity related to natural geologic formations and historic land uses; high naturally-occurring arsenic, calcium, iron, and manganese; and high levels of boron and phosphates related to historic land-use practices. High concentrations of nitrates, due to current anthropogenic sources and legacy sources, occur in many locations in the San Joaquin Valley Groundwater Basin, especially in the Eastern San Joaquin, Modesto, Merced, Kings, Kaweah, Tule, and Tulare Lake Subbasins. Under the No Action Alternative, it is anticipated that these conditions would continue to occur; and that groundwater quality could be further degraded due to reduction of groundwater elevation that can cause adjacent poorer-quality water to flow towards the groundwater withdrawals.

Proposed Action (Alternative 1)

Lower Klamath and Trinity River Region Groundwater conditions in the Lower Klamath and Trinity River Region are not directly related to CVP water supplies or operations.

Changes to Groundwater Use and Elevation Alternative 1 does not adversely affect water supplies in the Lower Klamath and Trinity River Region, and as such there are no impacts to groundwater use. Increased flows in the Lower Klamath and Trinity River Region may minimally increase the water surface elevation in the rivers during August and September. This could result in additional groundwater recharge, depending on the geographic location as well as duration. It will only have a minor effect on groundwater recharge, without creating any potentially-adverse impacts to groundwater elevation, as compared to the No Action Alternative.

Changes to Land Subsidence As discussed above, Alternative 1 will only have a minor effect on groundwater use, without creating any potentially-adverse impacts to groundwater elevation as compared to the No Action Alternative, and as such, will have no potentially-adverse impacts on subsidence for the area.

Changes to Groundwater Quality There are no adverse effects to water supplies in the Lower Klamath and Trinity River Region under Alternative 1, and there is the potential for minor additional recharge, netting no negative impacts to groundwater use and elevation under this alternative. With additional recharge, there may be a slight dilution effect in the aquifer(s), but it is not considered enough to create a large-scale change in water chemistry. The effect of this is that there are no adverse impacts on groundwater quality in the Lower Klamath and Trinity River Region under Alternative 1.

Central Valley and Bay-Delta Region

Sacramento Valley

Changes to Groundwater Use and Elevation CalSim II modelling showed that for most year types, CVP North-of-Delta (NOD) deliveries were similar for Alternative 1 compared to the No Action Alternative. Accordingly, groundwater use and elevation for most year types would be similar for Alternative 1 compared to the No Action Alternative. CVP NOD deliveries for all year types to CVP Sacramento River Settlement Contractors, CVP Refuge Level 2 Deliveries, and all of CVP municipal and industrial (M&I) for Alternative 1 were similar (less than 2 percent change), as compared to the No Action Alternative. In addition, long-term average deliveries (e.g., average of all year types) to CVP Agricultural Water Service Contractors NOD would be similar (1 percent decrease). However, Alternative 1 deliveries to the CVP Agricultural Water Service Contractors NOD in critical years would decrease by 10 percent in comparison to the No Action Alternative. A decrease in deliveries of 10 percent represents 2 thousand acre-feet (TAF), which, as a result of decreased supplies, would create additional demand that would vary geographically. It is not possible to speculate how water districts would manage water supplies in response to decreases in surface water supply, or how water users might react. Accordingly, Alternative 1 may potentially impact groundwater use and elevations during critical years in localized areas (e.g., service areas of water service contractors) compared to the No Action Alternative.

Changes to Land Subsidence As groundwater elevations under Alternative 1 would be similar to the No Action Alternative under all year types (except critical years), land subsidence for these year types would also be similar under Alternative 1 as compared to the No Action Alternative. As discussed above, it is not possible to speculate how CVP Agricultural Water Service Contractors NOD would respond to reduced surface-water deliveries. However, as there may be potentially-adverse impacts to groundwater levels under Alternative 1, compared to the No Action Alternative, there may be potentially-adverse impacts to land subsidence.

Changes to Groundwater Quality Groundwater quality for all year types would be similar under Alternative 1 as compared to the No Action Alternative. As groundwater elevations under Alternative 1 would be similar to the No Action Alternative under all year types (except critical years), water quality for these year types would also be similar under Alternative 1 as compared to the No Action Alternative. Alternative 1 may adversely impact groundwater levels in localized areas in comparison to the No Action Alternative, however groundwater quality underlying these areas is generally of high quality. Accordingly, groundwater quality for critical years would be similar under Alternative 1 in comparison to the No Action Alternative.

San Joaquin Valley

Changes to Groundwater Use and Elevation CalSim II modelling showed that for most year types, CVP South-of-Delta (SOD) deliveries were similar for Alternative 1 compared to the No Action Alternative. Accordingly, groundwater use and elevation for most year types would be similar for Alternative 1 compared to the No Action Alternative. CVP SOD deliveries for all year types to CVP San Joaquin River Exchange Contractors, CVP Refuge Level 2 Deliveries, and all of CVP M&I for Alternative 1 were similar (less than 2 percent change), as compared to the No Action Alternative. In addition, long-term average deliveries (e.g., average of all year types) to CVP Agricultural Water Service Contractors SOD would be similar (1 percent change). However, Alternative 1 deliveries to the CVP Agricultural Water Service Contractors SOD in critical years would decrease by 7 percent, in comparison to the No Action Alternative. A decrease in deliveries of 7 percent represents 10 TAF, which, as a result of decreased supplies, would create additional demand that would vary geographically. Similarly, Alternative 1 deliveries are reduced during below normal and dry years by 10 TAF and 17 TAF, respectively. It is not possible to speculate how water districts would manage water supplies in response to decreases in surface water supply, or how water users might react. Accordingly, Alternative 1 may potentially impact groundwater use and elevations in localized areas (e.g., service areas of water service contractors) during some year types, compared to the No Action Alternative.

Changes to Land Subsidence Groundwater elevations under Alternative 1 would be similar to the No Action Alternative under all year types (except critical years), and land subsidence for these year types would also be similar under Alternative 1 as compared to the No Action Alternative. As discussed above, it is not possible to speculate how CVP Agricultural Water Service Contractors SOD would respond to reduced surface water deliveries. However, as there may be potentially-adverse impacts to groundwater levels under Alternative 1, compared to the No Action Alternative, there may be potentially-adverse impacts to land subsidence.

Changes to Groundwater Quality As discussed above, the average total CVP water deliveries do not impact the groundwater elevation, so there will be no impacts to water quality in the Sacramento Valley for almost all year types under Alternative 1. Similar impacts may occur for the CVP M&I SOD in critical year types, CVP Agricultural Water Service Contractors SOD in below normal year types, and CVP Agricultural Water Service Contractors SOD in dry year types, given that the groundwater use and elevation and will have similar impacts as compared to the No Action Alternative. Potentially-adverse impacts to water quality may be created for CVP Agricultural Water Service Contractors SOD in a critical year because the groundwater use and elevation may have potentially-adverse impacts.

Delta

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 1 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 1 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 1, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 1 will be similar to the No Action Alternative.

Changes to Groundwater Quality Under Alternative 1, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 1 will be similar to the No Action Alternative.

San Francisco Bay Area

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 1 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 1 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 1, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 1 will be similar to the No Action Alternative.

Changes to Groundwater Quality Under Alternative 1, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 1 will be similar to the No Action Alternative.

Trinity River Record of Decision Flow Rescheduling Alternative (Alternative 2)

Lower Klamath and Trinity River Region

Changes to Groundwater Use and Elevation Alternative 2 does not adversely affect water supplies in the Lower Klamath and Trinity River Region, and as such there are no impacts to groundwater use. River flows in the Lower Klamath and Trinity River Region may minimally increase the water surface elevation in the rivers during August and September. However, reduced flows may minimally decrease water-surface elevations in the rivers in May and June. These minimal changes in water-surface elevation would only have a minor effect on groundwater recharge, without creating any potentially-adverse impacts to groundwater elevation as compared to the No Action Alternative.

Changes to Land Subsidence As discussed above, Alternative 2 does not impact the Lower Klamath and Trinity River Region groundwater use or elevation, and as such, there are no impacts on subsidence for the area.

Changes to Groundwater Quality There are no affects to water supplies or related operations in the Lower Klamath and Trinity River Region under Alternative 2, so that there are no impacts to groundwater use and elevation under this alternative. The result is that there are no impacts on groundwater quality in the Lower Klamath and Trinity River Region under Alternative 2.

Central Valley and Bay-Delta Region

Sacramento Valley

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 2 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 2 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 2 will be similar to the No Action Alternative.

Changes to Groundwater Quality Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 2 will be similar to the No Action Alternative.

San Joaquin Valley

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 2 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 2 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 2 will be similar to the No Action Alternative.

Changes to Groundwater Quality Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 2 will be similar to the No Action Alternative.

Delta

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 2 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 2 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 2 will be similar to the No Action Alternative.

Changes to Groundwater Quality Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 2 will be similar to the No Action Alternative.

San Francisco Bay Area

Changes to Groundwater Use and Elevation CVP deliveries under Alternative 2 would be similar to those under the No Action Alternative. Consequently, groundwater use and elevation will be similar under Alternative 2 compared to the No Action Alternative.

Changes to Land Subsidence Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, land subsidence under Alternative 2 will be similar to the No Action Alternative.

Changes to Groundwater Quality Under Alternative 2, based on CVP deliveries, groundwater levels and elevations would be similar to the No Action Alternative. Consequently, groundwater quality under Alternative 2 will be similar to the No Action Alternative.

Summary of Impact Analysis

Table 6-1 presents the results of the environmental consequences analysis for implementing the action alternatives compared to the No Action Alternative.

Table 6-1. Comparison of Action Alternatives to No Action Alternative

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1	Groundwater use and elevation, land subsidence, and groundwater quality would be similar to the No Action Alterative for all year types except critical years. In portions of the Sacramento and San Joaquin Valleys, reduced surface water deliveries could increase demands on groundwater and potentially-adversely impact groundwater use and elevation, subsidence and water quality.	Reductions in water deliveries may lead to increased groundwater pumping. The magnitude of increased groundwater pumping would be minor and no mitigation is identified.
Alternative 2	No effects on groundwater resources/groundwater quality. Groundwater use and elevation, land subsidence, and groundwater quality would be similar to the No Action Alterative for all year types.	None needed

Potential Mitigation Measures

Changes in CVP operations under action alternatives, as compared to the No Action Alternative, would not result in substantial changes in groundwater resources. Therefore, there would be no adverse impacts to groundwater resources, and no mitigation measures are required.

Cumulative Effects Analysis

The cumulative effects analysis considers projects, programs, and policies that are not speculative; and are based upon known or reasonably foreseeable long-range plans, regulations, operating agreements, or other information that establishes them as reasonably foreseeable. The cumulative effects analysis for groundwater resources and groundwater quality are summarized in Table 6-2. The methodology for this cumulative effects analysis is described in the Cumulative Effects Technical Appendix.

Table 6-2. Summary of Cumulative Effects on Groundwater Resources of Action Alternatives as Compared to the No Action Alternative

Scenarios	Cumulative Effects of Actions
No Action Alternative with Associated Cumulative Effects Actions in Year 2030	*Conditions and Actions included in Quantitative Analyses* *(Conditions and actions incorporated into No Action Alternative modeling)* Climate change and sea-level rise, development under general plans, FERC relicensing projects, and some future projects to improve water quality or habitat are anticipated to reduce the availability of CVP and SWP water supplies; and therefore, potentially increase groundwater use, reduce groundwater elevations, increase subsidence, and degrade groundwater quality. *Additional Identified Actions* *(Additional reasonably foreseeable projects or actions identified in Cumulative Effects Technical Appendix)* Additional reasonably foreseeable actions considered under this cumulative effects analysis are not anticipated to affect groundwater resources (use, elevation, quality) or subsidence.
Alternative 1 with Associated Cumulative Effects Actions in Year 2030	*Alternative 1 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 1 may result in increased groundwater use, particularly in dry and critically dry years, as compared to the No Action Alternative, potentially resulting in cumulatively adverse impacts to groundwater use, groundwater elevations, groundwater quality, and subsidence. *Alternative 1 with Additional Identified Actions* The additional reasonably foreseeable actions are not anticipated to affect groundwater resources (use, elevation, quality) or subsidence.
Alternative 2 with Associated Cumulative Effects Actions in Year 2030	*Alternative 2 with Conditions and Actions included in Quantitative Analyses* Implementation of Alternative 2 would result in similar groundwater conditions (use, elevation, quality, subsidence) as compared to the No Action Alternative. *Alternative 2 with Additional Identified Actions* The additional reasonably foreseeable actions are not anticipated to affect groundwater resources (use, elevation, quality) or subsidence.

Key:
CVP = Central Valley Project
FERC = Federal Energy Regulatory Commission
SWP = State Water Project

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