Upper San Joaquin River Basin Storage Investigation

Draft Environmental Impact Statement
Executive Summary

Prepared by:

United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

U.S. Department of the Interior
Bureau of Reclamation

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This Draft Environmental Impact Statement (EIS) for the Upper San Joaquin River Basin Storage Investigation (Investigation) has been prepared by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, consistent with requirements of the National Environmental Policy Act (NEPA). Cooperating agencies pursuant to NEPA include the California Department of Parks and Recreation; Friant Water Authority; Madera-Chowchilla Water and Power Authority; San Joaquin River Exchange Contractors Water Authority; U.S. Army Corps of Engineers; U.S. Department of Commerce, National Marine Fisheries Service; U.S. Department of the Interior, Bureau of Indian Affairs; U.S. Department of the Interior, Bureau of Land Management; U.S. Department of the Interior, Fish and Wildlife Service; and U.S. Environmental Protection Agency.

The Investigation is a feasibility study that is one of five studies for potential surface water storage projects recommended in the 2000 CALFED Bay-Delta Program (CALFED) Programmatic Record of Decision (ROD), and is being conducted under the authority of Public Law 108-7 (Division D, Title II, Section 215) enacted in February 2003. This act authorized the Secretary of the Interior to conduct feasibility studies for several storage projects identified in the CALFED ROD, including the Investigation. Authorization was reaffirmed and supplemented by the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361, Title I, Section 103).

This Draft EIS documents the analysis of the potential environmental effects of alternatives to increase storage of water from the upper San Joaquin River watershed to improve water supply reliability and operational flexibility in Central Valley Project San Joaquin Valley areas and other regions of California, and enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish. In addition to the No-Action Alternative, this Draft EIS considers five action alternatives, which include constructing a dam in the upstream portion of Millerton Lake at river mile 274, and which vary based on operations and intake feature configurations.

This Draft EIS is being circulated for public and agency review and comment for 45 days following the date when the EPA publishes the notice of availability of weekly receipt of environmental impact statements in the Federal Register. Reclamation will hold public hearings during the public review period. Comments provided during the public review period will be addressed in the Final EIS.

For further information, please contact Melissa Harris, Project Manager, at the address above, by telephone at (916) 978-5075, or by e-mail at mmharris@usbr.gov.

Executive Summary

Introduction and Background

This Draft Environmental Impact Statement (EIS) has been prepared as part of the Upper San Joaquin River Basin Storage Investigation (Investigation) to document potential physical, biological, cultural, and socioeconomic effects of alternatives to expand water storage capacity in the upper San Joaquin River watershed. The Investigation is led by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), in cooperation with the California Department of Water Resources (DWR). The purpose of the Investigation is to determine the type and extent of Federal, State of California (State), and regional interest in a potential project to expand water storage capacity in the upper San Joaquin River watershed to (1) improve water supply reliability and flexibility of the water management system for agricultural, municipal and industrial (M&I), and environmental uses; and (2) enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

This document, pursuant to the National Environmental Policy Act (NEPA), tiers from the CALFED Bay-Delta Program (CALFED) Final Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/R) and Record of Decision (ROD) (CALFED 2000a and 2000b) for developing the project purpose and a range of reasonable alternatives. This document also supports the Draft Feasibility Report (Reclamation 2014) prepared for the Investigation and confirms the draft findings of environmental feasibility.

Reclamation, as the Federal Lead Agency under NEPA, has prepared this Draft EIS to disclose the potential direct, indirect, and cumulative impacts of alternatives. Cooperating agencies pursuant to NEPA are those that have jurisdiction by law or special expertise in a resource area affected. Cooperating agencies for this Investigation include the California Department of Parks and Recreation (State Parks); Friant Water Authority (FWA); Madera-Chowchilla Water and Power Authority; San Luis & Delta-Mendota Water Authority; San Joaquin River Exchange Contractors Water Authority; U.S. Army Corps of Engineers (USACE); U.S. Department of

Commerce, National Marine Fisheries Service (NMFS); U.S. Department of the Interior, Bureau of Indian Affairs (BIA); U.S. Department of the Interior, Bureau of Land Management (BLM); U.S. Department of the Interior, Fish and Wildlife Service (USFWS); and U.S. Environmental Protection Agency (EPA). Agencies consulted under NEPA (consistent with Section 1501.2 of the Council on Environmental Quality (CEQ) Regulations) include the California Department of Fish and Wildlife (CDFW), Central Valley Regional Water Quality Control Board (Central Valley Water Board), San Joaquin Valley Air Pollution Control District (SJVAPCD), and Federal Energy Regulatory Commission (FERC).

DWR is the California Environmental Quality Act (CEQA) Lead Agency for the Investigation, but has had limited funding to be an active participant. This Draft EIS has also been prepared in consideration of CEQA and State CEQA Guidelines to support the CEQA Lead Agency and Responsible and Trustee agencies that would be involved in approving a proposed action. However, at the time of release of this Draft EIS, DWR was unable to provide CEQA review. When a project (such as the Investigation) requires compliance with CEQA and NEPA, and the NEPA document is ready before the CEQA document – as is the case here – the CEQA Lead Agency (DWR) should use the EIS rather than preparing an EIR when the following two conditions occur:

1. An EIS will be prepared before an EIR would otherwise be completed for the project

2. The EIS complies with the CEQA Guidelines (see CEQA Guidelines section 15221)

Despite the similarities between NEPA and CEQA, there are several differences that require careful coordination between the Federal and State agencies responsible for complying with NEPA and CEQA. For example, CEQA requires discussions of mitigation measures and growth inducing impacts, and more recently a greenhouse gas emissions impact analysis. The approach to preparing this Draft EIS consistent with both NEPA and CEQA requirements is described where appropriate throughout this Draft EIS, including an overview of the considerations for conducting the impact analyses provided in Chapter 3, “Considerations for Describing the Affected Environment and Environmental Consequences.”

The Investigation's progress and results have been documented in a series of interim reports. The Investigation will culminate in a Final Feasibility Report and Final EIS, consistent with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC 1983); Reclamation policies, and directives and standards; State policies and guidance; and applicable environmental laws, regulations, and policies. The Draft Feasibility Report (Reclamation 2014) and this Draft EIS document the results of the feasibility study process to date, and build on the results and findings of previous planning documents, including the CALFED PEIS/R and ROD (CALFED 2000a and 2000b), *Phase 1 Investigation Report* (Reclamation and DWR 2003), *Initial Alternatives Information Report* (Reclamation and DWR 2005), and *Plan Formulation Report* (Reclamation and DWR 2008).

Extensive alternatives analysis was performed as part of the plan formulation process for the Investigation, with 22 reservoir sites evaluated for their ability to meet project objectives and/or the purpose and need, and in consideration of environmental effects, cost-effectiveness, and overall feasibility. The number of alternative dam and reservoir sites was reduced through a phased evaluation process. As alternative sites were eliminated from further detailed consideration, evaluation of the remaining alternative sites was conducted in progressively greater level of detail. This process resulted in the selection of Temperance Flat River Mile (RM) 274 Reservoir as the site which best meets the objectives, purpose and need, planning criteria, and provides the greatest overall and net benefits.

Study Authorization

Authorizations for the Investigation are described below.

Federal Authorization

In 2003, Federal authorization was provided to conduct a feasibility study for storage in the upper San Joaquin River Basin (Public Law 108-7, Division D, Title II, Section 215). This act authorized the Secretary of the Interior to conduct feasibility studies for several storage projects identified in the CALFED ROD (2000b), including the Investigation. Authorization was reaffirmed and supplemented by the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361).

State Authorization

California Water Code Section 227 authorizes DWR to study reservoirs or reservoir systems for gathering and distributing flood or other water not under beneficial use in any stream, stream system, lake, or other body of water.

Relationship to CALFED and Tiering

CALFED is a collaboration of 25 Federal and State agencies with regulatory and management responsibilities in the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta), originally established to develop a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The objective of the collaborative planning process is to identify comprehensive solutions to the problems of ecosystem quality, water delivery reliability, water quality, and Sacramento-San Joaquin Delta (Delta) levee integrity.

In July 2000, the CALFED agencies released the Final CALFED PEIS/R (CALFED 2000a), which analyzed a range of alternatives to solve Bay-Delta system problems. Preliminary studies in support of the CALFED PEIS/R considered more than 50 surface water storage sites throughout California and recommended more detailed study of five sites identified in the subsequent ROD, issued in August 2000 (CALFED 2000a, 2000b, 2000c). The CALFED ROD described a Storage Program that included five surface water storage projects in the Central Valley as follows:

> *Expanding water storage capacity is critical to the successful implementation of all aspects of the CALFED Program. Not only is additional storage needed to meet the needs of a growing population but, if strategically located, it will provide much needed flexibility in the system to improve water quality and support fish restoration efforts. Water supply reliability depends on capturing water during peak flows and during wet years.*

The Investigation is one of the five surface water storage studies recommended in the ROD. For the upper San Joaquin River Basin, the CALFED ROD states the following:

> *… 250-700 [thousand acre-feet (TAF)] of additional storage in the upper San Joaquin watershed… would be designed to contribute to restoration of and improve water quality for the San Joaquin River and facilitate conjunctive water management and water exchanges that improve the quality of water deliveries to urban communities. Additional storage could come from enlargement of Millerton Lake at Friant Dam or a functionally equivalent storage program in the region.*

This document tiers from the CALFED Final PEIS/R (CALFED 2000a) and ROD (including CEQA certification) (CALFED 2000b). The CALFED Final PEIS/R can be reviewed at http://calwater.ca.gov/calfed/library/. Tiering is provided for in CEQ Regulations Section 1502.20 and CEQA Guidelines Section 15152.

Findings in the CALFED ROD established the initial basis for potential Federal interest in the Investigation; hence, the objectives and guidance identified in the CALFED ROD represent important context for the Investigation-specific planning objectives (2000b).

Relationship to San Joaquin River Restoration Program

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and Central Valley Project (CVP) Friant Division contractors. After more than 18 years of litigation, the lawsuit, known as *NRDC et al. v. Kirk Rodgers et al*., reached a Stipulation of Settlement (Settlement). The Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved on October 23, 2006.

The Settlement establishes two primary goals:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with

the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- **Water Management Goal** – To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The San Joaquin River Restoration Program (SJRRP) implements the Settlement, as authorized in 2009 by the San Joaquin River Restoration Settlement Act (Settlement Act).

The actions included in the Selected Alternative described in the SJRRP ROD (Reclamation 2012) are included in the future conditions evaluated in this Draft EIS. Achievement of the Settlement goals is independent of any alternatives evaluated in this Draft EIS.

Intended Use of Environmental Impact Statement

The purpose of this Draft EIS is to disclose the potential direct, indirect, and cumulative impacts of implementing a proposed action and a range of reasonable alternatives including the No Action Alternative, consistent with NEPA and CEQA requirements. This Draft EIS serves as an informational document for decision makers, public agencies, nongovernmental organizations, and the general public regarding the potential environmental consequences of implementing a proposed Federal action and a range of reasonable alternatives.

This Draft EIS is being circulated for public review. Comments received during the public review period will be considered by the lead agency, and responses to comments will be included in the Final EIS. Continued public outreach, including public hearings, will be conducted before completion of the Final EIS. Please see http://www.usbr.gov/mp/sccao/storage/ for more information on these meetings.

After the Final EIS is published, Reclamation may prepare and adopt a ROD to implement a recommended plan/preferred alternative, if authorized. This Draft EIS has been prepared consistent with CEQA requirements to support required State and/or local agency decisions and permits.

Purpose and Need for Action, and Objectives

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action" (40 Code of Federal Regulations [CFR] 1502.13). The State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Section 15124(b)). The purpose, need, and objectives provided below are consistent with CALFED objectives and guidance.

Project Purpose and Need

The purpose of the proposed action is to increase storage of water from the upper San Joaquin River watershed to improve water supply reliability and operational flexibility in CVP San Joaquin Valley areas and other regions of California; and to enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

Alternatives were evaluated for their ability to meet the project purpose and need during alternatives development and screening. Action alternatives respond to needs related to water supply reliability and operational flexibility, San Joaquin River ecosystem enhancement opportunities, and other resource needs, as summarized below.

Water Supply Reliability and Operational Flexibility

California's water supply system faces critical challenges with demands exceeding supplies for urban, agricultural, and environmental (fisheries, wildlife refuges) water uses across the State. Without further investment in water management and infrastructure, current statewide shortages are expected to increase to approximately 4.9 million acre-feet per year by 2030. Challenges will be greater during drought years, when available surface water for environmental and agricultural purposes is in short supply, resulting in users turning to pumping water from an overdrafted groundwater system, exacerbating overdraft (DWR 2009).

Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. Increasing CVP and State Water Project (SWP) operational constraints have reduced the timing and volume of available water supply for agricultural and urban uses, leading to growing competition for limited

water resources. In addition, over time, projected climate change could impact precipitation and runoff, snowpack, flood risk management, water demand, and sea levels, and will further reduce water supply reliability. In light of current and future water supplies and demands and climate change effects, the CVP and SWP systems lack the flexibility in water delivery timing, location, and storage capacity that is needed to fully meet their multiple purposes.

In the Friant Division of the CVP, the 520 thousand acre-feet (TAF) storage capacity of Millerton Lake, located on the upper San Joaquin River, is small relative to the average annual inflow to the lake of approximately 1.8 million acre-feet. The development of additional storage capacity would provide Reclamation with operational flexibility and the ability to capture sufficient water in wet years to meet demands in other years.

San Joaquin River Ecosystem

Chinook salmon (*Oncorhynchus tshawytscha*) populations are known to be affected by many factors, including water temperature and flow conditions. The development of additional storage capacity provides opportunities to manage stored water supplies in a way that could enhance temperature and flow conditions in the San Joaquin River downstream from Friant Dam.

Other Resources

Several other needs associated with the San Joaquin River have been identified by various Federal and State agencies. Major storms during the past three decades have demonstrated that Friant Dam has little capacity to store water from large runoff events, resulting in flood releases downstream in almost 50 percent of the years. Demands for hydropower and ancillary services are expected to increase in the future. Demands are also increasing for water-oriented recreation in the Central Valley. San Joaquin River water quality downstream from Mendota Pool is degraded due to low flow and poor quality discharges. Additionally, urban drinking water treatment costs are rising.

Project Objectives

A set of primary and secondary planning objectives was developed for the Investigation to address the purpose and need. Primary objectives are those for which specific alternatives are formulated to address. Secondary planning objectives are actions, operations, or features that should be

considered in the plan formulation process, but only to the extent possible through pursuit of the primary objectives.

Primary Objectives

The primary planning objectives are as follows:

- Increase water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in the Friant Division of the CVP, other San Joaquin Valley areas, and other regions of California.

- Enhance water temperature and flow conditions in the San Joaquin River downstream from Friant for salmon and other native fish.

Secondary Objectives

The secondary planning objectives are as follows:

- Reduce flood damages downstream from Friant Dam.

- Maintain the value of hydropower attributes in the study area.

- Maintain and increase recreational opportunities in the study area.

- Improve San Joaquin River water quality downstream from Friant Dam.

- Improve the quality of water supplies delivered to urban areas.

Study Area

The Study Area evaluated in this Draft EIS includes both a primary and an extended study area to reflect the localized effects of a potential new major dam and reservoir upstream from Friant Dam in the upstream portion of Millerton Lake, and the effects of subsequent water deliveries over a larger geographic area. The primary study area was refined as the Investigation progressed and the number and location of feasible storage sites narrowed. The primary study area presented in this Draft EIS includes the following (Figure ES-1):

- San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the proposed Temperance Flat RM 274 Reservoir

- Areas that could be directly affected by construction-related activities, including the footprint of proposed temporary and permanent facilities upstream from Friant Dam

The extended study area encompasses the following (Figure ES-2):

- San Joaquin River downstream from Friant Dam, including the Sacramento-San Joaquin Delta

- Lands served by San Joaquin River water rights

- Friant Division of the CVP, including underlying groundwater basins in the eastern San Joaquin Valley

- South-of-Delta (SOD) water service areas of the CVP and SWP

Detailed descriptions of the Study Area and existing conditions of physical, biological, cultural, and socioeconomic resources within the study area are included in this Draft EIS.

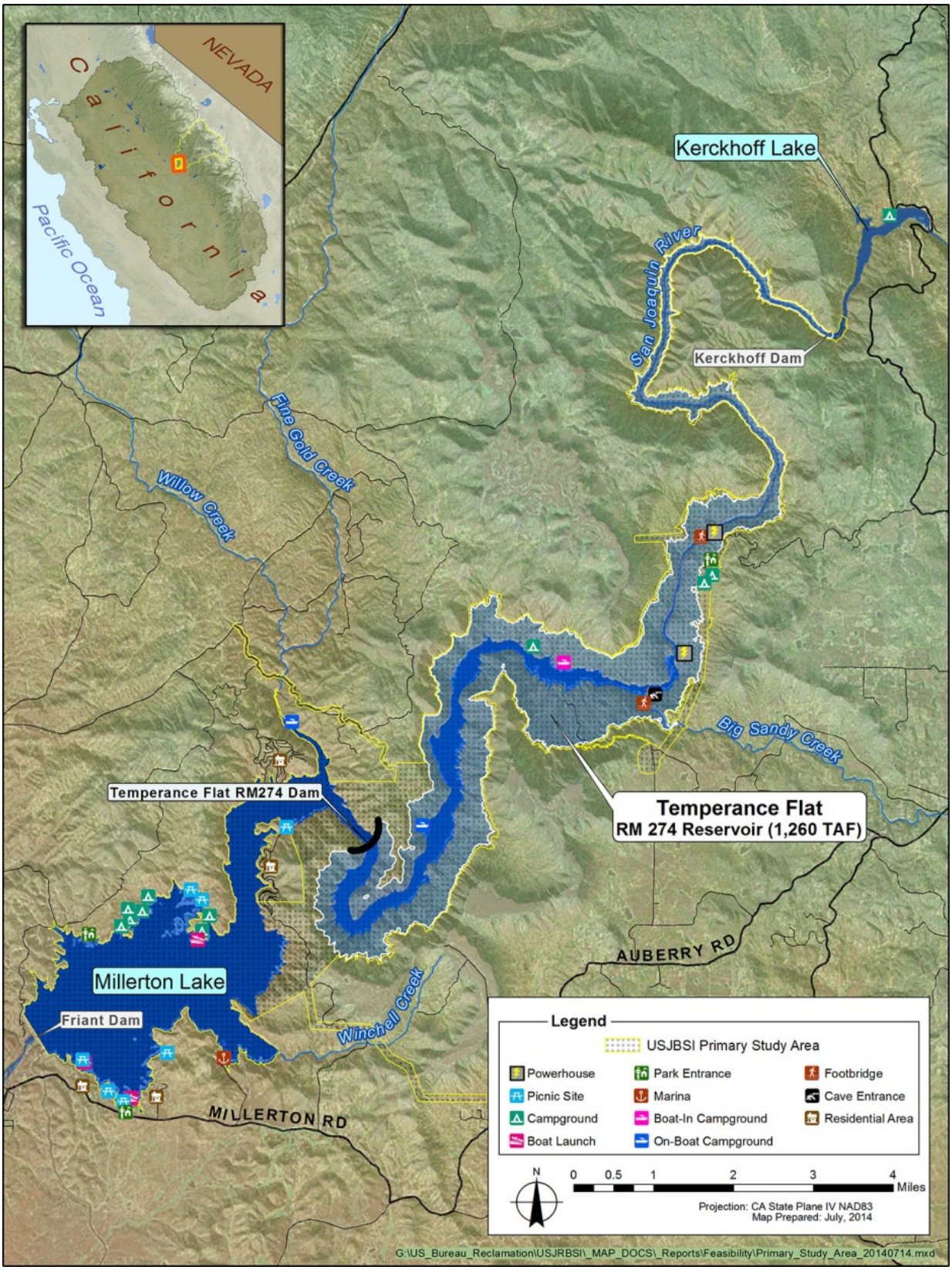

Figure ES-1. Primary Study Area Including Proposed Temperance Flat RM 274 Reservoir and Dam

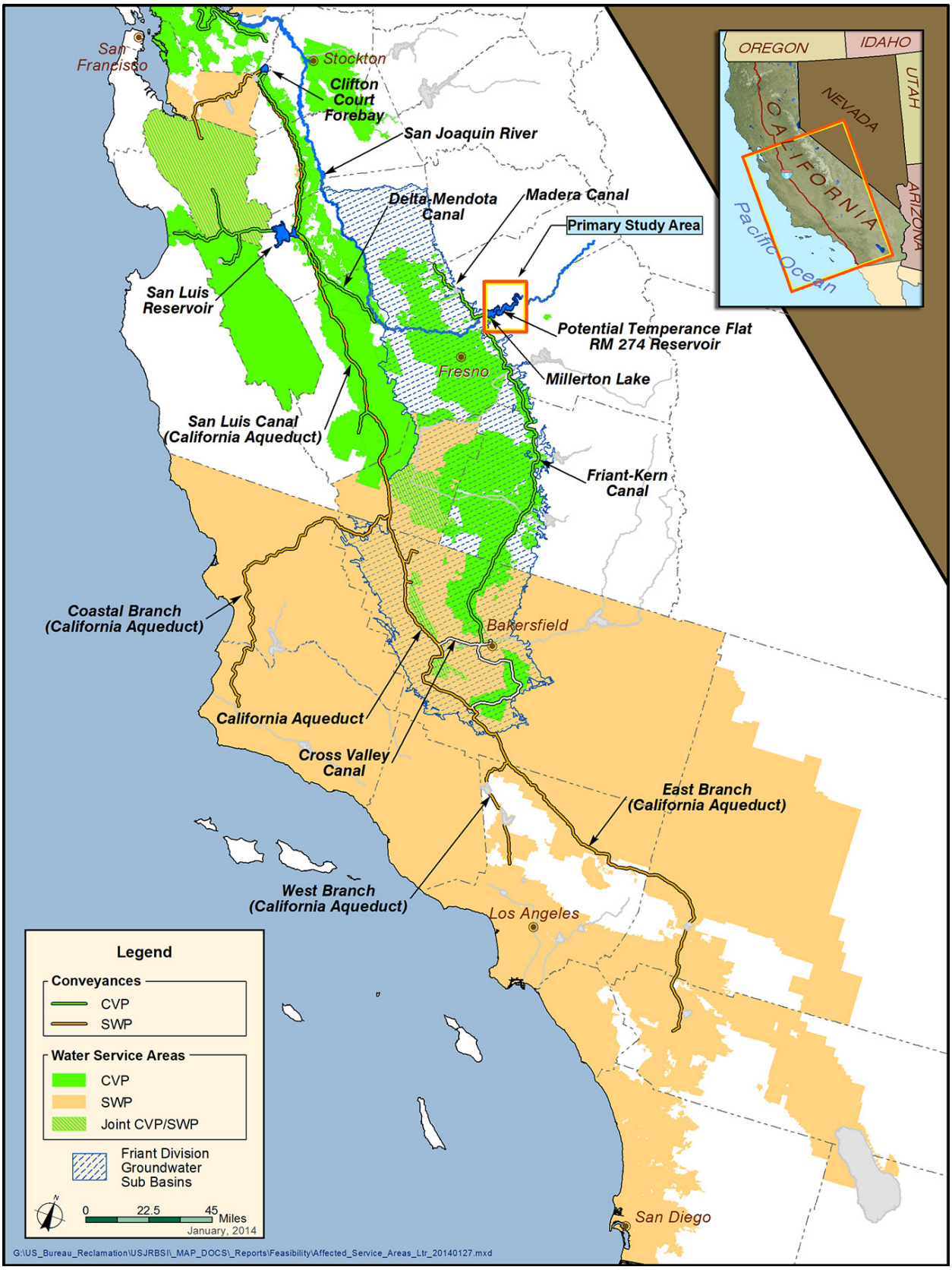

Figure ES-2. Extended Study Area

Description of Alternatives

The plan formulation process for the Investigation was divided into five phases, as shown in Figure ES-3. The Plan Formulation Phase included refinement of management measures, and formulation and refinement of initial alternatives, including selection of Temperance Flat RM 274 Reservoir as the site to be carried forward for more detailed analysis in the feasibility phases of the Investigation. The Temperance Flat RM 274 site was chosen for further evaluation after a detailed plan formulation and site selection process during the Investigation considering the ability to achieve site specific project objectives and/or the purpose and need. The site selection process evaluated 22 separate dam and reservoir sites, in addition to the 52 sites considered in the *CALFED Initial Surface Water Storage Screening* (2000c) and documented in the Plan Formulation Appendix to this Draft EIS. Alternative dam and reservoir sites included options suggested during the scoping process.

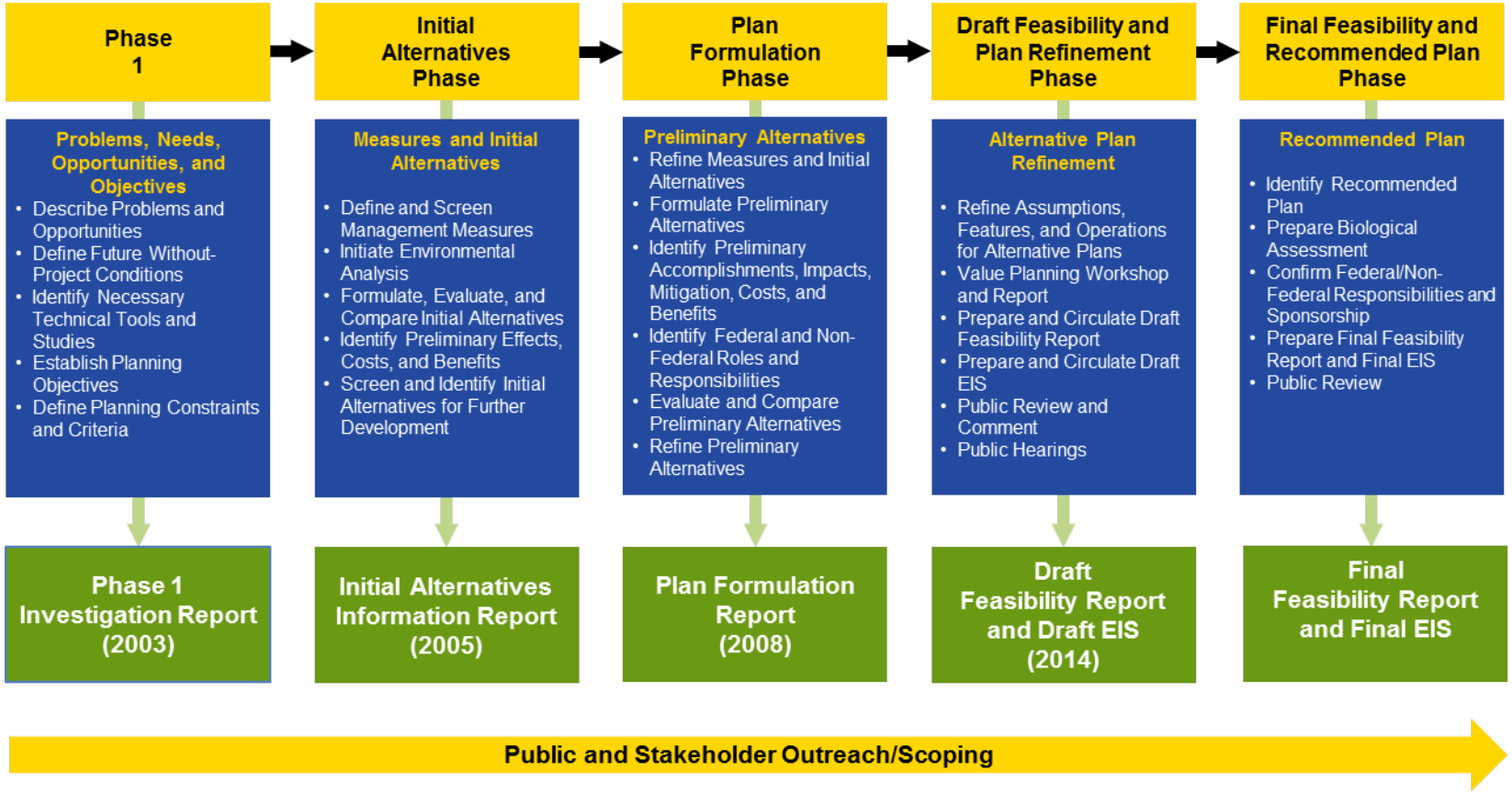

Figure ES-3. Plan Formulation Process

Action alternatives considered in the Draft EIS fundamentally consist of constructing new surface water storage facilities and operating them to address the primary planning objectives of increasing water supply reliability and enhancing temperature and flow conditions in the San Joaquin River. All of the action alternatives include the following management measures:

- **Temperance Flat RM 274 Reservoir –** All action alternatives would increase surface water storage capacity by constructing a dam in the upstream portion of Millerton Lake at RM 274.

- **Modify storage and release operations at Friant Dam –** All action alternatives would modify Friant Dam operations to facilitate coordinated operations with the additional storage in Temperance Flat RM 274 Reservoir and provide multi-purpose benefits.

- **Increase flood storage space in or upstream from Millerton Lake –** All action alternatives would increase incidental flood storage space by constructing a dam in the upstream portion of Millerton Lake at RM 274.

- **Construct new hydropower generation facilities –** All action alternatives would generate hydropower with a new powerhouse using releases from the new reservoir.

- **Replace or upgrade recreational facilities –** All action alternatives would develop replacement facilities to provide similar or greater recreational opportunities at Millerton Lake and the new reservoir.

No Action Alternative

Under the No Action Alternative, the project would not be implemented. The No Action Alternative (which also constitutes the No Project Alternative under CEQA) is considered the basis for comparison with potential action alternatives, consistent with NEPA and CEQA guidelines and the Federal P&G (WRC 1983) and *Principles and Requirements for Federal Investments in Water Resources* (CEQ 2013). NEPA and CEQA require consideration of future conditions under the No Action Alternative and No Project Alternative, respectively. Accordingly, the No Action Alternative reflects projected conditions in 2030 if the project is not implemented. CEQA also requires consideration of

existing conditions as a basis of comparison with the action alternatives for the impact analysis.

SJRRP Reasonably Foreseeable Actions Included in No Action Alternative

SJRRP actions implemented as of January 2014 are considered part of the existing conditions evaluated in this Draft EIS. These actions include the management and release of Restoration Flows pursuant to Paragraph 13 of the Settlement, recapture of Restoration Flows at existing facilities on the San Joaquin River, and recirculation of those flows to the Friant Division of the CVP, pursuant to Paragraph 16 of the Settlement (Natural Resources Defense Council et al. 2006).

Actions from the SJRRP PEIS/R ROD Preferred Alternative are included in the future conditions evaluated in this Draft EIS. All actions included under the existing conditions are also included in the future conditions. Additional SJRRP actions anticipated to be implemented in the future are reasonably foreseeable under the No Action Alternative, and are included in the future conditions.

Water Temperature and Flow Conditions

The No Action Alternative includes release of full Restoration Flows from Friant Dam to the San Joaquin River as provide in the Settlement. No actions other than SJRRP actions would be taken to enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam under the No Action Alternative.

Water Supply Reliability and System Operational Flexibility

Under the No Action Alternative, Friant Dam would continue operating similarly to existing conditions (with implementation of the Settlement, including Restoration Flows). The No Action Alternative would continue to meet water supply demands at levels similar to existing conditions.

Flood Management, Hydropower Attributes, Recreation, San Joaquin River Water Quality, Urban Water Quality

Flood system improvements along the San Joaquin River downstream from Friant Dam are currently underway or will be initiated in the future by USACE, DWR, and local/regional flood management districts. Additionally, modifications to San Joaquin River flow conveyance features downstream from Friant Dam will be initiated in the future by Reclamation under the SJRRP.

California's demand for electricity is expected to substantially increase in the future. Under the No Action Alternative, Pacific Gas and Electric Company (PG&E) is assumed to relicense the existing Kerckhoff Hydroelectric Project under the Federal Energy Regulatory Commission in 2022. PG&E will have decommissioned the No. 2 unit in the Kerckhoff Powerhouse (PG&E 2012), which would decrease the powerhouse capacity below the 30-megawatt Renewable Portfolio Standard limit.

As California's population continues to grow, demands for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley would grow significantly. Regional population growth in the vicinity of Millerton Lake is expected to result in increased demand for recreation and increased visitation at Millerton Lake (Reclamation and State Parks 2010).

Several activities to improve San Joaquin River water quality conditions through reducing pollutant concentrations and/or reducing pollutant loading to the river are underway, including continued implementation of the Westside Regional Drainage Plan and the Grassland Bypass Project.

Under the No Action Alternative, there would be no actions to increase storage in the upper San Joaquin River Basin that could enhance CVP and/or SWP operational flexibility to meet water quality goals in the Delta or facilitate water quality exchanges and similar programs to improve urban water quality.

Action Alternatives

Each of the action alternatives includes Temperance Flat RM 274 Dam and Reservoir, including constructing a roller-compacted concrete arch gravity dam located 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake (see Figure ES-4 through ES-7). Temperance Flat RM 274 Reservoir would provide about 1,260 TAF of additional storage capacity. In addition, each action alternative includes features and related construction activities such as the following:

- Constructing diversion works and cofferdams; an intake structure; a powerhouse and transmission facilities; a valve house; and access roads

- Creating and using an aggregate quarry, batch plant, staging area, and waste area; specific locations are

subject to change based on further engineering and geotechnical analyses

- Modifying existing PG&E hydroelectric project facilities
- Relocating recreational facilities and reservoir area utilities
- Clearing vegetation from within the inundation area
- Coordinate with the SJRRP to revise Restoration Flow Guidelines, the Recapture and Recirculation Plan, and accounting for Recovered Water Account and delivery of water under Paragraph 16b, as necessary
- Coordinate with the SJRRP on scheduling of releases from Friant Dam for downstream delivery of additional water supply developed by Temperance Flat RM 274 Reservoir, and floodplain habitat planning efforts for Reach 2B and Reach 4B.

The action alternatives are designed to address the purpose and need, and project objectives, to varying degrees. The action alternatives vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and reservoir minimum carryover storage targets), and intake feature configurations (low level or selective level intake for water temperature management). Operations of the action alternatives are summarized in Table ES-1.

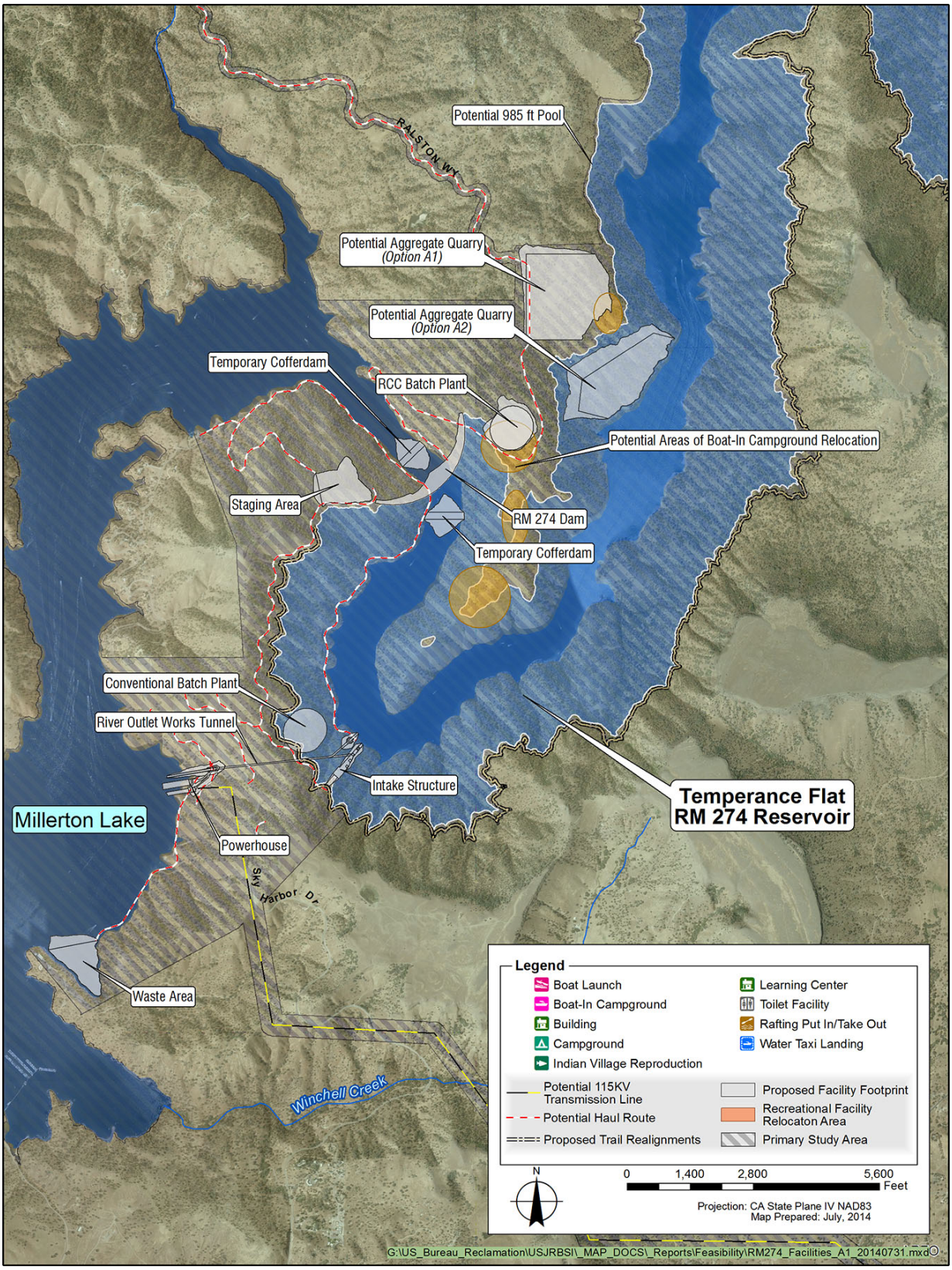

Figure ES-4. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option A

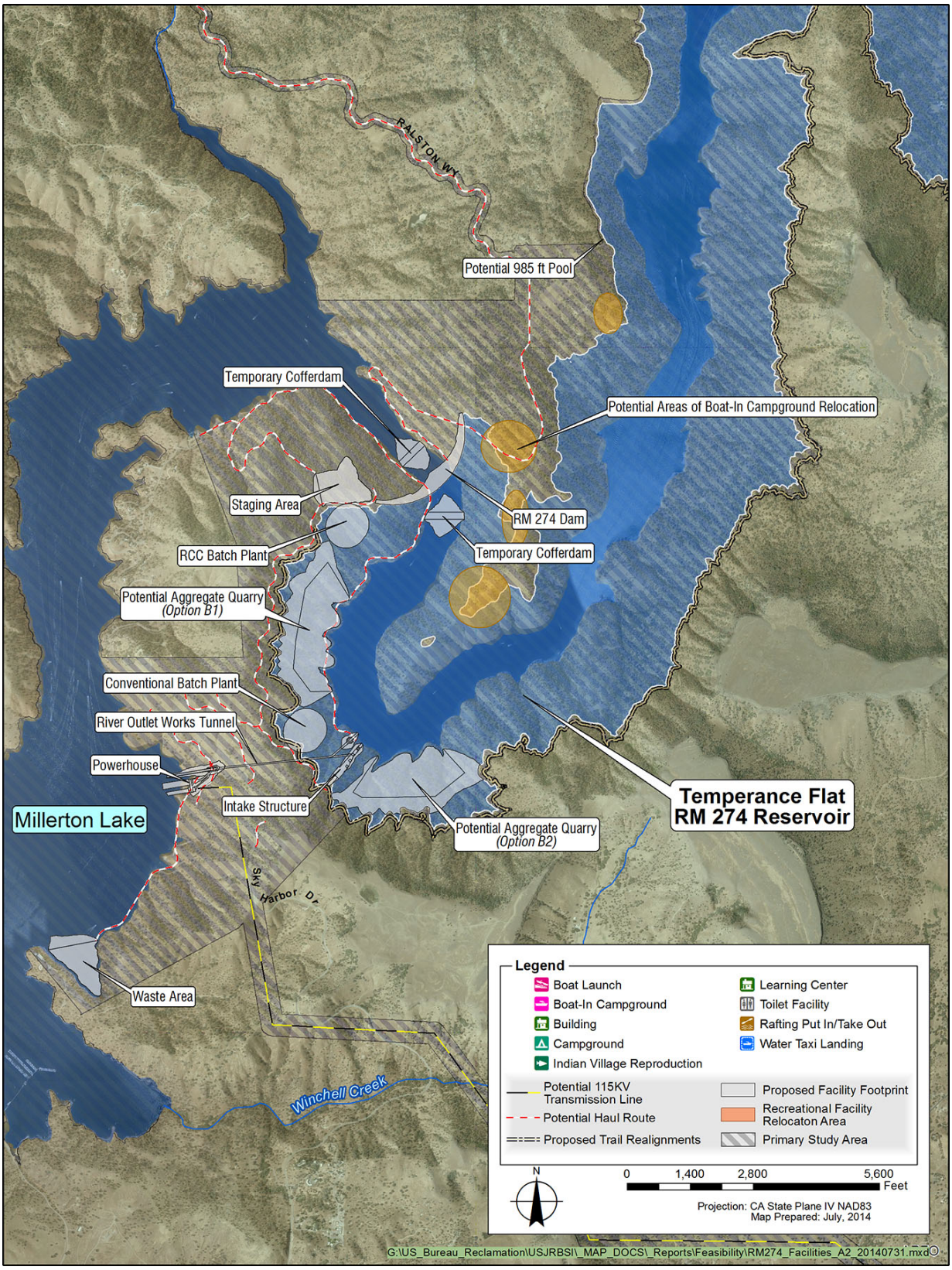

Figure ES-5. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option B

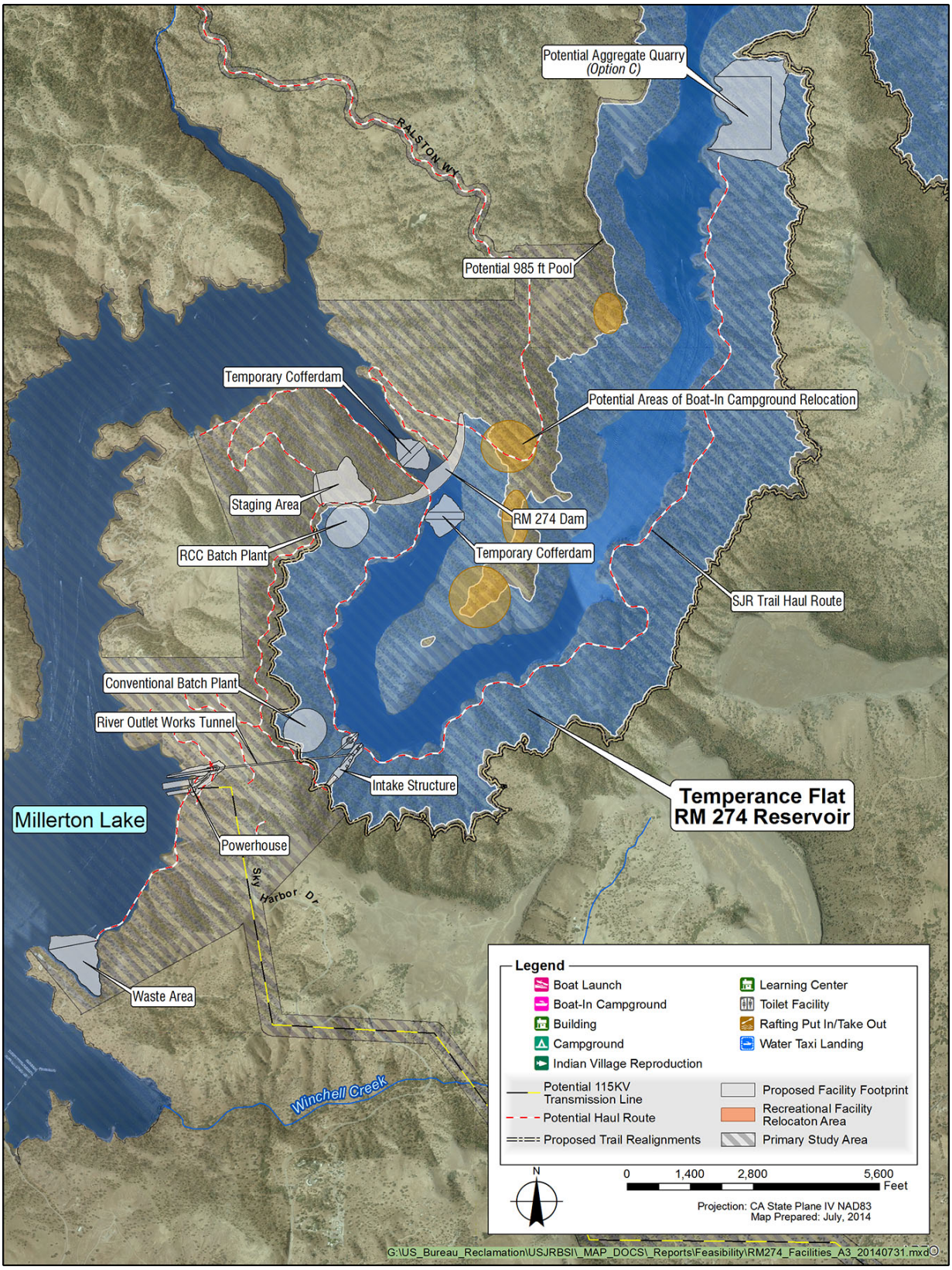

Figure ES-6. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option C

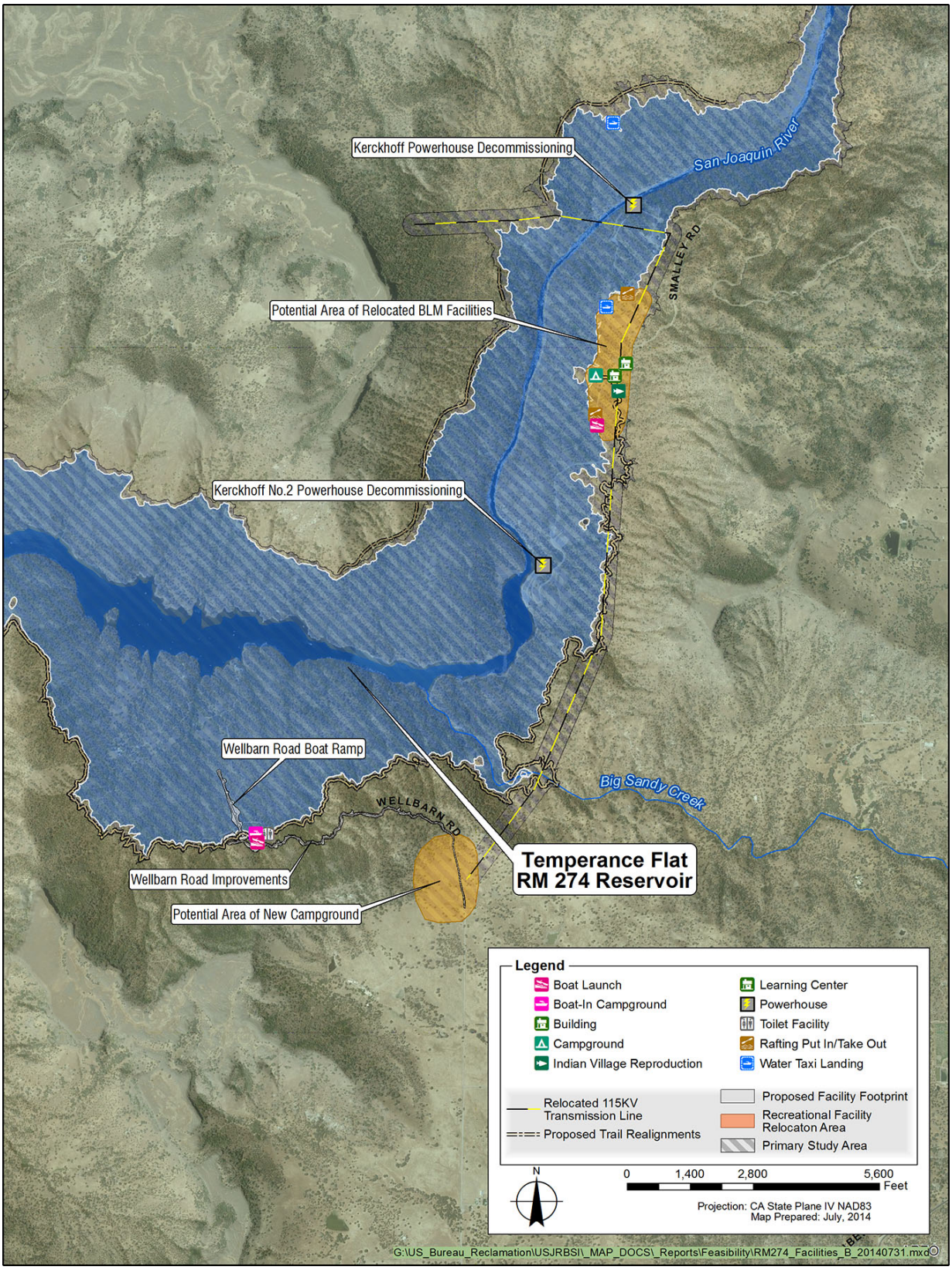

Figure ES-7. Proposed Temperance Flat RM 274 Reservoir Upstream Project Features

Table ES-1. Summary of Operations of Action Alternatives

Action Alternative	Conveyance Route to Friant Division of the CVP	Conveyance Route to CVP SOD Contractors	Conveyance Route to SWP SOD M&I Contractors	Millerton Lake Carryover Storage (TAF)	Temperance Flat Carryover Storage (TAF)	Intake Structure Type[1]
Alternative Plan 1	Friant-Kern/ Madera Canals	N/A	San Joaquin River[2]	340 TAF	200 TAF	LLIS
Alternative Plan 2	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	San Joaquin River[2]	340 TAF	200 TAF	LLIS
Alternative Plan 3	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	Friant-Kern Canal	340 TAF	200 TAF	LLIS
Alternative Plan 4	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	San Joaquin River[2]	340 TAF	325 TAF	SLIS
Alternative Plan 5	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	N/A	130 TAF[4]	100 TAF	LLIS

Notes:

[1] SLIS may be used for water temperature management.

[2] Water supply delivered via the San Joaquin River to Mendota Pool could be available for exchange with CVP SOD contractors, CVPIA Level 2 refuge supplies, or San Joaquin River Exchange Contractor supplies.

[3] Alternative Plans 2 through 5 would exchange Temperance Flat RM 274 Reservoir water supply for Level 2 refuges supplies delivered from the Delta, diversifying the CVPIA Level 2 water supply, and freeing up Delta supplies to be delivered to CVP SOD contractors.

[4] Millerton Lake would be operated with a preference for maintaining minimum storage at 340 TAF (when Temperance Flat is not full), but allows for Millerton Lake to be drawn down to 130 TAF when needed for water supply delivery.

Key:
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
Delta = Sacramento-San Joaquin Delta
LLIS = low-level intake structure
M&I = municipal and industrial
N/A = not applicable
RM = river mile
SLIS = selective-level intake structure
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet

Alternative Plan 1

Alternative Plan 1 would provide new water supplies to the Friant Division and SWP SOD M&I contractors. New supplies to SWP SOD M&I contractors would be delivered via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water could be delivered to SWP SOD M&I contractors via the California Aqueduct. Alternative Plan 1 would include a 200 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

Alternative Plan 1 would include a fixed, low level intake structure (LLIS) on Temperance Flat RM 274 Reservoir. The LLIS would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The LLIS would consist of two, low-level fixed-wheel gates sized

in combination to pass 20,000 cubic feet per second during high-flow conditions. Water through each gate would flow directly into the outlet works tunnel. Because the lower gates would also function to release higher flood flows, both would be necessary but only one gate would be opened, as needed, for normal releases.

Alternative Plan 2

Alternative Plan 2 would provide new water supplies to Friant Division contractors via the Friant-Kern Canal and Madera Canals; and SWP SOD M&I contractors and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes an LLIS and a 200 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

Alternative Plan 3

Alternative Plan 3 would provide new water supplies to: the Friant Division contractors via the Friant-Kern and Madera Canals; SWP SOD M&I contractors via existing cross-valley conveyance and the California Aqueduct; and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes an LLIS and a 200 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

Alternative Plan 4

Alternative Plan 4 would provide new water supplies to the Friant Division contractors via the Friant-Kern and Madera Canals; and SWP SOD M&I contractors and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative would include a selective-level intake structure (SLIS) and a 325 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

Alternative Plan 5

Alternative Plan 5 would provide new water supplies to Friant Division contractors via the Friant-Kern and Madera Canals; and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes a LLIS and a 100 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 130 TAF minimum carryover storage target. This action alternative considers an operational preference for keeping Millerton Lake storage at 340 TAF, but allows for Millerton Lake to be drawn down to 130 TAF when needed for water supply delivery and to fill completely (to 450 TAF) once Temperance Flat RM 274 Reservoir is full. Alternative Plan 5 also includes modification of the water supply allocation operational rules to increase drier year water supply reliability with minimal impact to long term average annual water supply reliability.

Environmental Commitments

Reclamation, its contractors, and/or its construction partners would implement the following specified environmental commitments and best management practices as part of any action alternative identified for implementation to avoid or minimize potential impacts:

- **Develop and Implement Construction Management Plans –** If any action alternative is approved and authorized for implementation, Reclamation would then develop and implement construction management plans to avoid or minimize potential impacts on public health and safety during project construction, to the greatest extent feasible.

- **Comply with Permit Terms and Conditions –** If any action alternative is approved and authorized for construction, Reclamation would then require its contractors and suppliers, its general contractor, and all of the general contractor's subcontractors and suppliers to comply with all of the terms and conditions of all required project permits, approvals, and conditions attached thereto.

- **Provide Relocation Assistance through Federal Relocation Assistance Program –** All relocation and property acquisition activities, such as those associated with temporary easements during construction or condemnation for permanent changes in the study area,

would be performed in compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act) (49 CFR 24).

- **Develop and Implement Comprehensive Mitigation Strategy** – Reclamation would develop and implement a comprehensive mitigation strategy to minimize potential impacts to physical, biological, and socioeconomic resources described in this Draft EIS. The mitigation strategy, including a framework for mitigation implementation and monitoring, will be included in the Final EIS.

- **Develop and Implement Resource Management Plan** – Reclamation would lead development of a Resource Management Plan, in collaboration with BLM and State Parks, for lands potentially affected by implementation of action alternatives. The plan would be prepared as a long-term plan to coordinate management of resources in the area and define the roles and responsibilities of each agency.

- **Cultural Resources** – If a project is authorized, then Reclamation would implement regulations at 36 CFR Part 800 to identify historic properties (including traditional cultural properties, sacred sites, and sacred areas, as appropriate), assess effects, and resolve adverse effects through the consultation process. To further avoid, minimize, or mitigate adverse effects to cultural resources, Reclamation would implement the following actions, as part of the Section 106 process or independently:

  - Develop a Cultural Resources Data Recovery Plan.

  - Conduct subsurface archaeological investigations before ground disturbing activities.

  - Stop work for discovery of previously undiscovered cultural resources during project construction.

  - Stop potentially damaging work if human remains are uncovered during construction.

  - Reduce through the Secretary of the Interior Standards to Heritage Documentation Programs

standards for buildings that are listed, or are eligible for listing, on the National Register of Historic Places.

- **Develop and Implement Stormwater Pollution Prevention Plan** – Any project authorized for construction would be subject to construction-related stormwater permit requirements of the Federal Clean Water Act National Pollutant Discharge Elimination System program. Reclamation would obtain any required permits through the Central Valley Regional Water Quality Control Board before conducting any ground-disturbing construction activity.

- **Fisheries Conservation** – To minimize potential adverse effects on fish species, Reclamation would implement in-water construction work windows timed to cause the least disturbance to sensitive fish species, monitor construction activities for potential impacts to important fishery resources, perform fish rescue/salvage within the construction area, and prepare a letter report detailing the methodologies used and the findings of fish monitoring and rescue efforts.

- **Water Quality Protection** – To minimize potential adverse effects to water quality, Reclamation would implement in-water construction work windows, comply with all water quality permits and regulations, and implement water quality best management practices.

- **Revegetation Plan** – Reclamation, in conjunction with cooperating agencies and private landowners, would prepare a comprehensive revegetation plan to be implemented in conjunction with other management plans.

- **Invasive Species Management** – Reclamation would develop and implement a control plan to prevent the introduction of zebra/quagga mussels (*Dreissena rostriformis bugensis*), invasive plants, and other invasive species to project areas.

- **Construction Material Disposal** – Reclamation's contractors would take measures to recycle or reuse demolished materials, such as steel or copper wire,

concrete, asphalt, and reinforcing steel, as required and where practical.

- **Asphalt Removal** – Per California Fish and Game Code 5650 Section (a), all asphaltic roadways and parking lots inundated by project implementation would be demolished and removed according to Fresno or Madera County standards, as applicable. Asphalt would be disposed of at an approved and permitted waste facility.

- **Reduce Fugitive Dust Emissions** – For reducing construction-related fugitive dust emissions, Reclamation would submit a dust control plan, and construction activities would not commence until SJVAPCD has approved the plan. Reclamation would also implement the additional SJVAPCD-recommended enhanced and additional control measures to further reduce fugitive dust emissions.

- **Fire Protection and Prevention Plan** – To minimize the risk of wildfire or threat to workers, property, and the public, Reclamation would prepare and implement a fire protection and preventions plan addressing dispensing of flammable/combustible liquids; welding and cutting; use, storage, and transport of compressed gas cylinders; management of open and enclosed storage yards or facilities; fire prevention measures; and fire emergency response.

Summary of Alternative Plan Accomplishments

Accomplishments of the action alternatives are summarized in Table ES-2.

Table ES-2. Potential Physical Accomplishments of Action Alternatives

Potential Physical Accomplishments[1,2]	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Dry and Critical Year Increase in Total Delivery (TAF)	19	24	30	21	121
Long-Term Average Annual Increase in Agricultural Delivery (TAF)[3]	30	49	52	41	94
Long-Term Average Annual Increase in M&I Delivery (TAF)	40	22	24	20	-7
Long-Term Average Annual Increase in Total Delivery (TAF)	70	71	76	61	87
Long-Term Average Annual Spring-Run Chinook Abundance Increase–High SAR (percent)[4]	2.8%	2.8%	0.6%	4.9%	-8.8%
Dry and Critical Year Spring-Run Chinook Abundance Increase–High SAR (percent)[4]	15.9%	13.2%	14.7%	13.2%	18.3%
Long-Term Average Annual Spring-Run Chinook Abundance Increase–Low SAR (percent)[4]	0.6%	0.4%	-0.6%	2.8%	-13.1%
Dry and Critical Year Spring-Run Chinook Abundance Increase–Low SAR (percent)[4]	14.0%	9.2%	13.3%	11.1%	16.3%
Net Increase in Friant Dam Hydropower Generation (GWh/year)	15.7	15.6	15.6	15.7	14.0
Replacement of Kerckhoff Hydroelectric Project Value (percent)[5]	83.8%	83.8%	83.8%	91.2%	73.4%
Increase in Recreation (thousands of visitor-days)[6]	108	109	106	120	69
Increase in Incidental Flood Space (TAF)[7]	354 – 481	353 – 479	351 – 470	243 – 347	406 – 555

Notes:

[1] Operations based on Reclamation March 2012 CalSim II Benchmark with Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP (USFWS 2008) and Biological Opinion and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009).

[2] Accomplishments are reported as changes in comparison to No Action Alternative.

[3] Simulated water demands in the Friant Division of the CVP are based on existing Class 1 and Class 2 contracts.

[4] Action alternatives are compared to the No Action Alternative, which varies depending on the SAR.

[5] Impacts to Kerckhoff Hydroelectric Project will be mitigated. Costs include additional reimbursement required after onsite replacement.

[6] Sum of potential annual visitor days at Millerton Lake and Temperance Flat RM 274 Reservoir.

[7] Incidental flood space is the flood space available during November through March at the 90 percent exceedance.

Key:
CVP = Central Valley Project
GWh/year = gigawatt hours per year
M&I = municipal and industrial
mg/L = milligrams per liter
NE = not evaluated
RM = river mile
SAR = smolt-to-adult return rate
SWP = State Water Project
TAF = thousand acre-feet
TDS = total dissolved solids

Alternatives Considered but Eliminated from Detailed Evaluation

A wide range of alternatives were formulated and evaluated in the feasibility study and this Draft EIS based on the study authorities and other pertinent direction, problems, needs, and opportunities, primary and secondary planning objectives, and project purpose and needs. The number of alternatives, including 22 dam and reservoir sites, was reduced through a phased evaluation process. Some project alternatives were not retained because they did not adequately meet (or were beyond the scope of) the purpose and need statement, did not contribute to both primary planning objectives, had extremely high costs, or had high social or environmental impacts. These alternatives are not analyzed in the Draft EIS, but are described in the Plan Formulation Appendix to this Draft EIS, along with assumptions, findings, and rationale for their elimination from further consideration.

Major Conclusions of the Environmental Analysis

An environmental document prepared to comply with NEPA must consider the context and intensity of the potential environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is a determining factor in whether an EIS must be prepared. An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. State CEQA Guidelines, Section 15382, defines a significant effect on the environment as “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project.”

This Draft EIS documents the analysis of the potential direct and indirect effects of the No Action Alternative and action alternatives, and cumulative effects of the action alternatives, for each environmental resource area. Direct effects are those that would be caused by the action and would occur at the same time and place. Indirect effects are reasonably foreseeable consequences that may occur at a later time or at a distance from the project area. Examples of indirect effects are growth inducement and other effects related to changes in land use patterns, population density, or growth rate, and related effects on the physical environment. Cumulative effects are those

which would result from the incremental impact of the action alternatives when added to other past, present, and reasonably foreseeable future actions.

The effects of the No Action Alternative and action alternatives were determined by comparing estimates of resulting conditions with baseline conditions. These baseline conditions differ between NEPA and CEQA. Under NEPA, the No Action Alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared; the No Action Alternative is also compared to existing conditions. Under CEQA, existing conditions are the baseline to which alternatives are compared.

Summary of Impacts

The action alternatives would affect environmental resources in the primary and extended study areas. Some of the impacts would be temporary, construction-related effects that would be less than significant or would be reduced to less-than-significant levels through mitigation. Other impacts would be permanent. In addition, some effects of the project would be beneficial. Under CEQA, potentially significant impacts are treated as significant impacts. Therefore, consistent with CEQA, unless feasible mitigation measures have been identified to reduce the magnitude of a significant or potentially significant impact to less than significant, the level of significance after mitigation is considered significant and unavoidable.

Table ES-3 summarizes the environmental impacts of the action alternatives, the level of significance of each impact before mitigation, recommended mitigation measures, and the level of significance of each impact after mitigation. Table ES-4 lists the cumulative impacts of the action alternatives.

Summary of Significant and Unavoidable Impacts

After consideration of actions, operations, and features to avoid, mitigate, and/or compensate for adverse effects, the action alternatives would likely result in some significant and unavoidable or potentially significant and unavoidable impacts. Direct and indirect impacts, including potentially significant and unavoidable or significant and unavoidable impacts, are listed in Table ES-3. Cumulative impacts are listed in Table ES-4. These impacts are described in Chapters 4 through 26 (direct and indirect impacts) and Chapter 27 (cumulative impacts).

Areas of Controversy

Federal, State, and local stakeholders identified several areas of concern during the public outreach activities for the Investigation, including public scoping activities, agency meetings, public review and comment on the Draft Feasibility Report, and related ongoing public outreach activities. Major concerns include: impacts on air quality, biological resources, cultural resources, hydropower generation, the Millerton Lake Cave system, and the San Joaquin River Gorge area; and the potential to induce growth.

Issues to be Resolved

Special Designations

BLM concluded a preliminary determination to suggest that the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse is suitable for inclusion in the National Wild and Scenic Rivers System during development of the Draft Bakersfield Resource Management Plan and EIS (2011 and 2012). Inclusion of this segment of the San Joaquin may affect the Investigation. Next steps for inclusion of this segment in the National Wild and Scenic Rivers System would include Congressional determination of suitability or nonsuitability, or Secretary of the Interior's determination of suitability or nonsuitability and submittal of reports to the president. The president would then report recommendations to Congress, and propose designation.

Off-Site Mitigation for Impacts on Biological Resources

Potential mitigation lands containing wetland and special-status species habitat comparable to habitat that would be affected by the action alternatives have been identified near the study area. Reclamation is initiating informal consultation with the USFWS to identify appropriate mitigation requirements. Mitigation strategies for biological impacts will be discussed in more detail in the Final Feasibility Report and Final EIS.

Hydropower Mitigation

The onsite hydropower replacement option (powerhouse connected to the outlet works of Temperance Flat RM 274 Reservoir), combined with additional mitigation, as needed, would be cost effective and is Reclamation's preferred power mitigation option for the Investigation. Additional powerhouse refinements may be conducted before completing the

feasibility study, and additional operational scenarios could be evaluated in the future that may further improve the value of onsite hydropower mitigation. Additional mitigation components may also be needed and could include a range of onsite and offsite power generation and transmission actions. Hydropower mitigation issues will continue to be coordinated with affected stakeholders during development of the Final Feasibility Report and Final EIS.

Identification of Preferred Alternative/Recommended Plan

Consistent with the CEQ Regulations, the preferred alternative for implementation will be identified in the Final EIS. Ultimately, the alternative that best meets the stated objectives and maximizes net public benefits will be identified with supporting rationale and documentation. The alternative recommended for implementation, or Recommended Plan in the Final Feasibility Report, may or may not be identified as the Environmentally Preferable Alternative, consistent with NEPA; the National Economic Development Plan, consistent with the P&G; the Least Environmentally Damaging Practicable Alternative, consistent with the Clean Water Act; or the Environmentally Superior Alternative, consistent with CEQA. A non-Federal sponsor may prefer another plan (locally preferred plan), which may be considered and recommended by the Secretary of the Interior for approval and authorization by Congress.

Public Involvement and Next Steps

Reclamation and DWR initiated the formal environmental analysis process for the Investigation consistent with NEPA and CEQA in February 2004 with the issuance of a Notice of Intent (NOI) and a Notice of Preparation (NOP), respectively. Pursuant to NEPA, the NOI notified the public of Reclamation's intent to prepare an EIS and provided notice of public scoping meetings. The NOI was published on February 3, 2004 in the Federal Register (Volume 69, pages 5184-5185). Pursuant to CEQA, an NOP was submitted by DWR to the State Clearinghouse on February 6, 2004 and published on March 22, 2004 in the State Clearinghouse Newsletter (February 1 through 15, 2004, page 41).

Public scoping activities are conducted as part of compliance with both NEPA and CEQA. In 2004, Reclamation and DWR convened a set of four public scoping meetings in Sacramento

(March 16), Modesto (March 16), Friant (March 17), and Visalia (March 18), California to inform interested groups and individuals about the Investigation and to solicit ideas and comments. A Scoping Report was prepared consistent with Reclamation guidance and in compliance with NEPA requirements, and released in December 2004 (Reclamation and DWR 2004).

In addition to scoping activities, other public outreach activities have included seven workshops held during Phase 1 of the Investigation; more than 30 stakeholder briefings that have been organized by Reclamation at the request of agencies and stakeholder groups; four project update public meetings held during the initial alternatives and plan formulation phases of the Investigation; local stakeholder interviews regarding regional opportunities for groundwater storage and banking; Study area tours of Millerton Lake and alternative dam site location(s) given by the Investigation team to stakeholders and organized by local water resources interest groups; public release of major Reclamation studies and reports for the Investigation; and a project website for the Investigation (http://www.usbr.gov/mp/sccao/storage).

In addition to stakeholder and public outreach efforts, interagency coordination has assisted Reclamation in determining the scope of this Draft EIS, developing project components and objectives, identifying the range of alternatives, and defining potential environmental impacts, impact significance, and mitigation measures.

This Draft EIS will be circulated for public and agency review and comment for 45 days following the date when the EPA publishes the notice of availability of weekly receipt of environmental impact statements in the Federal Register. During the public comment period, Reclamation intends to hold public meetings/hearings. Comments provided during the public review period will be addressed in the Final EIS.

A Final EIS will be prepared and circulated in accordance with NEPA requirements and will include responses to all comments. When the Final EIS is complete, Reclamation will publish the document, along with the Final Feasibility Report, and the notice of availability will be printed in the Federal Register, which will mark the start of a 30-day public review period before Reclamation could issue a ROD to implement a recommended plan/preferred alternative, if authorized by Congress.

Table ES-3. Summary of Impacts and Mitigation Measures

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-1: Reduce Mobile-Source Exhaust Emissions	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
AQ-2: Project-Generated Construction-Related Toxic Air Contaminant Emissions that would Expose Sensitive Receptors to Substantial Pollutant Concentrations and Increased Health Risks	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-2: Implement Mitigation Measure AQ-1, Reduce Mobile-Source Exhaust Emissions	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
AQ-3: Project-Generated Operational Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-4: Reduce Greenhouse Gas Emissions	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-1: Loss of Riverine Habitat for Lotic Fish Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-2: Short-term Degradation of Aquatic Habitat from Accidental Spills or Seepage of Hazardous Materials during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-3: Short-term Degradation of Aquatic Habitat from Increased Turbidity or Sedimentation during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-4: Loss of Reservoir Fish Habitat Resulting from Changes in Water Temperature	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-5: Changes to Reservoir Fish Habitat Caused by Turbidity from Increased Surface Area of Exposed Shoreline	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-6: Loss of Reservoir Fish Caused by Entrainment	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-7: Change in Shallow-Water Habitat for Largemouth Bass, Spotted Bass, Smallmouth Bass, and Other Sport Fish Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-8: Change in Open-Water Habitat for Striped Bass and American Shad	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-10: Change in Habitat Potential for Spring-Run Chinook Salmon	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	Beneficial	None Required	Beneficial
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	PS	None Available	PSU
FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-12: Change to Habitat for Moderately Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
FSH-13: Changes to Habitat for Highly Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-14: Changes to Spawning and Rearing Habitat from Changes to Flood Pulses and Floodplain Connectivity	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS and Beneficial	None Required	PSU and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-15: Change in Fish Habitat and Migratory Behaviors from Changes in Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-16: Change in Fish Habitat and Migratory Behaviors from Changes in Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-17: Loss of Fish Habitat from Changes in Tributary Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Available	PSU
		Alternative Plan 1	PS		PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
FSH-19: Loss of Suitable Fish Habitat from Salinity Changes in the Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-20: Loss of Suitable Fish Habitat from Change in Flow Patterns in the South Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-21: Reduction in Fish Abundance from Changes in Exports and Entrainment in the South Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-22: Loss of Suitable Fish Habitat Resulting from Changes in X2	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-1: Relocate Special-Status Plant Populations	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
BOT-2: Loss of Riparian Habitat and Other Sensitive Communities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-2: Compensate for Loss of Specific Habitats	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-3: Loss or Degradation of Waters of the United States, Including Wetlands, and Waters of the State	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-3: Ensure No Net Loss of Wetlands	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
BOT-4: Introduction and Spread of Invasive Plants	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	BOT-4: Implement a Weed Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-5: Elimination of a Plant Community or Substantial Reduction in the Number or Restriction of the Range of an Endangered, Rare, or Threatened Plant Species	Primary Study Area	No Action Alternative	NI		NI
		Alternative Plan 1	LTS	None Required	LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources	Primary Study Area	No Action Alternative	NI	None Required BOT-6: Implement Mitigation Measures BOT-1, BOT-2, and BOT-3	NI
		Alternative Plan 1	S		LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-7: Conflict with Provisions of an Adopted Habitat Conservation Plan Protecting Wetland or Botanical Resources	Primary Study Area	No Action Alternative	NI		NI
		Alternative Plan 1	NI	None Required	NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 4	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-1: Substantial Impact on Special-Status Invertebrates	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-1a: Mitigate Impacts on VELB, WLD-1b: Mitigate Impacts on Pipevine Swallowtail, WLD-1c: Mitigate Impacts on Listed Vernal Pool Branchiopods	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-2a: Mitigate Impacts on California Tiger Salamander and Western Spadefoot, WLD-2b: Mitigate Impacts on Foothill Yellow-Legged Frog and California Red-Legged Frog, WLD-2c: Mitigate Impacts on Western Pond Turtle, WLD-2d: Mitigate Impacts on Coast Horned Lizard	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-3: Substantial Impact on Special-Status Raptors	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-3a: Mitigate Impacts on Bald Eagle and Golden Eagle, WLD-3b: Mitigate Impacts on California Spotted Owl, WLD-3c: Mitigate Impacts on Burrowing Owl WLD-3d: Mitigate Impacts on American Peregrine Falcon and Prairie Falcon, WLD-3e: Mitigate Impacts on Cooper's Hawk and Sharp-Shinned Hawk, WLD-3f Mitigate Impacts on Osprey, WLD-3g: Mitigate Impacts on Northern Harrier	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-4a: Mitigate Impacts on Yellow Warbler, WLD-4b: Mitigate Impacts on Grasshopper Sparrow and California Horned Lark, WLD-4c: Mitigate Impacts on Loggerhead Shrike, WLD-4d: Mitigate Impacts on Bird Species Protected by the Migratory Bird Treaty Act	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-5: Substantial Impact on Ringtail	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-5: Mitigate Impacts on Ringtail	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-6: Substantial Impact on American Badger	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-6: Mitigate Impacts on American Badger	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-7: Substantial Impact on San Joaquin Pocket Mouse	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-7: Mitigate Impacts on San Joaquin Pocket Mouse	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-8: Substantial Impact on Special-Status Bat Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-8: Mitigate Impacts on Special-Status Bat Species	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-9: Substantial Impact on Migratory and Wintering Deer Herds	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-9: Mitigate Impacts on Migratory and Wintering Deer Herds	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-11: Potential Reduction in Habitat or Populations of Special-Status Invertebrates	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-12: Potential Reduction in Habitat or Populations of Special-Status Amphibians and Reptiles	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-13: Potential Reduction in Habitat or Populations of Special-Status Bird Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-14: Potential Reduction in Habitat or Populations of Special-Status Mammal Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-15: Potential Interference with Migratory Corridors or Nursery Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-16: Potential Impact on Riparian Habitat for Special-Status Bird Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	WLD-16: Monitor and Manage Riparian Vegetation Structure Within Extended Study Area	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-17: Conflict with Local or Regional Policies Protecting Wildlife Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-18: Potential Conflict with Adopted Conservation Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL-1:Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL 2: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL 3: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
CUL-4 Destruction or Damage to Traditional Cultural Properties	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	CUL 4: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
CUL-5 Destruction or Damage to Indian Sacred Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	CUL 5: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low Income Populations	Primary Study Area	No Action Alternative	NDHA	None Required	NDHA
		Alternative Plan 1	DHA	ENJ-1: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	DHA
		Alternative Plan 2	DHA		DHA
		Alternative Plan 3	DHA		DHA
		Alternative Plan 4	DHA		DHA
		Alternative Plan 5	DHA		DHA
	Extended Study Area	No Action Alternative	NDHA	None Required	NDHA
		Alternative Plan 1	NDHA		NDHA
		Alternative Plan 2	NDHA		NDHA
		Alternative Plan 3	NDHA		NDHA
		Alternative Plan 4	NDHA		NDHA
		Alternative Plan 5	NDHA		NDHA

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions and Slope Instability	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	GEO-1: Develop and Implement a Seismic Action Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	None Available	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations	Primary Study Area	No Action Alternative	NI	None Available	NI
		Alternative Plan 1	PS		PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-5: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that Are Unsuited to Land Application of Waste	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FLD-3: Place Within a 100-Year Flood Hazard Area Structures which would Impede or Redirect Flood Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GRW-1: Change in Groundwater Levels	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS		LTS
GRW-2: Change in Groundwater Quality	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
SWS-1: Changes in Ability to Divert Water from Friant Dam	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SWS-2: Changes in Ability to Divert Water from San Joaquin River	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SWS-3: Change in Water Levels in the Old River near the Tracy Road Bridge	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
SWS-4: Change in Water Levels in the Grant Line Canal Above the Grant Line Canal Barrier	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
SWS-5: Change in Water Levels in the Middle River near the Howard Road Bridge	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-2: Temporary Construction-Related Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-3: Temporary Construction-Related Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	SWQ-4: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	San Joaquin River from Friant Dam to the Merced River Confluence	No Action Alternative	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	San Joaquin River from the Merced River Confluence to the Delta	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
Impact SWQ-6: Long-Term Effects on Delta Salinity that would Violate D-1641 Salinity Objectives	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-7: Long-Term Effects on Delta Salinity that would Violate the X2 Standard	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-8: Long-Term Effects on Water Quality that would Violate Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ITA-1: Interfere with the Exercise of a Federally Reserved Water Right, or Degrade Water Quality Where There is a Federally Reserved Water Right	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
ITA-2: Interfere with the Use, Value, Occupancy, Character or Enjoyment of an ITA	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ITA-3: Failure to Protect ITAs from Loss, Damage, Waste, Depletion, or Other Negative Effects	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
LUP-1: Disruption of Existing Land Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-1: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
LUP-2: Conflict with Adopted Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-2: Conduct Conflict Resolution with Land Managers	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-3: Protect Agricultural Land Productivity	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
LUP-4: Conversion of Forest Land	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	None Available	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	NOI-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
NOI-2: Construction-Generated Ground Vibration	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise	Primary Study Area	No Action Alternative	NI	None Required NOI-3: Install Sound Barriers along County Road 211 and County Road 210, and Restrict Truck Hauling on Public Roads to the Less-Sensitive Daytime Hours	NI
		Alternative Plan 1	S		SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
NOI-4: Long-Term Operational Stationary- and Area-Source Noise	Primary Study Area	No Action Alternative	NI		NI
		Alternative Plan 1	LTS	None Required	LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
NOI-5: Long-Term Increases in Traffic Noise	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	NOI-5: Implement Measures to Reduce Exposure to Operational Traffic Noise along Wellbarn Road and Smalley Road	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PAL-1: Potential for Damage to or Destruction of Unique Paleontological Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	PAL-1: Implement a Recovery Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services	Primary Study Area	No Action Alternative	PS	None Available	PSU
		Alternative Plan 1	S		SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
PWR-2: Change in Energy Generation at Friant Dam Powerhouses	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
PWR-3: Change in Energy Generation and Use Within the Friant Division of the CVP Water Service Area	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-4: Decrease in CVP System Energy Generation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
PWR-5: Decrease in SWP System Energy Generation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
PWR-6: Increase in CVP System Pumping Energy Use	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-7: Increase in SWP System Pumping Energy Use	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-1: Potential for Exposure to Hazardous Materials	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS	None Required	LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-2: Potential Emission of Hazardous Materials within 0.25 Mile of a School	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-2: Reduce Exposure of Hazards to Schools	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-3: Increase Hazards from a Known Hazardous Materials Contamination Site	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-3: Reduce Hazards from Hazardous Material Sites	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-4: Interfere with Evacuation Routes and Emergency Vehicle Access	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	HAZ-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-5: Locate Electrical Transmission Facilities Near a School	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-6: Increase Hazards of Wildland Fires	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-7: Increase Hazards of West Nile Virus	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	HAZ-7: Reduce Hazards of West Nile Virus	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-8: Increase Hazards of Valley Fever	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-8: Reduce Hazards of Valley Fever	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-9: Increase Exposure to Damage from Acts of Terrorism	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-10: Increase Exposure to Hazards Associated with Abandoned Mine Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-11: Increase Potential for Blast-Related Injury during Construction	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-11: Reduce Hazards from Blasting	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-1: Permanent Loss or Closure of a Recreation Facility	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-1a: Allow On- Boat Camping, REC-1b: Create New Shoreline Access Site	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-2: Permanent Loss of a Resource Used for Recreation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-2: Preserve Fine Gold Creek Watershed Cave System	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-3: Substantial or Long-Term Reduction or Elimination of Recreation Opportunities or Experiences	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	REC-3a: Limit Construction Activities near Recreation Areas, REC-3b:Instream Whitewater Boating Improvements, REC-3c: Extend the San Joaquin River Trail through the SJRG SRMA	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-4: Loss of Access to a Locally Important Recreation Site or Area	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-4: Maintain Public Access	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-5: Increased Use of Existing Neighborhood and Regional Parks or Other Recreation Facilities such that Substantial Physical Deterioration of the Facilities Would Occur or Be Accelerated	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-6: Impacts Associated with New or Expanded Recreation Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-1: Temporary Increases in Employment and Personal Income Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-2: Temporary Increases in Population and Housing Demand Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-3: Temporary Increases in Business Income and Local Sales Tax Revenue Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-4: Increases in Employment and Personal Income Resulting from Operations and Maintenance	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-5: Increases in Spending, Employment, and Personal Income from Increased Recreational Visitation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-6: Increases in Population and Housing Demand Resulting from Operations and Maintenance	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-7: Increases in Business Income and Local Sales Tax Revenue Associated with O&M and Recreation Visitation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-8: Decreases in Property Tax Revenue from Acquisition of Privately Owned Land	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	S	None Required	SU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
SOC-10: Increases in Population and Housing Demand Within the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-11: Increases in Business Income and Local Sales Tax Revenue Within the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	S	None Required	SU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
TRN-1: Reduce Level of Service For Designated Roads	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
TRN-2: Increase Traffic Hazards on Local Roads	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-2: Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
TRN-3: Interfere With Emergency Access	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-3: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
TRN-4: Decrease Performance of Bicycle Or Pedestrian Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
UTL-1: Result in Exceeding Wastewater Treatment Requirements or Requiring New or Expanded Wastewater Treatment Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	UTL-1: Prepare and Implement a Wastewater Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
UTL-2: Result in Exceeding Stormwater Drainage Infrastructure Capacity or Requiring New or Expanded Stormwater Drainage Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
UTL-3: Increase in Solid Waste Generation That Exceeds Permitted Landfill Capacity	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	UTL-3: Prepare and Implement a Solid Waste Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
UTL-4: Damage to or Disruption of Utility or Service Systems	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
VIS-1: Consistency With Applicable Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
VIS-2: Degradation and/or Obstruction of a Scenic View	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	VIS-2: Minimize Construction-Related Visual Impact on Scenic Views from KOPs	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table ES-3. Summary of Impacts and Mitigation Measures (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	VIS-3: Minimize or Avoid Visual Impact of Daytime Glare and Nighttime Lighting	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
VIS-4: Impacts on a Designated Scenic Highway	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
- = Not Applicable
B = beneficial
LTS = less than significant
NDHA = not disproportionately high and adverse
NI = no impact
O&M = operation and maintenance
DHA = disproportionately high and adverse
PS = potentially significant
PSU = potentially significant and unavoidable
S = significant
SU = significant and unavoidable
TBD = to be determined

Table ES-4. Impacts of Alternative Plans with Potential to Result in a Cumulatively Considerable Incremental Contribution to a Significant Cumulative Impact

Resource Area	Impact
Air Quality and Greenhouse Gas Emissions	AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations AQ-4: Generation of Greenhouse Gas Emissions that Would Significantly Impact the Environment
Biological Resources – Fisheries and Aquatic Ecosystems	FSH-1: Loss of Riverine Habitat for Lotic Fish Species FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and DO Concentrations
Biological Resources – Botanical and Wetlands	BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat BOT-2: Loss of Riparian Habitat and Other Sensitive Communities BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources
Biological Resources – Wildlife	WLD-1: Substantial Impact on Special-Status Invertebrates WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles WLD-3: Substantial Impact on Special-Status Raptors WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act WLD-5: Substantial Impact on Ringtail WLD-6: Substantial Impact on American Badger WLD-7: Substantial Impact on San Joaquin Pocket Mouse WLD-8: Substantial Impact on Special-Status Bat Species WLD-9: Substantial Impact on Migratory and Wintering Deer Herds WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines
Cultural Resources	CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District CUL-4 Destruction or Damage to Traditional Cultural Properties CUL-5 Destruction or Damage to Indian Sacred Sites
Environmental Justice	ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low Income Populations
Geology and Soils	GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations
Hydrology – Groundwater	GRW-1: Change in Groundwater Levels GRW-2: Change in Groundwater Quality
Hydrology – Surface Water Quality	SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River
Land Use Planning and Agricultural Resources	LUP-1: Disruption of Existing Land Uses LUP-2: Conflict with Adopted Plans LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts LUP-4: Conversion of Forest Land

Table ES-4. Impacts of Alternative Plans with Potential to Result in a Cumulatively Considerable Incremental Contribution to a Significant Cumulative Impact (contd.)

Resource Area	Impact
Noise and Vibration	NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise NOI-5: Long-Term Increases in Traffic Noise
Power and Energy	PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services
Socioeconomics, Population, and Housing	SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas
Visual Resources	VIS-1: Consistency with Applicable Plans VIS-2: Degradation and/or Obstruction of a Scenic View VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting

Key:
CVP = Central Valley Project
DO = Dissolved Oxygen
SWP = State Water Project

Draft
Environmental Impact Statement

Upper San Joaquin River Basin Storage Investigation

Prepared by:

United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

U.S. Department of the Interior
Bureau of Reclamation

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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.

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Abbreviations and Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
µS/cm	microsiemens per centimeter
AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ACWD	Alameda County Water District
AIA	Air Impact Assessment
ANN	artificial neural network model
AP	Air Pollution
APCO	Air Pollution Control Officer
APE	area of potential effect
AQAP	air quality attainment plans
ARB	California Air Resources Board
Banks Pumping Plant	Harvey O. Banks Pumping Plant
BAU	Business as Usual
Bay-Delta	San Francisco Bay/Sacramento–San Joaquin Delta
Berkeley case	*Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners of the City of Oakland, 2001*
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BO	biological opinion
BPS	Best Performance Standards
BST	Benchmark Study Team
CAA	Fish and Wildlife Coordination Act, Clean Air Act
CAAA	Federal Clean Air Act Amendments of 1990
CaCO3	calcium carbonate
Cal EMA 2010	*2010 State of California Multi-Hazard Mitigation Plan*

Cal/EPA	California Environmental Protection Agency
CAL FIRE	California Department of Forestry and Fire Protection
Cal-IPC	California Invasive Plant Council
Cal/OSHA	California Occupational Safety and Health Administration
CalEEMod	California Emissions Estimator Model
CALFED	CALFED Bay-Delta Program
CalSim	California Water Resources Simulation Model
Caltrans	California Department of a Transportation
CAT	Climate Action Team
CCAA	California Clean Air Act
CCD	Census-County Division
CCID	Central California Irrigation District
CCP	comprehensive conservation plan
CCR	California Code of Regulations
CCWD	Contra Costa Water District
CDC	Centers for Disease Control and Prevention
CDEC	California Data Exchange Center
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CDP	Census-Designated Place
CDPH	California Department of Public Health
Central Valley Water Board	Central Valley Regional Water Quality Control Board
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CEVA	Cumulative Environmental Vulnerability Assessment
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH4	methane
CHP	California Highway Patrol
CI/KR	critical infrastructure and key resources
CMS	comprehensive mitigation strategy
CNDDB	California Natural Diversity Database

CNEL	community noise equivalent level
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Coordinated Operation Agreement
CPUC	California Public Utilities Commission
CRPR	California Rare Plant Rank
CSA	Community Service Area
CSBA	California Striped Bass Association
CSLC	California State Lands Commission
CT	Current Trend
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVHM	Central Valley Hydrologic Model
CVP	Central Valley Project
CWA	Federal Clean Water Act
CWC	California Water Code
CWHR	California Wildlife Habitat Relationship
D-1422	State Water Board Decision 1422
D-1641	State Water Board Water Right Decision 1641
dBA	A-weighted decibel
dBA/DD	dBA per doubling of distance
DBCP	dibromochloropropane
DCTRA	Deer Creek & Tule River Authority
DDT	dichloro-diphenyltrichloroethane
DEET	diethyl-meta-toulamide
Delta	Sacramento-San Joaquin Delta
DHS	U.S. Department of Homeland Security
diesel PM	diesel particulate matter
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DOC	California Department of Conservation
DOF	California Department of Finance
DSM2	Delta Simulation Model 2
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources

E. coli	*Escherichia coli*
EA	Environmental Assessment
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EDD	California Employment Development Department
EDT	Ecosystem Diagnosis and Treatment
EG	Expansive Growth
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMF	electromagnetic fields
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERP	Ecosystem Restoration Program
ESA	Federal Endangered Species Act
Exchange Contractors	Madera-Chowchilla Water and Power Authority; San Luis & Delta-Mendota Water Authority; San Joaquin River Exchange Contractors Water Authority
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FICAN	Federal Interagency Committee on Aviation Noise
FMMP	Farmland Mapping and Monitoring Program
FPA	Friant Power Authority
FPP	Friant Power Project
FR	Federal Register
FRAP	California Fire and Resource Assessment Program
FSZ	Farmland Security Zone
FTA	Federal Transit Administration
FWA	Friant Water Authority
GAMA	Groundwater Ambient Monitoring Assessment
GCM	Global Climate Model
GGS	giant garter snake
GHG	greenhouse gas
GIS	Geographic Information System
GLO	General Land Office

GPS	Global Positioning System
GSM	Central Valley Ground-Surface Water Model
GWh	gigawatt-hours
GWh/year	gigawatt-hours per year
HCP	habitat conservation plan
HDP	Heritage Documentation Program
hp	horsepower
I:E	inflow:export
I-5	Interstate 5
ID	irrigation district
IDC	interest during construction
IEP	Interagency Ecological Program
IFIM	incremental methodology
IMPLAN	IMpact analysis for PLANning model
in/year	inch per year
Investigation	Upper San Joaquin River Basin Storage Investigation
IPCC	Intergovernmental Panel on Climate Change
IRWMP	Integrated Regional Water Management Plan
IS	Initial Study
ISR	Indirect Source Review
ITA	Indian Trust Assets
ITP	Incidental Take Permit
Jones Pumping Plant	C.W. “Bill” Jones Pumping Plant
JPOD	Joint Point of Diversion
KCWA	Kern County Water Agency
km	kilometers
KOP	key observation point
kV	kilovolt
kW	kilowatt
LCP	land conservation plan
LCPSIM	Least Cost Planning Simulation Model
L_{dn}	day-night noise level
L_{eq}	equivalent noise level
LIM	Land Inventory and Monitoring
LLIS	low-level intake structure
L_{max}	maximum noise level

L_{min}	minimum noise level
LOD	level of development
LOPP	lease of power privilege
LOS	level of service
LPP	locally preferred plan
LSJLD	Lower San Joaquin Levee District
LSJRTP	Lower San Joaquin River and Tributaries Project
LSZ	low salinity zone
LTGen	LongTermGen
L_X	statistical descriptor
M&I	municipal and industrial
MAF	million acre-feet
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
mg/L	milligrams per liter
MMP	mitigation and monitoring plan
MOU	memorandum of understanding
mph	miles per hour
MPO	Metropolitan Planning Organization
msl	mean sea level
MT	metric ton
$mtCO_2e$/year	metric tons of CO2 equivalents per year
MW	megawatt
MWh	megawatt-hours
N_2O	nitrous oxide
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission
NAVD 1988	North American Vertical Datum 1988
NED	national economic development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIPP	National Infrastructure Protection Plan
NL	notification limit
NMFS	National Marine Fisheries Service
NO2	nitrogen dioxide
NOA	naturally occurring asbestos
NoCC	No Climate Change

NOD	North-of-Delta
NOI	Notice of Intent
NOP	Notice of Prepration
NO_X	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRCS	National Resource Conservation Service
NRDC	Natural Resources Defense Council
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic Rivers System
O&M	operations and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OES	California Office of Emergency Services
OHP	Office of Historic Preservation's
OHWM	ordinary high-water mark
OMP	operations and management plan
OMWEM	Other Municipal Water Economics Model
OPR	Office of Planning and Research
ORV	outstandingly remarkable values
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
P&G	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
PA	programmatic agreement
Parkway	San Joaquin River Parkway
PCB	polychlorinated biphenyl
PCE	passenger car equivalent
pCi/L	picocuries per liter
PEIS/R	Programmatic Environmental Impact Statement/Environmental Impact Report
PG&E	Pacific Gas and Electric Company
PM_{10}	respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
$PM_{2.5}$	particulate matter standards of 2.5 microns in aerometric diameter or less

PMF	Probable Maximum Flood
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
ppm	parts per million
ppt	parts per thousand
PPV	peak particle velocity
PRC	Public Resources Code
PRPA	Paleontological Resources Preservation Act
PWC	personal watercraft
RBDD	Red Bluff Diversion Dam
RCC	roller-compacted concrete
RCRA	Resource Conservation and Recovery Act
RD	Reclamation District
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	River Mile
RMP	Resource Management Plan
RMS	root mean squared
RMZ	resource management zone
ROD	Record of Decision
ROG	reactive organic gas
ROW	right of way
RPA	Reasonable and Prudent Alternative
rpm	revolutions per minute
RTS	reservoir triggered seismicity
RV	recreational vehicle
RWA	Recovered Water Account
SALMOD	Salmonid Population Model
SAR	smolt-to-adult return rate
SB	Senate Bill
SBWQM	South Bay Water Quality Model
SCE	Southern California Edison Company
SCVWD	Santa Clara Valley Water District
SDWA	South Delta Water Agency
SEL	single-event (impulsive) noise level)
Settlement	*NRDC et al. v. Kirk Rodgers et al., Stipulation of Settlement*
SG	Slow Growth
SHPO	State Historic Preservation Office
SIP	State implementation plan

SJAFCA	San Joaquin Area Flood Control Agency
SJR5Q	San Joaquin River Temperature Model
SJRA	San Joaquin River Agreement
SJRG	San Joaquin River Gorge
SJRRP	San Joaquin River Restoration Program
SJTSP	San Joaquin Tributary Settlement Process
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SJVDP	San Joaquin Valley Drainage Program
SLCC	San Luis Canal Company
SLIS	selective-level intake structure
SLLPIP	San Luis Low Point Improvement Project
SLWRI	Shasta Lake Water Resources Investigation
SMARA	California Surface Mining and Reclamation Act of 1975
SMT	Study Management Team
SO2	sulfur dioxide
SOD	South-of-Delta
SPFC	State Plan of Flood Control
SQRU	Scenic Quality Rating Unit
SR	State Route
SRA	State Recreation Area
SRMA	Special Recreation Management Area
SRWQM	Sacramento River Water Quality Model
SSJVIC	Southern San Joaquin Valley Information Center
State	State of California
State Parks	California Department of Parks and Recreation
State Water Board	State Water Resources Control Board
SVP	Society of Vertebrate Paleontology
SWAP	Statewide Agricultural Production Model
SWE	Snow Water Equivalent
SWP	State Water Project
SWP Power	SWP Power California
TAC	toxic air contaminant
TAF	thousand acre-feet
TCD	temperature control device

TCR	transportation concept report
TDS	total dissolved solid
TMDL	Total Maximum Daily Loads
TMP	traffic management plan
TNW	Traditional Navigable Water
tpd	tons per day
UCMP	University of California Museum of Paleontology
Uniform Act	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
UP	Union Pacific
URBEMIS	2007 Urban Emissions model
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Geological Survey
v	volt
VAMP	Vernalis Adaptive Management Program
VdB	vibration decibel
VOC	volatile organic compound
VRM	Visual Resource Management
WD	Water District
WDR	Waste Discharge Requirement
WMA	Wildlife Management Area
WNV	West Nile virus
WOMT	Water Operations Management Team
WRIMS	Water Resources Integrated Modeling System
WROS	Water Recreation Opportunity Spectrum
WSD	Water Storage District
WSMP 2040	Water Supply Management Program 2040
WWD	Waterworks Districts

Chapter 1
Introduction

This Draft Environmental Impact Statement (EIS) has been prepared as part of the Upper San Joaquin River Basin Storage Investigation (Investigation) to document potential physical, biological, cultural, and socioeconomic effects of alternatives to expand water storage capacity in the upper San Joaquin River watershed. The Investigation is led by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), in cooperation with the California Department of Water Resources (DWR). The purpose of the Investigation is to determine the type and extent of Federal, State of California (State), and regional interest in a potential project to expand water storage capacity in the upper San Joaquin River watershed to (1) improve water supply reliability and flexibility of the water management system for agricultural, municipal and industrial (M&I), and environmental uses; and (2) enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

This document, pursuant to the National Environmental Policy Act (NEPA), tiers from the CALFED Bay-Delta Program (CALFED) Final Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/R) and Record of Decision (ROD) (CALFED 2000a and 2000b) for developing the project purpose and a range of reasonable alternatives. This document also supports the Draft Feasibility Report (Reclamation 2014) prepared for the Investigation and confirms the draft findings of environmental feasibility.

Reclamation, as the Federal Lead Agency under NEPA, has prepared this Draft EIS to disclose the potential direct, indirect, and cumulative impacts of alternatives. Cooperating agencies pursuant to NEPA are those that have jurisdiction by law or special expertise in a resource area affected. Cooperating agencies for this Investigation include the California Department of Parks and Recreation (State Parks); Friant Water Authority (FWA); Madera-Chowchilla Water and Power Authority; San Luis & Delta-Mendota Water Authority; San Joaquin River Exchange Contractors Water Authority (Exchange Contractors); U.S. Army Corps of Engineers (USACE); U.S. Department of Commerce, National Marine

Fisheries Service (NMFS); U.S. Department of the Interior, Bureau of Indian Affairs (BIA); U.S. Department of the Interior, Bureau of Land Management (BLM); U.S. Department of the Interior, Fish and Wildlife Service (USFWS); and U.S. Environmental Protection Agency (EPA). Agencies consulted under NEPA (consistent with Section 1501.2 of the CEQ guidelines) include the California Department of Fish and Wildlife (CDFW), Central Valley Regional Water Quality Control Board (Central Valley Water Board), San Joaquin Valley Air Pollution Control District (SJVAPCD), and Federal Energy Regulatory Commission (FERC).

DWR is the California Environmental Quality Act (CEQA) Lead Agency for the Investigation, but has had limited funding to be an active participant. This Draft EIS has also been prepared in consideration of CEQA and State CEQA Guidelines to support the CEQA Lead Agency and Responsible and Trustee agencies that would be involved in approving a proposed alternative. However, at the time of release of this Draft EIS, DWR was unable to provide CEQA review. When a project (such as the Investigation) requires compliance with CEQA and NEPA, and the NEPA document is ready before the CEQA document – as is the case here – the CEQA Lead Agency (DWR) should use the EIS rather than preparing an EIR when the following two conditions occur:

1. An EIS will be prepared before an EIR would otherwise be completed for the project

2. The EIS complies with the CEQA Guidelines (see CEQA Guidelines section 15221)

Despite the similarities between NEPA and CEQA, there are several differences that require careful coordination between the Federal and State agencies responsible for complying with NEPA and CEQA. For example, CEQA requires discussions of mitigation measures and growth inducing impacts, and more recently a greenhouse gas (GHG) emissions impact analysis. The approach to preparing this Draft EIS, consistent with both NEPA and CEQA requirements, is described where appropriate throughout this Draft EIS, including an overview of the considerations for conducting the impacts analysis provided in Chapter 3, “Considerations for Describing the Affected Environment and Environmental Consequences.”

The Investigation's progress and results have been documented in a series of interim reports. The Investigation will culminate in a Final Feasibility Report and Final EIS, consistent with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC 1983); Reclamation policies, and directives and standards; State policies and guidance, as appropriate; and applicable environmental laws, regulations, and policies. The Draft Feasibility Report (Reclamation 2014) and this Draft EIS document the results of the feasibility study process to date, and build on the results and findings of previous planning documents, including the CALFED PEIS/R and ROD (CALFED 2000a and 2000b), *Phase 1 Investigation Report* (Reclamation and DWR 2003), *Initial Alternatives Information Report* (Reclamation and DWR 2005), and *Plan Formulation Report* (Reclamation and DWR 2008). The plan formulation process and measures evaluations documented in these interim milestone planning reports are incorporated by reference in this Draft EIS.

Extensive alternatives analysis was performed as part of the plan formulation process for the Investigation since 2002, with 22 reservoir sites evaluated for their ability to meet basic project purpose and objectives, and in consideration of environmental effects, cost-effectiveness, and overall feasibility. The number of alternative dam and reservoir sites was reduced through a phased evaluation process. This process resulted in the selection of Temperance Flat River Mile (RM) 274 Reservoir as the site which best meets the objectives, purpose and need, and planning criteria, and which provides the greatest overall and net benefits, as described in the Plan Formulation Appendix.

Draft EIS Purpose

The purpose of this Draft EIS is to disclose the potential direct, indirect, and cumulative impacts of implementing a proposed action and a range of reasonable alternatives including the No Action Alternative, consistent with NEPA and CEQA requirements. This Draft EIS serves as an informational document for decision makers, public agencies, nongovernmental organizations, and the general public regarding the potential environmental consequences of implementing a proposed Federal action and a range of reasonable alternatives. The preferred alternative for implementation will be identified in the Final EIS.

This Draft EIS is being circulated for public review. Comments received during the public review period will be considered by Reclamation, and responses to comments will be included in the Final EIS. Continued public outreach, including public hearings, will be conducted before completion of the Final EIS. For more information on these meetings, please see http://www.usbr.gov/mp/sccao/storage/.

After the Final EIS is published, Reclamation may prepare and adopt a ROD to implement a recommended plan/preferred alternative, if authorized. This Draft EIS has been prepared consistent with CEQA requirements to support required State and/or local agency decisions and permits.

National Environmental Policy Act

NEPA provides an interdisciplinary framework for Federal agencies to take environmental factors into account during a decision making process (42 United States Code [USC] 4321, 40 Code of Federal Regulations [CFR] 1500.1). NEPA requires an EIS whenever a proposed Federal action (e.g., a proposal for legislation or an activity financed, assisted, conducted, or approved by a Federal agency with Federal agency control) may significantly affect the quality of the human environment. Section 1508.14 of the Council on Environmental Quality (CEQ) Regulations defines the human environment to include "the natural and physical environment and the relationship of people with that environment."

The EIS, in conjunction with other relevant material, is used by the Federal Government to plan actions and make decisions. Section 1502.1 of the CEQ Regulations states that an EIS primarily serves as an action-forcing device to infuse the policies and goals defined in NEPA into ongoing programs and actions of the Federal Government. As an informational document, an EIS provides a rigorous and objective evaluation of a range of reasonable alternatives; the full and open disclosure of environmental consequences before an agency takes action; an interdisciplinary approach to project evaluation; identification of measures to mitigate impacts; and an avenue for public and agency participation in decision making (40 CFR 1502.1). NEPA defines mitigation as avoiding, minimizing, rectifying, reducing, or compensating for significant effects of a proposed action (40 CFR 1508.20). NEPA also requires evaluating a proposed action and alternatives at an equal level of detail.

NEPA requires that a Federal Lead Agency "include [in an EIS] appropriate mitigation measures not already included in the proposed action or alternatives" (40 CFR 1502.14(f)). An EIS must also include discussions of "means to mitigate adverse environmental impacts (if not fully covered under Section 1502.14(f))." In preparing a ROD under 40 CFR 1505.2, a Federal Lead Agency must "[s]tate whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation."

California Environmental Quality Act

The State CEQA Guidelines (14 California Code of Regulations [CCR] Section 15064(f)(1)) require that an Environmental Impact Report (EIR) be prepared whenever a project may result in a significant environmental impact. Section 15064(d) states that "in evaluating the significance of the environmental effect of a project, the CEQA Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project." An EIR is an informational document used to inform public agency decision makers and the general public of the significant environmental effects of a project, identify possible ways to mitigate or avoid the significant effects, and describe a reasonable range of alternatives to the project that could feasibly attain most of the basic objectives of the project while substantially lessening or avoiding any of the significant environmental impacts. When determining whether to approve a project, State and local public agencies are required by CEQA to consider the information presented in the EIR.

CEQA requires that State and local government agencies consider the potential environmental effects of projects over which they have discretionary authority before taking action on those projects (Public Resources Code [PRC] Section 21000 et seq.). CEQA also requires that each public agency avoid or mitigate to less-than-significant levels, wherever feasible, the significant environmental effects of projects it approves or implements. If a project would result in significant and unavoidable environmental impacts that cannot be feasibly mitigated to less-than-significant levels, the project can still be approved, but the CEQA Lead Agency's decision makers must issue a "statement of overriding considerations" explaining in

writing the specific economic, social, or other considerations that they conclude, based on substantial evidence, make those significant effects acceptable.

Section 15126.6(a) of the State CEQA Guidelines also requires that an EIR describe and evaluate a reasonable range of alternatives that would feasibly attain most of the basic project objectives, and would avoid or substantially lessen any significant adverse impact of the project, as proposed. A reasonable range of alternatives is analyzed to define issues and provide a clear basis for choice among options. CEQA requires that the CEQA Lead Agency consider alternatives that would avoid or reduce one or more of the significant adverse impacts identified for a project in an EIR. The State CEQA Guidelines state that the range of alternatives required to be evaluated in an EIR is governed by the "rule of reason"; the EIR needs to describe and evaluate only those alternatives necessary to permit a reasonable choice and to foster informed decision making and informed public participation (Section 15126.6(f)). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts, or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly and those that could impede to some degree the attainment of all project objectives (Section 15126(b)). CEQA does not require alternatives to be evaluated in the same level of detail as the proposed action. The preferred alternative, or proposed action, is not identified in this Draft EIS.

Compliance and Permits Supported by the EIS

This Draft EIS, when finalized, is intended to be used by the Federal Lead Agency when considering approval of a proposed action or an alternative to a proposed action. All Cooperating Agencies and other Federal, State, and local agencies with permitting or approval authority over any aspect of the proposed action are expected to use the information contained in the Final EIS to meet most, if not all, of their information needs, to make decisions and/or issue permits with respect to the proposed action. Table 1-1 presents the permits, petitions, and similar compliance, coordination, and consultation efforts that may be needed for implementing a proposed action, as described in Chapter 28, "Other NEPA and CEQA Considerations," and Chapter 29, "Public Involvement, Consultation, and Coordination."

Table 1-1. Applicable Laws, Regulations, and Permits for This Draft EIS

Resource	Applicable Laws/Regulations/Permits	Regulating Agency/Agencies
Wetlands and Waters of the United States	Clean Water Act, Section 404 – Permit	U.S. Army Corps of Engineers and U.S. Environmental Protection Agency
Wetlands and Waters of the United States	Clean Water Act, Section 401/Porter-Cologne Water Quality Control Act – Water Quality Certification or Waiver	Central Valley Regional Water Quality Control Board
Wetlands and Waters of the United States	Rivers and Harbors Act, Section 9 – Approval	U.S. Army Corps of Engineers
Wetlands and Waters of the United States	Rivers and Harbors Act, Section 10 – Permit	U.S. Army Corps of Engineers
Wetlands and Waters of the United States	Rivers and Harbors Act, Section 13/Clean Water Act Section 402/Porter-Cologne Water Quality Control Act – National Pollutant Discharge Elimination System Permit(s)	Central Valley Regional Water Quality Control Board
Wetlands and Waters of the United States	California Fish and Game Code, Section 1602 – Streambed Alteration Agreement	California Department of Fish and Wildlife
Federally Listed Species	Federal Endangered Species Act, Section 7 – Consultation	U.S. Department of the Interior, Fish and Wildlife Service ; and National Marine Fisheries Service
State-Listed Species	California Endangered Species Act, Section 2081 – Incidental Take Permit	California Department of Fish and Wildlife
Essential Fish Habitat	Magnuson-Stevens Fishery Conservation and Management Act	National Marine Fisheries Service
Fish and Wildlife	Fish and Wildlife Coordination Act – Report	U.S. Department of the Interior, Fish and Wildlife Service
Fish and Wildlife	Bald and Golden Eagle Protection Act	U.S. Department of the Interior, Fish and Wildlife Service
Cultural Resources	National Historic Preservation Act, Section 106 – Consultation	State Historic Preservation Officer
Power and Energy	License Amendment	Federal Energy Regulatory Commission
Water Rights	California Water Code – Water Right Petitions	State Water Resources Control Board
State Lands	Land Use Lease	State Lands Commission
Air Quality	Authority to Construct, Permit to Operate	San Joaquin Valley Air Pollution Control District
Public Roadways	Encroachment Permit	California Department of Transportation and/or local agencies
Surface Mining	California Surface Mining and Reclamation Act – Permit	California Surface Mining and Reclamation Act lead agencies and California Department of Conservation

Key:
EIS = Environmental Impact Statement

Relationship to CALFED and Tiering

CALFED is a collaboration of 25 Federal and State agencies with regulatory and management responsibilities in the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta), originally established to develop a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The objective of the collaborative planning process is to identify comprehensive solutions to the problems of ecosystem quality, water delivery reliability, water quality, and Sacramento-San Joaquin Delta (Delta) levee integrity.

In July 2000, the CALFED agencies released the Final CALFED PEIS/R (CALFED 2000a), which analyzed a range of reasonable alternatives to solve Bay-Delta system problems. Preliminary studies in support of the CALFED PEIS/R considered more than 50 surface water storage sites throughout California and recommended more detailed study of five sites identified in the subsequent ROD, issued in August 2000 (CALFED 2000a, 2000b, 2000c). The CALFED ROD described a Storage Program that included five surface water storage projects in the Central Valley as follows:

> *Expanding water storage capacity is critical to the successful implementation of all aspects of the CALFED Program. Not only is additional storage needed to meet the needs of a growing population but, if strategically located, it will provide much needed flexibility in the system to improve water quality and support fish restoration efforts. Water supply reliability depends on capturing water during peak flows and during wet years.*

The Investigation is one of the five surface water storage studies recommended in the ROD. For the upper San Joaquin River Basin, the CALFED ROD states the following:

> *… 250-700 [thousand acre-feet (TAF)] of additional storage in the upper San Joaquin watershed… would be designed to contribute to restoration of and improve water quality for the San Joaquin River and facilitate conjunctive water management and water exchanges that improve the quality of water deliveries to urban communities. Additional storage could come*

> *from enlargement of Millerton Lake at Friant Dam or a functionally equivalent storage program in the region.*

This document tiers from the CALFED Final PEIS/R (CALFED 2000a) and ROD (including CEQA certification) (CALFED 2000b). The CALFED Final PEIS/R can be reviewed at http://calwater.ca.gov/calfed/library/. Tiering is provided for in CEQ Regulations Section 1502.20 and CEQA Guidelines Section 15152.

Relationship to San Joaquin River Restoration Program

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and Central Valley Project (CVP) Friant Division contractors. After more than 18 years of litigation, the lawsuit, known as *NRDC et al. v. Kirk Rodgers et al.*, reached a Stipulation of Settlement (Settlement). The Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved on October 23, 2006.

The Settlement establishes two primary goals:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- **Water Management Goal** – To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The San Joaquin River Restoration Program (SJRRP) implements the Settlement, as authorized in 2009 by the San Joaquin River Restoration Settlement Act (Settlement Act).

The actions included in the Selected Alternative described in the SJRRP ROD (Reclamation 2012) are included in the future conditions evaluated in this Draft EIS. Achievement of the Settlement goals is independent of any alternatives evaluated in this Draft EIS.

Purpose and Need for Action, and Objectives

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action" (40 CFR 1502.13). The State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Section 15124(b)). The purpose and need, and objectives provided below are consistent with CALFED objectives and guidance.

Project Purpose and Need

The purpose of the proposed action is to increase storage of water from the upper San Joaquin River watershed to improve water supply reliability and operational flexibility in CVP San Joaquin Valley areas and other regions of California; and to enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

The proposed action responds to needs related to water supply reliability and operational flexibility, San Joaquin River ecosystem enhancement opportunities, and other resource needs, as summarized below.

Water Supply Reliability and Operational Flexibility

California's water supply system faces critical challenges with demands exceeding supplies for urban, agricultural, and environmental (fisheries, wildlife refuges) water uses across the State. Without further investment in water management and infrastructure, current statewide shortages are expected to increase to approximately 4.9 million acre-feet (MAF) per year by 2030. Challenges will be greater during drought years, when available surface water for environmental and agricultural purposes is in short supply, resulting in users turning to pumping from an overdrafted groundwater system, and exacerbating overdraft (DWR 2009).

Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. Increasing CVP and State Water Project (SWP) operational constraints have reduced the timing and volume of available water supply for agricultural and urban uses, leading to growing competition for limited water resources. In addition, over time, projected climate change could impact precipitation and runoff, snowpack, flood risk management, water demand, and sea levels, and will further reduce water supply reliability. In light of current and future water supplies and demands and climate change effects, the CVP and SWP systems lack the flexibility in water delivery timing, location, and storage capacity that is needed to fully meet their multiple purposes.

In the Friant Division of the CVP, the 520 thousand acre-feet (TAF) storage capacity of Millerton Lake, located on the upper San Joaquin River, is small relative to the average annual inflow to the lake of approximately 1.8 MAF. The development of additional storage capacity would provide Reclamation with greater operational flexibility and the ability to capture sufficient water in wet years to meet demands in other years.

San Joaquin River Ecosystem

Chinook salmon (*Oncorhynchus tshawytscha*) populations are known to be affected by many factors, including water temperature and flow conditions. The development of additional storage capacity provides opportunities to manage stored water supplies in a way that could enhance temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

Other Resources

Several other needs associated with the San Joaquin River have been identified by various Federal and State agencies. Major storms during the past three decades have demonstrated that Friant Dam has little capacity to store water from large runoff events, resulting in flood releases downstream in almost 50 percent of the years. Demands for hydropower and ancillary services are expected to increase in the future. Demands are also increasing for water-oriented recreation in the Central Valley. San Joaquin River water quality downstream from Mendota Pool is degraded due to low flow and poor quality discharges. Additionally, urban drinking water treatment costs are rising.

Project Objectives

A set of primary and secondary planning objectives was developed for the Investigation to address the purpose and need. Primary objectives are those for which specific alternatives are formulated to address. Secondary planning objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary objectives.

Primary Objectives

The primary planning objectives are as follows:

- Increase water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in the Friant Division of the CVP, other San Joaquin Valley areas, and other regions of California.
- Enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

Secondary Objectives

The secondary planning objectives are as follows:

- Reduce flood damages downstream from Friant Dam.
- Maintain the value of hydropower attributes in the study area.
- Maintain and increase recreational opportunities in the study area.
- Improve San Joaquin River water quality downstream from Friant Dam.
- Improve the quality of water supplies delivered to urban areas.

Responsibilities of Lead Agencies and Responsible Agencies

As previously described, Reclamation is the lead NEPA agency in preparing this Draft EIS, and DWR is the CEQA Lead Agency for the Investigation. The actions addressed in this Draft EIS include actions to be undertaken by Reclamation, and the effects of these actions are the sole responsibility of

Reclamation. This Draft EIS was also prepared in accordance with CEQA and could be used by State and local permitting agencies that would be involved in reviewing and approving the project. The State is reviewing the need for the State to take discretionary actions, including permitting actions, in association with a Federal action. At the time of release of this Draft EIS, DWR was unable to provide CEQA review for concurrent release as a Draft EIR. The DWR would independently evaluate the content – including alternatives, impact analysis, and proposed mitigation measures – for consistency with CEQA and agency requirements, including needs of any State or local permitting or approving agencies.

As part of the project planning and environmental review process, Reclamation and the CEQA Lead Agency will incorporate certain environmental commitments and best management practices into any alternative plan recommended for implementation to avoid or minimize potential effects. Reclamation has also committed, contingent on congressional authorization, to coordinate the planning, engineering, design phases of the project with applicable resource agencies. Specific actions to avoid, mitigate, and/or compensate for potential adverse environmental effects are identified and addressed in this Draft EIS to the greatest extent practicable.

Under CEQA, CDFW and the State Water Resources Control Board (State Water Board) are Responsible Agencies insofar as they have limited roles related to the actions analyzed in this Draft EIS. To allow CDFW and the State Water Board to take action as Responsible Agencies, which involves making findings that the agencies have “considered” the EIR (see State CEQA Guidelines Section 15096(f)), the CEQA Lead Agency will be required to certify the EIS as meeting CEQA requirements; adopt Findings of Fact, a Statement of Overriding Considerations, if needed, and a Mitigation Monitoring and Reporting Program; approve the program; and file a Notice of Determination. To support the CEQA Lead Agency, Reclamation has prepared this Draft EIS to provide sufficient information to allow CDFW and the State Water Board, as Responsible Agencies, to (1) consider the environmental effects of the project-level actions, (2) mitigate or avoid environmental effects of those parts of the project over which those agencies have discretionary authority, and (3) make findings, required by CEQA Guidelines Section 15091, that their respective decision-making bodies reviewed and considered the environmental effects presented in the EIS. As Responsible Agencies, if CDFW and the State Water Board

decide to take action to approve and implement their portions of the project, CDFW and the State Water Board must approve feasible mitigation measures that would reduce the magnitude of, or avoid, any significant impacts.

Study Area

The San Joaquin River is California's second longest river and discharges to the Delta and, ultimately, to the Pacific Ocean through San Francisco Bay. Originating high in the Sierra Nevada Mountains, the San Joaquin River carries snowmelt and rainfall runoff from mountain meadows south of Yosemite National Park to the valley floor near Fresno, then northwest through the valley to the Delta. Tributaries to the San Joaquin River from the east include the Merced, Tuolumne, and Stanislaus rivers; small streams, sloughs, wetlands, and agricultural drainage form the inflow from the west. The upper San Joaquin River Basin encompasses the San Joaquin River and tributary lands from its source high in the Sierra Nevada to its confluence with the Merced River. Friant Dam and Millerton Lake are located on the upper San Joaquin River about 20 miles northeast of Fresno.

The Study Area evaluated in this Draft EIS includes both a primary and an extended study area to reflect the localized effects of a potential new major dam and reservoir upstream from Friant Dam in the upstream portion of Millerton Lake, and the effects of subsequent water deliveries over a larger geographic area. The primary study area was refined as the Investigation progressed and the number and location of feasible storage sites was narrowed. The primary study area presented in this Draft EIS includes the following (Figure 1-1):

- San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the proposed Temperance Flat RM 274 Reservoir (Temperance Flat Reservoir Area)

- Areas that could be directly affected by construction-related activities, including the footprint of proposed temporary and permanent facilities upstream from Friant Dam

The extended study area encompasses the following (Figure 1-2):

- San Joaquin River downstream from Friant Dam, including the Delta
- Lands served by San Joaquin River water rights
- Friant Division of the CVP, including underlying groundwater basins in the eastern San Joaquin Valley
- South-of-Delta (SOD) water service areas of the CVP and SWP

Detailed descriptions of the Study Area and existing conditions of physical, biological, cultural, and socioeconomic resources within the Study Area are included in this Draft EIS.

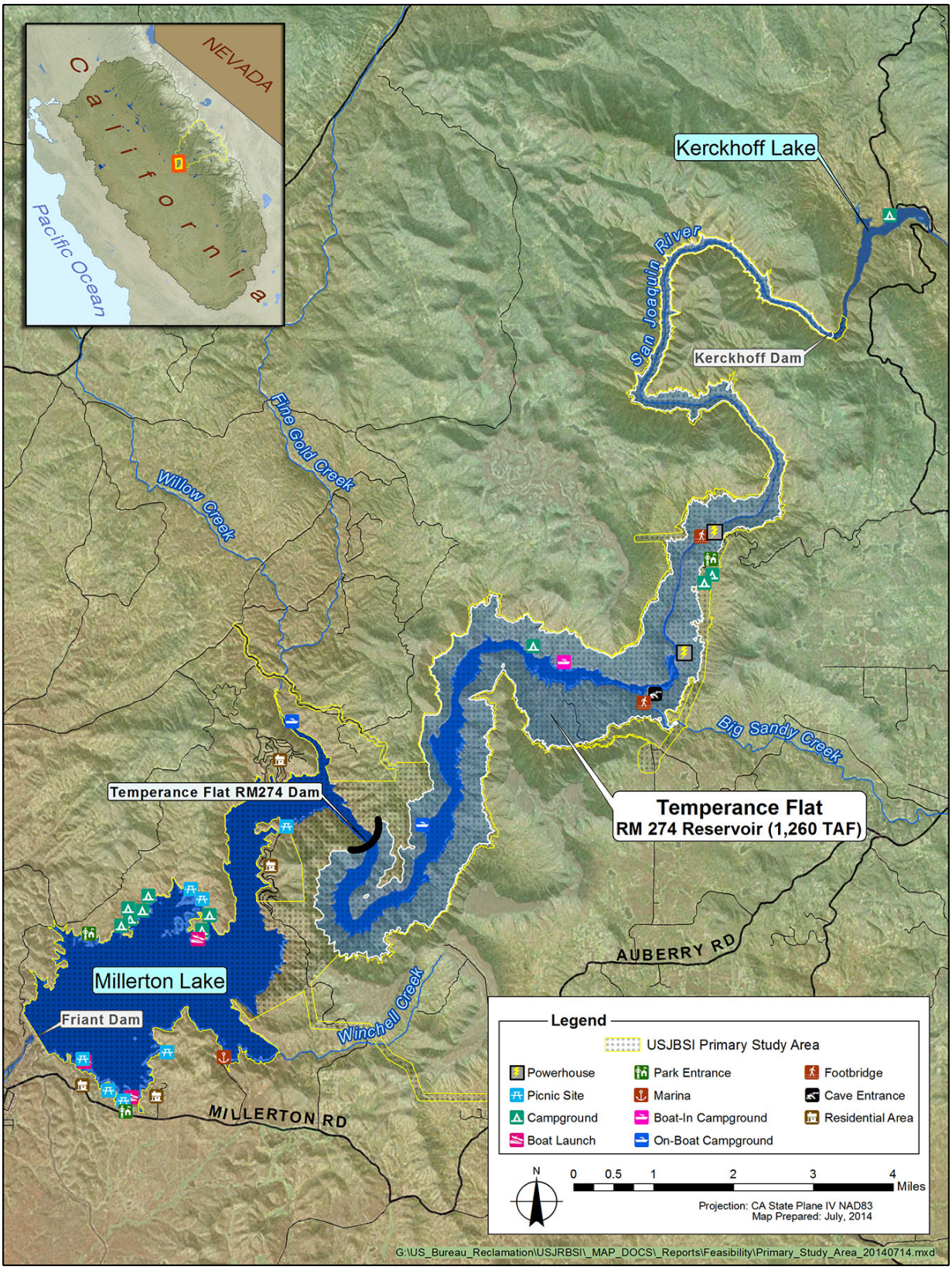


Figure 1-1. Primary Study Area Including Proposed Temperance Flat RM 274 Reservoir and Dam

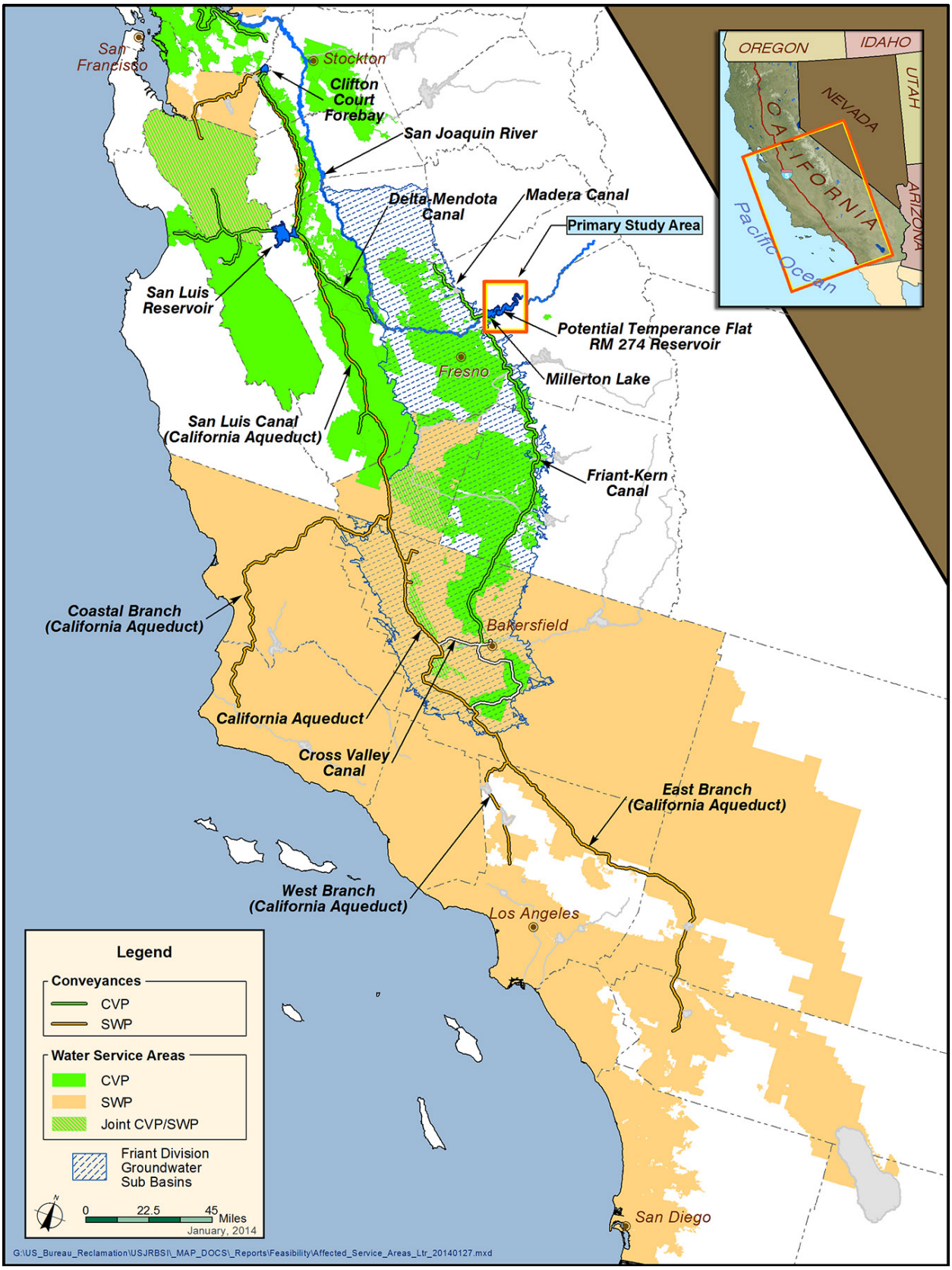


Figure 1-2. Extended Study Area

Areas of Controversy

Federal, State, and local stakeholders identified several areas of controversy during public outreach activities for the Investigation, including public scoping activities, agency meetings, public review and comment on the Draft Feasibility Report, and related ongoing public outreach activities. Major concerns include:

- **Impacts on Air Quality** – Construction activities would adversely affect air quality conditions in the San Joaquin Valley Air Basin, which is classified as a nonattainment basin for ozone and particulate matter standards of 2.5 microns in aerometric diameter or less ($PM_{2.5}$) by the EPA and California Air Resources Board (ARB).

- **Impacts on Biological Resources** – Habitat for aquatic and terrestrial wildlife populations, including oak woodland habitat, riverine habitat, pool and riffles, and rare plant populations, would be inundated.

- **Impacts on Cultural Resources** – Sites of cultural and religious significance, including sacred sites and sites related to historical activities of Native Americans, exist in and around the inundation area.

- **Impacts on Hydropower Generation** – Pacific Gas and Electric Company's (PG&E) Kerckhoff Hydroelectric Project powerhouses would be inundated and require decommissioning of the power generation infrastructure.

- **Impacts on Millerton Lake Cave System** – The Millerton Lake Cave system, an approximately 1 mile long granite cave created by abrasive, river scouring, would be inundated.

- **Impacts on the San Joaquin River Gorge Area** – The San Joaquin River Gorge area encompasses the San Joaquin River between Kerckhoff Dam and Millerton Lake. BLM has determined that this stretch of river is potentially eligible and suitable for designation as a Federal Wild and Scenic River.

- **Potential to Induce Growth** – Water supply reliability of the water management system for existing and

projected agricultural, urban, and environmental uses would be improved. Some comments provided during scoping expressed concerns that increasing storage in the upper San Joaquin River Basin would encourage population growth and increase demand for resources.

Issues to Be Resolved

Efforts are underway to resolve the following issues.

Special Designations

During development of the Draft Bakersfield Resource Management Plan (RMP) (BLM 2011) and EIS (BLM 2012), BLM completed a preliminary suitability determination of river segments located within the RMP area for inclusion under the National Wild and Scenic Rivers System (NWSRS). Based on criteria from the BLM Manual 8351 (BLM 1993) and the Interagency Wild and Scenic Rivers Coordinating Council Guidelines on Wild and Scenic Rivers Suitability (Interagency Wild and Scenic Rivers Coordinating Council 1999), BLM concluded a preliminary determination to suggest that the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse is suitable for inclusion in the NWSRS.

The BLM cannot administratively designate a stream via a planning decision or other agency decision into the NWSRS, and the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse is not designated or will not be automatically designated as part of the NWSRS. Next steps for inclusion of this segment in the NWSRS would include Congressional determination of suitability or nonsuitability, or Secretary of the Department of Interior determination of suitability or nonsuitability and submittal of reports to the president. The president would then report recommendations to Congress, and propose designation of the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse under the NWSRS. Inclusion of the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse under the NWSRS may affect the Investigation.

Off-Site Mitigation for Impacts on Biological Resources

Potential mitigation lands containing wetland and special-status species habitat comparable to habitat that would be affected by the action alternatives have been identified near the Study Area. Reclamation is initiating informal consultation with the

USFWS to identify appropriate mitigation requirements. Mitigation strategies for biological impacts will be discussed in more detail in the Final Feasibility Report and Final EIS.

Hydropower Mitigation

The onsite hydropower replacement option (powerhouse connected to the outlet works of Temperance Flat RM 274 Reservoir), combined with additional mitigation as needed, would be cost effective and is Reclamation's preferred power mitigation option for the Investigation. Additional powerhouse refinements may be conducted before completing the feasibility study. Further refinements in unit number, size, and operation could be considered. Additional operational scenarios could be evaluated in the future that may further improve the value of onsite hydropower mitigation. Scenarios that could be considered include integrating operations of Temperance Flat RM 274 Reservoir with other CVP and SWP SOD facilities, which would increase the amount of water stored in Temperance Flat RM 274 Reservoir (and corresponding head for generation) through exchange or changes in carryover storage levels. Additional mitigation components may also be needed and could include a range of onsite and offsite power generation and transmission actions. These actions could potentially replace previous proposed mitigation actions. Hydropower mitigation issues will continue to be coordinated with affected stakeholders during development of the Final Feasibility Report and EIS.

Identification of Preferred Alternative/Recommended Plan

Consistent with the CEQ guidelines, the preferred alternative for implementation will be identified in the Final EIS. Ultimately, the alternative that best meets the stated objectives and maximizes net public benefits will be identified with supporting rationale and documentation. The alternative recommended for implementation, or Recommended Plan in the Final Feasibility Report, may or may not be identified as the Environmentally Preferable Alternative, consistent with NEPA; the National Economic Development Plan, consistent with the P&Gs, the Least Environmentally Damaging Practicable Alternative, consistent with the Clean Water Act; and the Environmentally Superior Alternative, consistent with CEQA. A non-Federal sponsor may prefer another plan (locally preferred plan (LPP)) which may be considered and recommended by the Secretary of the Department of the Interior for approval and authorization by Congress.

Organization of EIS

This Draft EIS is organized as described below.

The **Executive Summary** summarizes this Draft EIS; presents the intended use of this Draft EIS; describes lead agencies, project location, project background and future actions, purpose and need for action, and planning objectives; provides an overview of the alternatives under consideration, and major conclusions of the environmental analysis; documents the known areas of controversy and issues to be resolved; and summarizes the environmental impacts, mitigation measures, and significance conclusions for the alternatives under consideration.

Chapter 1, "Introduction," summarizes project background and context; EIS purpose and uses; relationship to CALFED and the SJRRP; purpose and need for action and objectives; responsibilities of Lead, Responsible, and Cooperating agencies; study area; areas of controversy; issues to be resolved; and EIS organization.

Chapter 2, "Alternatives," summarizes the methods used for selecting the alternatives, describes the alternatives under consideration, and discusses alternatives that have been eliminated from detailed evaluation in this Draft EIS.

Chapter 3, "Considerations for Describing Affected Environment and Environmental Consequences," describes the Study Area, and the approach and terms used to describe the environmental and regulatory setting and environmental consequences for the resource topics presented in Chapters 4 through 26.

Chapters 4 through **7** and **9** through **26** include the affected environment for 22 resource topics, and discussions of methods, significance criteria, environmental impacts, and mitigation measures for potential direct and indirect impacts. **Chapter 8** summarizes existing and potential future climate conditions in the Study Area, the performance of the action alternatives under projected climate conditions, and the potential for the anticipated effects of the action alternatives to change under future climate conditions.

Chapter 27, "Cumulative Impacts," provides an analysis of overall cumulative effects of the alternatives, including the No

Action Alternative, together with other past, present, and reasonably foreseeable future projects.

Chapter 28, "Other NEPA and CEQA Considerations," describes potential significant and unavoidable impacts, the relationship of short-term uses and long-term productivity, irreversible and irretrievable commitments of resources, and growth-inducing impacts of implementing the proposed action. This chapter also describes Federal laws and regulations that apply to project compliance. In addition, this chapter lists potential permits, regulatory approvals, and needed authorizations.

Chapter 29, "Public Involvement, Consultation, and Coordination," summarizes public involvement activities under NEPA and CEQA; Native American consultation and coordination; consultation and coordination with other Federal, State, regional, and local agencies; major topics of public and stakeholder interest; and next steps in the environmental review process.

Chapter 30, "References," provides a bibliography of sources cited throughout this Draft EIS.

Chapter 31, "EIS Distribution List," lists the agencies, organizations, libraries, and individuals receiving a copy of the Draft EIS for review.

Chapter 32, "List of EIS Preparers," lists individuals who participated in preparing this Draft EIS and provides qualifications for those individuals, shown by organization and agency.

Chapter 33, "Index," lists key terms and topics discussed throughout this Draft EIS, and the location of the most relevant discussion or definition of the terms and topics.

Appendices contain background information that supports this Draft EIS. The appendices include Plan Formulation, Modeling, and Physical Resources.

Chapter 2
Alternatives

This chapter documents compliance with NEPA and CEQA requirements for the development, analysis, and documentation of alternatives, and describes the five action alternatives and the No Action Alternative evaluated in detail in this Draft EIS. This chapter includes the following sections:

- **Summary Description of Alternatives**, providing a brief overview of the action alternatives and No Action Alternative

- **Alternatives Development Process**, describing the overall plan formulation process and phases for the Investigation, project objectives, planning constraints and considerations, management measures, and development and refinement of alternatives

- **No Action Alternative**, describing the No Action Alternative, a scenario in which a project is not implemented

- **Action Alternatives**, describing each action alternative evaluated in this Draft EIS, including features and operations of the action alternatives, environmental commitments, and construction activities and schedule

- **Summary of Potential Accomplishments of Action Alternatives**, summarizing the major potential accomplishments of the action alternatives related to water supply reliability, system operational flexibility, water temperature and flow conditions, flood damage reduction, hydropower, recreation, and water quality

- **Preferred Alternative and Rationale for Selection**, describing the basis for selecting a plan for recommendation, including the criteria and considerations used in selecting a recommended course of action by the Federal Government; the preferred alternative will be identified in the Final EIS

The purpose of including action alternatives in an EIS is to offer a clear basis for choice by decision makers and the public

about whether to proceed with a proposed action or project. NEPA requires consideration of a range of alternatives. This range must include all reasonable alternatives, which must be rigorously explored and objectively evaluated, as well as other alternatives eliminated from detailed study. A brief discussion of the reasons for eliminating alternatives must be included (Section 1502.14). CEQA requires that an EIR describe a reasonable range of alternatives that could feasibly avoid or lessen any significant environmental impacts while substantially attaining the basic objectives of the proposed action or project. A No Action Alternative (which also constitutes the No Project Alternative under CEQA) is also analyzed, as required by NEPA and CEQA.

Summary Description of Alternatives

This chapter summarizes the alternatives considered in detail in this Draft EIS, which include a No Action Alternative and five action alternatives:

- **No Action Alternative** – Under the No Action Alternative, the project would not be implemented. The No Action Alternative reflects projected conditions under a 2030 level of development if the project is not implemented.

- **Alternative Plan 1** – Alternative Plan 1 would construct a dam in the upstream portion of Millerton Lake at RM 274 and provide new water supplies to the Friant Division of the CVP via the Friant-Kern and Madera Canals, and to SWP SOD M&I contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes a low-level intake structure (LLIS) and a 200 TAF minimum carryover storage target (water that is kept in the reservoir as a minimum storage reserve for cold water pool, hydropower generation, recreation, and emergency response, rather than delivered) in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

- **Alternative Plan 2** –Alternative Plan 2 would construct a dam in the upstream portion of Millerton Lake at RM

274 and provide new water supplies to the Friant Division of the CVP via the Friant-Kern Canal and Madera Canals, and to both SWP SOD M&I contractors and CVP SOD contractors, including refuges, via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes an LLIS and a 200 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

- **Alternative Plan 3** – Alternative Plan 3 would construct a dam in the upstream portion of Millerton Lake at RM 274 and provide new water supplies to: the Friant Division of the CVP via the Friant-Kern and Madera Canals; SWP SOD M&I contractors via existing cross-valley conveyance and the California Aqueduct; and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes an LLIS and a 200 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

- **Alternative Plan 4** – Alternative Plan 4 would construct a dam in the upstream portion of Millerton Lake at RM 274 and provide new water supplies to the Friant Division of the CVP via the Friant-Kern and Madera Canals; and SWP SOD M&I contractors and CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes a selective-level intake structure (SLIS) and a 325 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 340 TAF minimum carryover storage target, with a preference to store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above the target.

- **Alternative Plan 5** – Alternative Plan 5 would construct a dam in the upstream portion of Millerton Lake at RM 274 and provide new water supplies to the Friant Division of the CVP via the Friant-Kern and Madera Canals, and to CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. This action alternative includes a LLIS and a 100 TAF minimum carryover storage target in Temperance Flat RM 274 Reservoir. Millerton Lake would maintain a 130 TAF minimum carryover storage target, with preferences to store water in Millerton Lake up to 340 TAF and store water in Temperance Flat RM 274 Reservoir before increasing Millerton Lake storage above 340 TAF. Alternative Plan 5 also includes modification of the water supply allocation operational rules to increase drier year water supply reliability with minimal impact to long term average annual water supply reliability.

NEPA requires that agencies devote substantial treatment to each alternative such that reviewers may evaluate their comparative merits. In addition, the CEQ Regulations for implementing NEPA require a range of reasonable alternatives to be rigorously and objectively evaluated in an EIS (40 CFR 1502.14). Alternatives that cannot reasonably meet the project purpose and needs do not require detailed analysis and can, with explanation, be eliminated from further consideration.

CEQA requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified in an EIR. The State CEQA Guidelines state that an EIR needs to describe and evaluate only those alternatives necessary to permit a reasonable choice and to foster informed decision making and informed public participation (Section 15126.6(f)). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly, and those that could impede, to some degree, the attainment of all the project objectives (Section 15126.6(b)).

Alternatives Development Process

This section describes the alternatives development process for the Investigation. A more detailed description of this process is included in the Plan Formulation Appendix. Action alternatives

considered in the Draft Feasibility Report and Draft EIS fundamentally consist of constructing new surface water storage facilities and operating them to address the primary planning objectives of increasing water supply reliability and enhancing temperature and flow conditions in the San Joaquin River.

Tiering from the CALFED Program EIS and ROD

The CALFED Program was initiated to help reduce the gap between water supplies and projected demands. Expanding water storage capacity is critical to successfully implementing all aspects of the program. Water supply reliability depends on capturing peak flows during wet years. New storage must be strategically located to provide the needed flexibility in the current water system to improve water quality, support fish restoration goals, and meet the needs of a growing population.

The CALFED agencies conducted an initial screening of 52 potential surface water storage sites to reduce the number of sites to 12, a more manageable number for more detailed evaluation during project-specific studies (CALFED 2000a). CALFED eliminated sites providing less than 200 TAF storage and those that conflicted with CALFED solution principles, objectives, or policies. Further, based on information existing at that time, CALFED identified some potential surface water storage sites that were more promising in contributing to CALFED goals and objectives and more implementable due to relative costs and stakeholder support. The CALFED ROD recommended detailed evaluation of the five most highly rated sites and acknowledged that other sites in the list of 12 could serve as alternatives. Surface water storage sites recommended by CALFED for subsequent evaluation focused on those with the greatest potential for helping meet CALFED goals and objectives: Shasta Lake Enlargement, Los Vaqueros Reservoir Enlargement, Sites Reservoir, In-Delta Storage, and development of storage in the upper San Joaquin River Basin (CALFED 2000b). Only the In-Delta Storage project was excluded from the Calfed Bay-Delta Authorization Act (P.L. 108-361) that authorized the Federal feasibility study. Table 2-1 summarizes the CALFED surface water storage site evaluations leading up to the Investigation, as well as the subsequent site evaluations in the interim planning documents developed for the Investigation to date, which are described further below.

Table 2-1. CALFED and Upper San Joaquin River Basin Storage Investigation Surface Water Storage Site Evaluations

Year	Activity, Authorization, or Document	Number of Alternative Sites / Notes
1997	CALFED Bay-Delta Program Storage and Conveyance Component Inventories	52 sites identified through an initial inventory of surface storage sites with potential to contribute to improving water management for beneficial uses of the Bay-Delta system
2000	CALFED Initial Surface Water Storage Screening	12 of the 52 sites evaluated for CALFED; 5 of the 12 sites retained for continued evaluation; The balance of the 12 sites were deferred
2000	CALFED Final PEIS/R (CALFED 2000a) and ROD (CALFED 2000b)	3 of the 5 sites recommended for site-specific study; The remaining 2 sites, including the upper San Joaquin River Basin, recommended for additional consideration
2003	Public Law 108-7, Division D, Title II, Section 215	Authorized Federal feasibility studies for storage in the upper San Joaquin River Basin
2003	Phase 1 Upper San Joaquin River Basin Investigation Report (Reclamation and DWR 2003)	17 sites considered that could develop upper San Joaquin River water supplies; 6 were retained for further analysis
2004	Public Law 108-361: Water Supply, Reliability, and Environmental Improvement Act	Confirmed authorization of planning and feasibility studies for the Upper San Joaquin River storage in Fresno and Madera Counties
2004	Public Scoping for the Upper San Joaquin River Basin Storage Investigation	5 additional surface water storage sites recommended for consideration during scoping
2005	Initial Alternatives Information Report (Reclamation and DWR 2005)	11 surface water storage sites considered; 4 sites retained for further analysis
2008	Plan Formulation Report (Reclamation and DWR 2008)	1 of the 4 sites identified as potentially feasible
2014	Draft Feasibility Report (Reclamation 2014) and Draft EIS	1 feasible reservoir site and up to 5 operational and physical alternatives evaluated

Key:
CALFED = CALFED Bay-Delta Program
EIS = Environmental Impact Statement
PEIS/R = Programmatic Environmental Impact Statement/Environmental Impact Report
ROD = Record of Decision

Feasibility Study Process

In 2004, Congress passed Public Law 108-362, authorizing the Secretary of the Interior to conduct formal feasibility studies of four of the surface storage projects identified in the CALFED ROD (2000b). Those projects are Shasta Lake Enlargement, Los Vaqueros Reservoir Enlargement, Sites Reservoir, and storage in the upper San Joaquin River Basin.

Formal feasibility studies are guided by the P&G (WRC 1983), and Reclamation policy requires the agency to comply with NEPA as part of the entire feasibility study process.

During the site-specific planning process for the Investigation, alternative storage locations and methods for water storage were evaluated for their ability to meet the site-specific objectives, environmental impacts, water right availability, constructability, and cost. Table 2-1 summarizes the chronology of the alternatives development process that led to

the current range of alternatives for the Investigation. The number of alternative reservoir sites was reduced through a phased evaluation process considering the ability to achieve site-specific project objectives and/or the purpose and need. As alternative sites were eliminated from further detailed consideration, evaluation of the remaining alternative sites was conducted in progressively greater levels of detail. The complete plan formulation approach and feasibility study process for the Investigation is illustrated in Figure 2-1 and described in the Plan Formulation Appendix to this Draft EIS. As shown in Figure 2-1, the process includes public and stakeholder outreach.

Progress and results of the Investigation are documented in a series of interim reports produced in five phases and will culminate in a Final EIS and Feasibility Report, as follows:

- **Phase 1** – During this phase, 17 possible reservoir sites in the upper San Joaquin Valley were identified and evaluated, and 6 were selected for continued study, including a raise of Friant Dam/enlargement of Millerton Lake. Formal initiation of NEPA and CEQA processes also began in this phase, through the Notice of Intent/Notice of Preparation and public scoping activities.

- **Initial Alternatives Phase** – During this phase, 24 reservoir measures were evaluated (based on location and size), many with multiple alternative hydropower generation options. In addition, several initial water operations scenarios addressing various planning objectives were identified and evaluated. Enlarging Millerton Lake and developing new reservoirs at three sites (Temperance Flat RM 274 Reservoir, Temperance Flat RM 279 Reservoir, and Fine Gold Reservoir) were selected for continued study.

- **Plan Formulation Phase** – Analyses conducted during this phase refined initial alternatives into four groupings of alternatives, based on two dam site locations and inclusion/exclusion of a new Trans Valley Canal. The four groupings of alternatives were then evaluated based on P&G planning criteria, the ability to address planning objectives, purpose and need, and meet planning constraints and considerations. The Temperance Flat RM 274 Reservoir grouping of

alternatives (without the Trans Valley Canal) was retained for detailed feasibility design and evaluation.

- **Draft Feasibility and Plan Refinement Phase** – This phase focused on further physical features and operations refinement of the action alternatives to identify a plan suitable to be recommended for implementation. This phase includes preparing and circulating this Draft EIS and a Draft Feasibility Report.

- **Final Feasibility and Recommended Plan Phase** – The next phase of the Investigation will focus on responding to comments, identifying a recommended plan, and confirming Federal and non-Federal responsibilities. This phase will conclude with responding to comments on the Draft EIS and preparing and publishing a Final EIS and a Final Feasibility Report to support a Federal recommendation and a Congressional decision.

Development of alternatives evaluated in this Draft EIS was guided by the purpose and need, planning objectives, constraints, and other considerations developed during the Draft Feasibility and Plan Refinement Phase. These considerations are presented in the following sections.

Purpose and Need

As summarized in Chapter 1, “Introduction,” the project purpose is to increase storage of water from the upper San Joaquin River watershed to improve water supply reliability and operational flexibility in CVP San Joaquin Valley areas and other regions of California; and to enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish. Alternatives were evaluated for their ability to meet the project purpose and need during each phase of alternatives development and screening, as described in the Plan Formulation Appendix to this Draft EIS. Temperance Flat RM 274 Reservoir is the site that best meets the purpose and need.

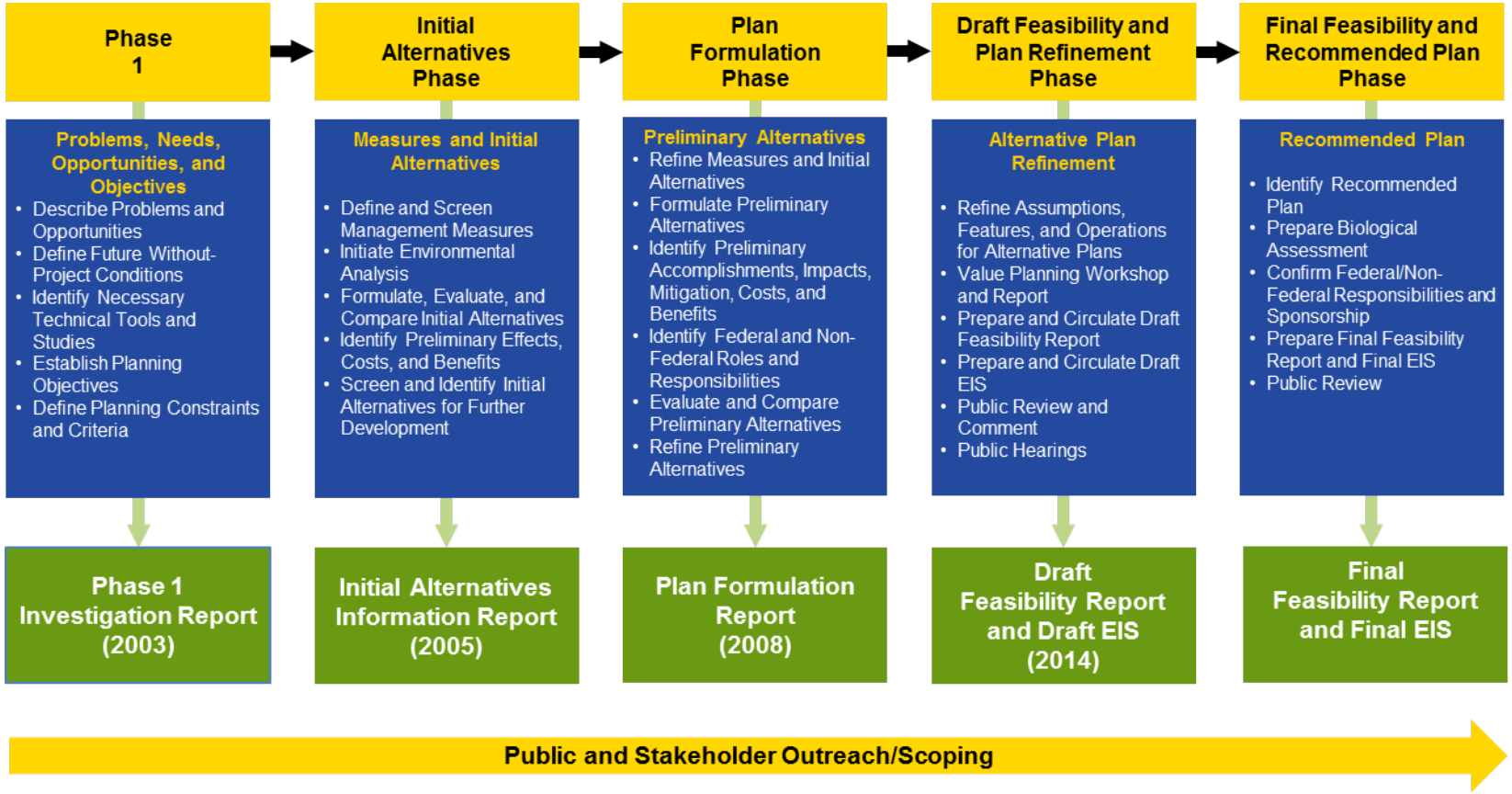


Figure 2-1. Plan Formulation Process

Planning Objectives

This section documents the Federal and State planning objectives and Investigation-specific objectives, constraints, considerations, and criteria.

The CALFED ROD (2000b) provides a programmatic framework for participating Federal and State agencies to develop a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. Findings in the CALFED ROD established the initial basis for potential Federal interest in the Investigation; hence, the objectives identified in the CALFED ROD represent important context for the Investigation-specific planning objectives (2000b).

Federal and State Objectives

The Federal objectives are guided by the P&G (WRC 1983), which focuses on national economic development, and encourages projects that maximize public benefits, both monetary and non-monetary.

The Federal objective for water resources planning is defined in the P&G:

> *The Federal objective of water and related resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.*

Contributions to national economic development (NED) are further defined as "increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are direct net benefits that accrue in the planning area and the rest of the Nation" (WRC 1983).

DWR requires that economic analyses of programs and projects be conducted fundamentally in accordance with the Federal planning principles defined in the P&G (WRC 1983); however, innovative methods and tools can also be incorporated when appropriate, such as mentioned in California's comprehensive water legislation, Senate Bill 1, enacted in 2009.

Investigation-Specific Planning Objectives

As a result of changing conditions, and using the CALFED ROD as a general framework, primary and secondary planning objectives were developed based on the problems, needs, and opportunities identified during Phase 1 of the plan formulation process, study authorities, and other pertinent direction, including information contained in the August 2000 CALFED ROD (2000b) and supporting documents. Primary objectives are those for which specific alternatives are formulated to address. The primary planning objectives are considered to have equal priority, with each pursued to the maximum practicable extent without adversely affecting the other. Secondary objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary objectives.

- Primary Planning Objectives:
  - Increase water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in the Friant Division of the CVP, other San Joaquin Valley areas, and other regions of California
  - Enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish
- Secondary Planning Objectives:
  - Reduce flood damages downstream from Friant Dam
  - Maintain the value of hydropower attributes in the study area
  - Maintain and increase recreational opportunities in the study area
  - Improve San Joaquin River water quality downstream from Friant Dam
  - Improve quality of water supplies delivered to urban areas

Planning Constraints and Other Considerations

The P&G provides fundamental guidance for the formulation of Federal water resources projects (WRC 1983). In addition,

basic planning constraints and other considerations specific to the Investigation must be developed and identified. Following is a summary of constraints and considerations being used for the Investigation.

Planning Constraints

Planning constraints help guide the feasibility study. Some planning constraints are more rigid than others. Examples of more rigid constraints include congressional direction in study authorizations; other current applicable laws, regulations, and policies; and physical conditions (e.g., topography, hydrology). Other planning constraints may be less restrictive but are still influential in guiding the process. Several key constraints identified for the Investigation are as follows.

Study Authorizations In 2003, Federal authorization was provided to prepare a Feasibility Report for storage in the upper San Joaquin River Basin (Public Law 108-7, Division D, Title II, Section 215). This act authorized the Secretary of the Interior to conduct feasibility studies for several storage projects identified in the CALFED ROD (2000b), including the Investigation. Additional authorization was given in the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361). Based on California Water Code (CWC) Section 227, State authorization is in place to study reservoirs or reservoir systems for gathering and distributing flood or other water not under beneficial use in any stream, stream system, lake, or other body of water.

CALFED Record of Decision CALFED was established to "develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system." The 2000 CALFED ROD (CALFED 2000b) includes program goals, objectives, and projects primarily to benefit the Bay-Delta system. The objectives for the Investigation are consistent with the CALFED ROD (CALFED 2000b), as follows:

> *…250-700 TAF of additional storage in the upper San Joaquin River watershed. It would be designed to contribute to restoration of and improve water quality for the San Joaquin River and facilitate conjunctive water management and water exchanges that improve the quality of water deliveries to urban communities. Additional storage could come from enlargement of Millerton Lake at Friant Dam or*

a functionally equivalent storage program in the region.

The ROD has been adopted by various Federal and State agencies as a framework for further consideration, including the Department of the Interior. The CALFED ROD also includes numerous other projects to help improve the ecosystem functions of the Bay-Delta system and states that developed plans should address the goals, objectives, and programs of the CALFED ROD (2000b).

Table 2-2 provides a summary of the CALFED ROD guidance and the site-specific objectives for the Investigation. Interpretation of the CALFED ROD objectives for the Investigation has been refined over time to reflect current and projected future conditions. Further details are included in the Plan Formulation Appendix.

Table 2-2. Summary of CALFED ROD Guidance and Investigation Specific Objectives

CALFED ROD Storage Program Guidance	Investigation Specific Objectives
Expand storage to meet needs of a growing population	Increase water supply reliability and system operational flexibility
Improve system flexibility	
Capture water during peak flows and wet years	
Facilitate conjunctive management	
Support fish restoration	Enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.
Contribute to restoration of the San Joaquin River	
Improve San Joaquin River water quality	Improve water quality in the San Joaquin River downstream from Friant Dam
Improve water quality delivered to communities	Improve quality of water supplies delivered to urban areas

Key:
CALFED ROD = CALFED Bay-Delta Program Record of Decision

Laws, Regulations, and Policies Numerous laws, regulations, executive orders, and policies need to be considered by either the Federal or state lead agencies, among them: the P&G, NEPA, Fish and Wildlife Coordination Act, Clean Air Act (CAA), Federal Clean Water Act (CWA), National Historic Preservation Act, California PRC, Federal Endangered Species Act (ESA) and California Endangered Species Act (CESA), CEQA, the CVPIA, and the San Joaquin River Restoration Settlement Act. Important laws and regulations are discussed in Chapter 28.

Statewide Water Operation Considerations

Reclamation developed a version of the California Water Resources Simulation Model (CalSim) II model, the March 2012 CalSim II Benchmark, based on a set of assumptions for facilities and operation of the CVP and SWP systems. This version of the CalSim model, and the associated facilities and assumptions were adopted as the basis for evaluation of the No Action Alternative and action alternatives in this analysis. This version of the model is referred to throughout this Draft EIS as the Reclamation March 2012 CalSim II Benchmark model.

Other Planning Considerations

Planning considerations relate to economic justification, environmental compliance, technical standards, etc., and may result from local policies, practices, and conditions. Planning considerations are used in the Investigation for formulating, evaluating, and comparing initial plans, and later, formulating detailed action alternatives. Examples of these planning considerations include the following:

- A direct and significant geographical, operational, and/or physical dependency must exist between major components of action alternatives.
- Action alternatives should meet the project purpose and need.
- Action alternatives should address, at a minimum, all of the identified primary planning objectives, and, to the greatest extent possible, the secondary planning objectives.
- Measures to address identified secondary planning objectives should be either directly or indirectly related to the primary planning objectives (i.e., plan features should not be independent increments).
- Action alternatives should account for offsetting affected hydropower generation value.
- Action alternatives should consider issues raised in coordination with other Federal and State agencies.
- Action alternatives should avoid any increases in flood damages or other substantial hydraulic effects to areas downstream on the San Joaquin River.

- Action alternatives should either avoid potential adverse effects to environmental, cultural, and historical resources or include features to mitigate significant impacts, when feasible.

- Action alternatives should not result in a substantial adverse effect on existing and future water supplies, or related water resources conditions.

- Action alternatives should either avoid potential adverse effects on recreational resources or include features to mitigate significant impacts, when feasible.

- Action alternatives should be formulated and evaluated based on a 100-year period of analysis.

- Construction costs for action alternatives should reflect current prices and price levels, and annual costs should include the current Federal discount rate and an allowance for interest during construction (IDC).

- Action alternatives should have a high certainty for achieving intended benefits and not depend on long-term actions unrelated to the Investigation (past the initial construction period) for success.

Management Measures

Once water resources problems, needs, and opportunities have been identified, and planning objectives, constraints, considerations, and criteria have been developed, the next major plan formulation process element is identifying management measures. A management measure is any structural or nonstructural project action or feature that could address the planning objectives and satisfy the other applicable planning constraints, considerations, and criteria. Numerous potential measures to address the planning objectives were identified based on information from previous studies, environmental scoping, and stakeholder outreach to address the planning objectives and satisfy the applicable planning constraints, considerations, and criteria. Measures were reviewed and refined through Investigation team meetings, field inspections, and coordination with stakeholders.

Measures Considered

Measures addressing primary planning objectives were grouped into broad categories associated with reservoir operations and water management, increasing surface water and groundwater storage and conveyance, reducing demand, performing water transfers and purchases, enhancing Delta exports, and constructing water temperature management devices. Measures addressing secondary planning objectives, which could be implemented in coordination with primary planning objective measures, were grouped according to specific secondary objectives.

Of the measures identified, several were selected for development into action alternatives investigated in the Draft Feasibility Report and Draft EIS. Other measures were eliminated from consideration during Phase 1, the Initial Alternatives Phase, the Plan Formulation Phase, and the Draft Feasibility and Plan Refinement Phase of the Investigation. Four measures identified to address only water supply reliability and system operations flexibility were retained for subsequent investigations (Table 2-3). Two measures identified to enhance water temperature and flow conditions in the San Joaquin River were retained for subsequent investigations. Three measures identified to address secondary planning objectives were retained for subsequent investigations.

Further detail on the management measures considered, deleted from consideration, and retained, is included in the Plan Formulation Appendix.

Table 2-3. Management Measures Addressing Planning Objectives

Planning Objective(s)	Measure Category	Measure	Status	Rationale
Both Primary Planning Objectives	Perform Reservoir Operations and Water Management	Modify storage and release operations at Friant Dam	Retained	Potential to combine with other measures involving development of San Joaquin River supplies. Consistent with other planning objective and opportunities. Consistent with CALFED goals. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Both Primary Planning Objectives	Increase Surface Water Storage in the Upper San Joaquin River Basin	Construct Temperance Flat RM 274 Reservoir	Retained	Reservoir sizes up to elevation 1,100 feet msl (2,110 TAF additional storage) at this site were considered. A maximum reservoir size at elevation 985 feet msl (1,260 TAF new storage capacity) was retained in the IAIR because larger, costlier reservoirs at the site were not justified due to substantial additional effects on environmental resources and hydropower generation. Temperance Flat RM 274 Reservoir also had greater benefits, greater net benefits, and a higher benefit-cost ratio than other reservoir sites considered. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Both Primary Planning Objectives	Increase Groundwater Storage	Increase conjunctive management of water in Friant Division of the CVP	Retained	Conjunctive management in the Friant Division of the CVP occurs by increasing incidental groundwater storage and/or recharge with additional Class 2 deliveries or the development of local surface water supplies, such as increasing surface water storage in the upper San Joaquin River Basin. Groundwater banks operated as allocable water supplies in the Friant Division of the CVP could increase water supply reliability and provide water for river releases. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.

Table 2-3. Management Measures Addressing Planning Objectives (contd.)

Planning Objective(s)	Measure Category	Measure	Status	Rationale
Primary Planning Objective of Increasing Water Supply Reliability and System Operational Flexibility	Perform Reservoir Operations and Water Management	Modify diversion to Madera and Friant-Kern canals	Retained	Modifying the timing and quantity of water diverted to Madera and Friant-Kern canals would increase water supply reliability to Friant Division contractors and may provide opportunities for groundwater banking. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Primary Planning Objective of Enhancing Water Temperature and Flow Conditions in the San Joaquin River	Perform Reservoir Operations and Water Management	Balance water storage in Millerton Lake and new upstream reservoirs	Retained	Balancing water storage levels between multiple reservoirs could improve water temperature management and affect hydropower generation and recreation. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Primary Planning Objective of Enhancing Water Temperature and Flow Conditions in the San Joaquin River	Construct Water Temperature Management Devices	Construct selective-level intake structures on new upstream dams	Retained	Selective withdrawal of cold or warm water for releases to Millerton Lake from new upstream reservoirs could help manage cold water in Millerton Lake and provides flexibility in managing cold water in potential reservoirs upstream from Millerton Lake. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Secondary Planning Objective of Reduce Flood Damages Downstream from Friant Dam	N/A	Increase flood storage space in or upstream from Millerton Lake	Retained	Available incidental flood storage space created through increasing surface water storage in the upper San Joaquin River Basin. Compatible with planning objectives and would not conflict with other opportunities or planning constraints/criteria. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.

Table 2-3. Management Measures Addressing Planning Objectives (contd.)

Planning Objective(s)	Measure Category	Measure	Status	Rationale
Secondary Planning Objective of Maintain Value of Hydropower Attributes	N/A	Construct new hydropower generation facilities on new surface water storage measures	Retained	Would increase the capability to recover lost generation capacity at each retained Temperance Flat Reservoir site. Would not conflict with other opportunities or planning constraints/criteria. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Secondary Planning Objective of Maintain and Increase Recreation Opportunities in the Study Area	N/A	Replace or upgrade recreational facilities	Retained	Compatible with any potential modification of Millerton Lake. Would be consistent with established planning guidelines for Federal water storage projects and with existing recreational uses at Millerton Lake State Recreation Area. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.

Key:
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
IAIR = Initial Alternatives Information Report (Reclamation and DWR 2005)
msl = above mean sea level
N/A = not applicable
RM = river mile
SWP = State Water Project
TAF = thousand acre-feet

In the discussion of Investigation management measures, the term "enhancement" specifically refers to actions that improve environmental conditions above the future without-project conditions. Correspondingly, the term "mitigation" refers to actions that compensate or offset project impacts, returning conditions back to a similar level as the future without-project conditions. The relationship between enhancement and mitigation is illustrated in Figure 2-2.

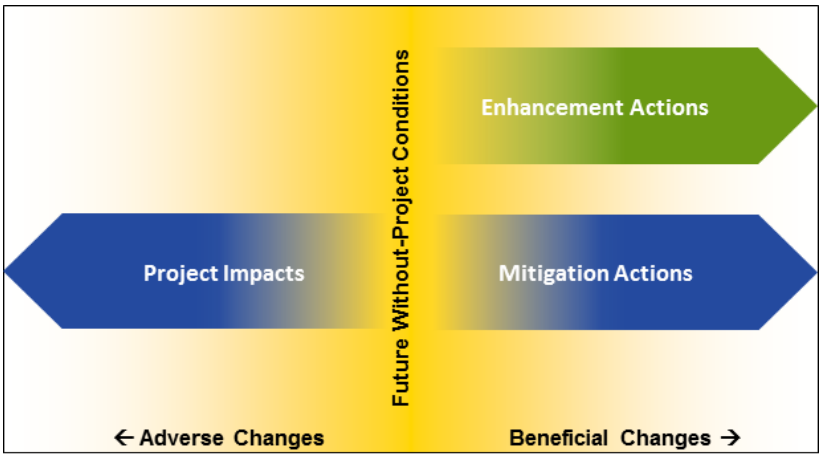


Figure 2-2. Conceptual Schematic of Enhancement Actions Versus Mitigation Actions

Measures that were eliminated from consideration and further development as action alternative components may be incorporated into action alternatives as mitigation measures. This is primarily because some measures may be found potentially effective in mitigating adverse impacts.

Measures Addressing Both Primary Planning Objectives
Measures retained that address both primary planning objectives of the Investigation include those that fall under the categories of Perform Reservoir Operations and Water Management, and Increase Surface Water Storage in the upper San Joaquin River Basin, as summarized in Table 2-3.

Modify Storage and Release Operations at Friant Dam
This measure would include modifications to storage and release operations at Friant Dam. These operational modifications would be intended to optimize the existing system of reservoirs. In addition, this measure may be combined with other measures involving developing water supplies in the upper San Joaquin River Basin to enhance San

Joaquin River water temperature and flow conditions and increase water supply reliability.

Temperance Flat RM 274 Reservoir During previous phases of the Investigation, several potential surface water storage sites in the upper San Joaquin River Basin were identified and evaluated for potential inclusion in action alternatives (Reclamation and DWR 2003, 2005, and 2008). Multiple sizes and configurations were considered at several sites. Evaluations considered water supply operations, general environmental consequences, construction costs, and energy generation and use. Locations of each of the 22 surface water storage measures considered are shown in Figure 2-3.

A detailed plan formulation and screening process considering 22 storage sites in addition to those evaluated by CALFED led to selection of the Temperance Flat RM 274 Reservoir as the preferred surface water storage measure for further development and inclusion in action alternatives in the Draft Feasibility and Plan Refinement Phase (Figure 2-4). Temperance Flat RM 274 Reservoir would include construction of a dam in the upstream portion of Millerton Lake at RM 274. The dam site is located approximately 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake.

With a top-of-active-storage capacity at elevation 985 feet above mean sea level (msl), Temperance Flat RM 274 Reservoir would provide 1,260 TAF of new storage capacity and extend about 18.5 miles upstream from RM 274 to Kerckhoff Dam. At top-of-active-storage capacity, the reservoir level would reach about 12 feet below the crest of Kerckhoff Dam. Reservoir sizes up to elevation 1,100 feet msl at this site were considered in previous phases of the Investigation. Reservoir sizes corresponding to elevations higher than elevation 985 feet msl were not retained because the incremental new water supply provided did not appear justified in light of substantial additional effects to environmental resources and hydropower generation, and higher construction costs (Reclamation and DWR 2005).

Historical Dam Site Selection

Almost 84 years ago, Hyde Forbes, an engineering geologist, issued a geological report on three potential dam sites on the San Joaquin River for the State of California. The report evaluated geologic conditions at the Friant, Fort Miller, and Temperance Flat (RM 274) sites. The geologic study contributed to planning efforts that led to construction of Friant Dam (Forbes 1930).

From a water storage perspective, the RM 274 site was considered superior to the two other sites, but the Friant location was selected because constructing a dam at RM 274 would have required extending canals around or through the current Millerton Lake area, or constructing a second dam at Friant for diverting water to the canals (Reclamation and DWR 2003).

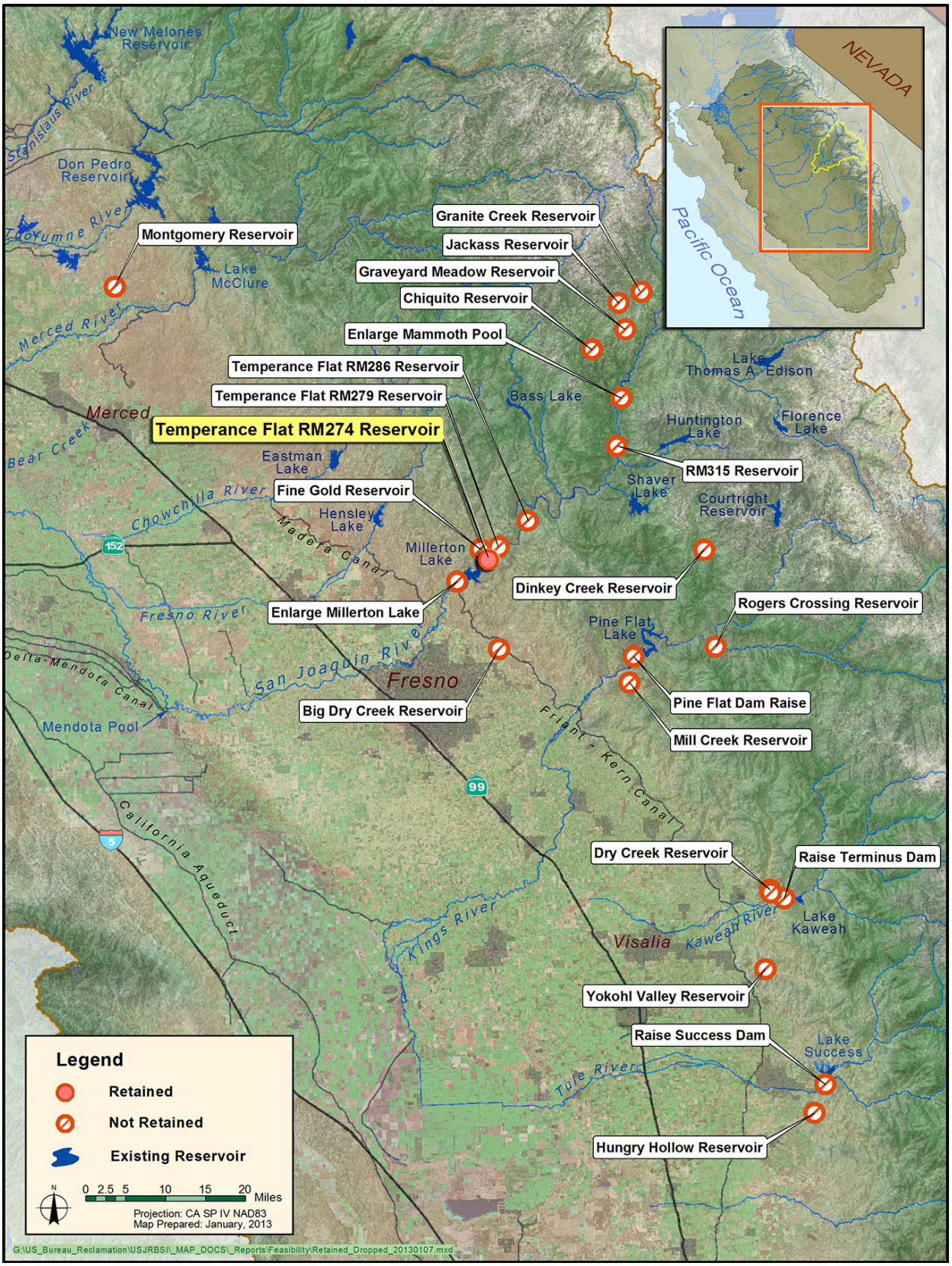


Figure 2-3. Surface Water Storage Measures Considered

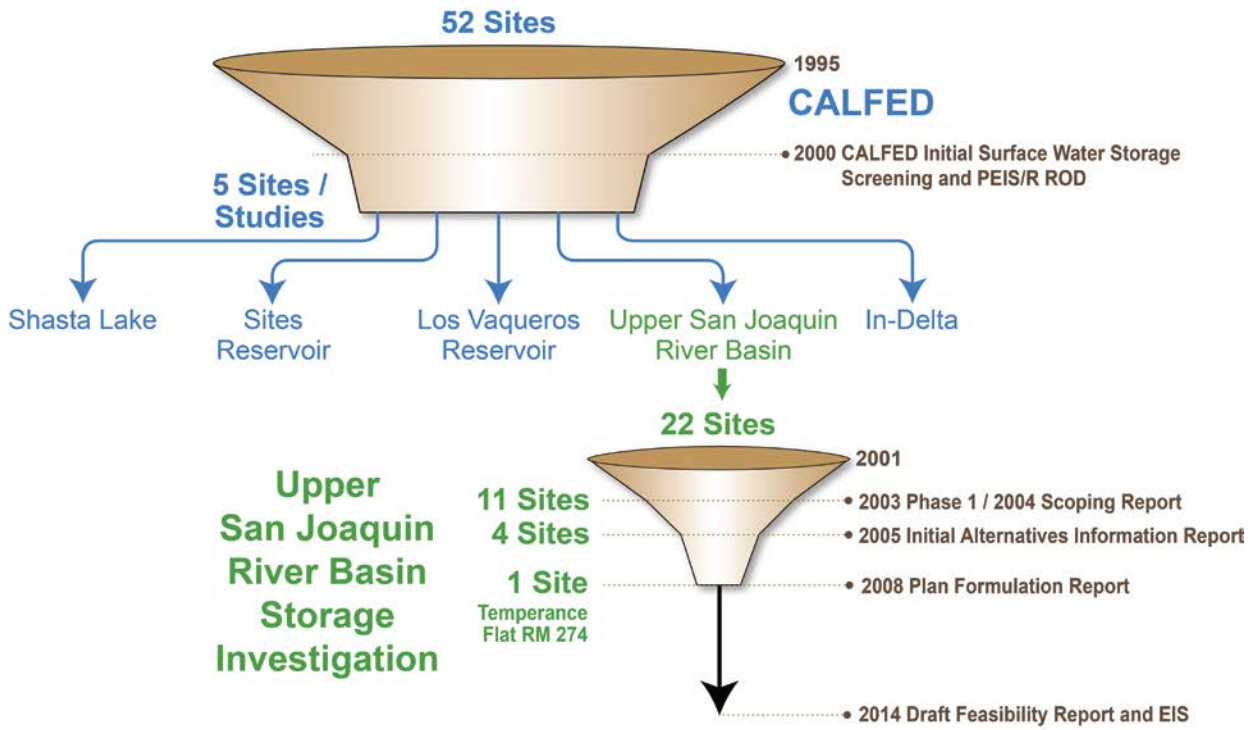


Figure 2-4. CALFED and Investigation Process Leading to Selection of Temperance Flat RM 274 Reservoir Site

Increase Conjunctive Management of Water in the Friant Division of the CVP The Friant Division of the CVP is already operated as a regional conjunctive management project. Currently, water deliveries under long-term Class 2 contracts are specifically intended for delivery to areas with access to groundwater. In wet years, Class 2 water and water delivered under Section 215 contracts are recharged to groundwater or delivered directly in lieu of groundwater pumping. Measures that increase the total delivery of Class 2 water and Section 215 supplies to Friant Division contractors, such as surface water storage measures, would increase conjunctive management and help reduce groundwater overdraft in the region.

Development of local surface water supplies for groundwater recharge, such as increasing surface water storage in the upper San Joaquin River Basin, or direct delivery in lieu of groundwater pumping, would also increase groundwater storage and help reduce regional overdraft. Increasing groundwater recharge through additional Class 2 deliveries or developing local surface water supplies could help facilitate exchange agreements between Friant Division water users and others. Several assumptions were applied to assess the

reasonable amount of additional water from Millerton Lake that could be stored in San Joaquin Valley groundwater basins with no additional surface water storage. When canal conveyance limitations and exhibited historical preferences for delivery of water during wet conditions were represented, it was found that an upper limit of about 50 TAF per year of additional groundwater recharge could be possible on an average annual basis. It should be noted that local stakeholders have indicated a preference to use conjunctive management projects to meet local water needs first, a preference that is also stated in the CALFED ROD (2000b).

Measures Specifically Addressing Increasing Water Supply Reliability and System Operational Flexibility Measures retained that specifically address the primary planning objective of increasing water supply reliability and system operational flexibility include those that affect reservoir operations and water management.

Modify Diversion to Madera and Friant-Kern Canals This measure would involve modifying the timing and quantity of water diverted to Madera and Friant-Kern canals, which would increase water supply reliability to Friant Division contractors and may provide opportunities for groundwater banking.

Measures Specifically Addressing Enhancing Water Temperature and Flow Conditions Measures retained that specifically address the primary planning objective of enhancing water temperature and flow conditions include those that perform reservoir operations and water management, and construct water temperature management devices.

Balance Water Storage in Millerton Lake and New Upstream Reservoirs The management of water supplies between Millerton Lake and additional upstream surface water storage in the upper San Joaquin River Basin could affect water supply, water temperature management, hydropower generation, and recreation. Reservoir-balancing scenarios were developed for surface water storage measures in the upper San Joaquin River Basin during the Plan Formulation Phase, and these reservoir-balancing scenarios were refined in the Draft Feasibility and Plan Refinement Phase of the Investigation.

Construct Selective-Level Intake Structures on New Upstream Dams SLISs could be constructed on the intakes for dams associated with measures to increase surface water storage in the upper San Joaquin River Basin. The SLISs would allow

selective withdrawal of cold or warm water from these upper reservoirs for temperature management, thereby enhancing temperature conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish during sensitive life stages.

Measures Addressing Secondary Planning Objectives
Measures retained that address secondary planning measures include those that improve management of flood flows at Friant Dam, maintain and increase energy generation and improve energy generation management, maintain and increase recreational opportunities in the Study Area, and improve quality of water supplies delivered to urban areas. Descriptions of measures that also apply to primary planning objectives are not repeated in this section.

Increase Flood Storage Space in or Upstream from Millerton Lake Development of additional storage for water supply would provide opportunities for additional dedicated or incidental flood storage space. Evaluations completed during the Initial Alternatives Phase considered the benefits associated with additional dedicated flood space in or upstream from Friant Dam (Reclamation and DWR 2005), but subsequent evaluations in the Plan Formulation and Draft Feasibility and Plan Refinement phases of the Investigation led to inclusion of incidental flood space with the additional storage.

Construct New Hydropower Generation Facilities on Retained New Surface Water Storage Measures The construction of new surface water storage facilities would present an opportunity to add hydropower generation facilities and improve energy generation management in the Study Area.

Replace or Upgrade Recreational Facilities Implementation of surface water storage and reservoir operations measures would affect existing recreational facilities in the primary study area. This measure includes developing suitable replacement facilities, with necessary upgrades to meet current standards and codes, to provide similar or greater recreational opportunities. It is recognized that some recreational experiences, such as whitewater rafting and caving, may not be replaceable for some action alternatives.

Measures Retained for Inclusion in Action Alternative

Measures retained through the Draft Feasibility and Plan Refinement Phase for further consideration in action alternatives in this Draft EIS are summarized below and in Table 2-4.

Table 2-4. Management Measures Retained for Action Alternatives in Draft Feasibility Report and this Draft Environmental Impact Statement

Objective Level	Planning Objective	Resources Management Measure Feature/Activity	Resources Management Measure Description
Primary	Increase Water Supply Reliability and Operational Flexibility; Enhance Water Temperature and Flow Conditions	Construct Temperance Flat River Mile 274 Reservoir	Increase surface water storage capacity by constructing dam in upstream portion of Millerton Lake at River Mile 274
Primary	Increase Water Supply Reliability and Operational Flexibility; Enhance Water Temperature and Flow Conditions	Modify storage and release operations at Friant Dam	Optimize existing system of reservoirs by modifying Friant Dam operations
Primary	Increase Water Supply Reliability and Operational Flexibility; Enhance Water Temperature and Flow Conditions	Increase conjunctive management of water in Friant Division of the Central Valley Project	Increase incidental groundwater storage and/or recharge with additional Class 2 deliveries by constructing a dam in the upper San Joaquin River Basin
Primary	Increase Water Supply Reliability and Operational Flexibility	Modify diversion to Madera and Friant-Kern canals	Increase water supply reliability by modifying the timing and quantity of water diverted to Madera and Friant-Kern canals
Primary	Enhance Water Temperature and Flow Conditions	Balance water storage in Millerton Lake and new upstream reservoirs	Improve water temperature management through balancing water storage levels between multiple reservoirs
Primary	Enhance Water Temperature and Flow Conditions	Construct selective-level intake structures on new upstream dams	Provide flexibility in managing cold water in potential reservoirs upstream from Millerton Lake through selective withdrawal of cold or warm water
Secondary	Reduce Flood Damages Downstream from Friant Dam	Increase flood storage space in or upstream from Millerton Lake	Increase incidental flood storage space by constructing a dam in upstream portion of Millerton Lake at River Mile 274
Secondary	Maintain Value of Hydropower Attributes	Construct new hydropower facilities on retained new surface water storage measures	Generate hydropower with new powerhouse using releases from new reservoir
Secondary	Maintain/Increase Recreational Opportunities	Replace or upgrade recreational facilities	Develop replacement facilities to provide similar or greater recreational opportunities at Millerton Lake and new reservoir

Draft Feasibility and Plan Refinement Phase

This section provides additional detail and context regarding the measures selected for inclusion in the Draft EIS action alternatives for Temperance Flat RM 274 Reservoir and rationale for some of the measures and options considered and deleted during plan refinement.

Physical Features Development Process for Action Alternatives

Several engineering studies have been performed for the Draft Feasibility and Plan Refinement Phase of the Investigation to support development of Temperance Flat RM 274 Reservoir action alternatives. This section summarizes development of the main physical features of the action alternatives: Temperance Flat RM 274 Dam and appurtenant structures, diversion and outlet works, hydropower generation features, and temperature management features. Further details on site engineering and features are included in the Draft Feasibility Report Engineering Summary Appendix (Reclamation 2014).

Dam and Appurtenant Structures The PFR included action alternatives with an embankment dam type (Reclamation and DWR 2008); however, Reclamation reevaluated both embankment and roller-compacted concrete (RCC) dam types and recommended the RCC dam type for development of feasibility-level designs at the Temperance Flat RM 274 Dam site (Reclamation 2009a). A value planning study was conducted in 2011 to identify potential means and methods to reduce costs on all engineering features while meeting planning objectives (Reclamation 2011). Proposals specific to the dam included assessment of a thinner straight RCC dam, a curved RCC dam, and a new spillway configuration. Considering the construction method for RCC, a single center arch dam layout was determined to be most appropriate for the Temperance Flat RM 274 Dam site (Reclamation 2013).

Diversion and Outlet Works After the PFR (Reclamation and DWR 2008), updated flood routings prompted a refinement of the diversion-during-construction concept to use two rockfill cofferdams, two RCC cofferdams, a diversion notch in the left abutment of the RCC dam, and a 30-foot-diameter tunnel in the Big Bend area (the tunnel would be used for diversion and river outlet works permanent releases) (Reclamation 2009b, 2010). The value planning study concluded that the 30-foot diversion tunnel and rockfill cofferdams built to elevation 580 feet msl would be sufficient for a 10-year return period flood. The cofferdams were also

designed to withstand larger floods and overtopping in the event that becomes necessary during construction, eliminating the need for the diversion notch and RCC cofferdams (Reclamation 2013).

Hydropower Generation Initial appraisal-level designs documented in the PFR for hydropower generation included an extended Kerckhoff No. 2 Powerhouse tunnel to supply water from Kerckhoff Dam to the proposed powerhouse (Reclamation and DWR 2008). Further assessment of the powerhouse design in the Draft Feasibility and Plan Refinement Phase included two power options: Power Option 1, consisting of two turbines for hydropower generation using water released from Temperance Flat RM 274 Reservoir; and Power Option 2, consisting of one turbine and an extended Kerckhoff No. 2 Powerhouse tunnel for hydropower generation using water released from Kerckhoff Lake, and one turbine for hydropower generation using water released from Temperance Flat RM 274 Reservoir. This assessment incorporated additional appraisal-level design data, refining layouts and design concepts, and establishing a cost range for power reimbursement planning purposes within constraints of water supply operations.

The value planning study had proposals specific to hydropower generation, including evaluating viability of onsite power facilities, and consolidating the powerhouse to the downstream toe of the dam. Hydroelectric pumped-storage facilities were considered during the value planning study; however, were rejected because it was found to be uneconomical given the variability in operations and head range (Reclamation 2011). Relocation of the powerhouse to the toe of the dam was also rejected because it would create congestion and schedule limitations at the construction site (Reclamation 2013). Additional economic evaluations were performed in the Draft Feasibility and Plan Refinement Phase to reinforce the viability of onsite power facilities.

Reclamation selected Power Option 1 as the preferred onsite hydropower option for feasibility-level designs (see Draft Feasibility Report Engineering Summary Appendix, Reclamation 2014). Power Option 2 was eliminated from further consideration in the Investigation because it was found to be less cost effective than Power Option 1 in meeting project requirements. In addition to Power Option 1, action alternatives include additional power reimbursement costs to fully offset the Kerckhoff Hydroelectric Project value.

Intake Structure and Temperature Management The PFR included consideration of temperature control devices (TCD) on Friant Dam and an SLIS at Temperance Flat RM 274 Reservoir (Reclamation and DWR 2008). Additional study during the Draft Feasibility and Plan Refinement Phase showed that an SLIS at Temperance Flat Reservoir would be more effective for cold-water pool management than a TCD at Friant Dam. The value planning study also proposed assessing the need for temperature management (Reclamation 2011). The incremental benefits and costs of an SLIS were evaluated using field costs and an economic benefit analysis for temperature improvements. Operations considered included a range of minimum carryover storage targets, and it was determined that the SLIS would be the most effective under action alternatives with higher Temperance Flat RM 274 Reservoir minimum carryover storage targets. For lower minimum carryover action alternatives, the SLIS cost was not as cost effective, and an LLIS was included in the design (Reclamation 2013).

Operations Development Process for Action Alternatives

Operations were refined after the Plan Formulation Phase during the Draft Feasibility and Plan Refinement Phase, which included evaluation of several potential operation assumptions. A range of values for each assumption was explored to assess how well they accomplished planning objectives and criteria. The major categories of operation assumptions included:

- Minimum carryover storage targets in Millerton Lake and Temperance Flat RM 274 Reservoir
- Hydropower generation options
- Temperature management options
- Water supply beneficiaries (Friant Division contractors, CVP SOD contractors, CVP wildlife refuges, SWP SOD M&I contractors)

Operation assumptions were combined into a number of preliminary action alternatives, which were then evaluated to better understand the inter-relationships and impacts on planning objectives and criteria from various combinations of assumptions. The potential range of operation assumptions was limited to the following:

- Maintain Temperance Flat RM 274 Reservoir minimum carryover storage targets to less than 400 TAF to

balance project objective achievements (water supply and emergency water supply, water temperature, hydropower, recreation).

- Operate Millerton Lake storage with a target of 340 TAF to balance project objective achievements (hydropower, recreation, water supply and emergency water supply, water temperature).
- Include multiple project beneficiaries to meet project objectives (economic and financial feasibility).
- Include an SLIS to improve reservoir cold-water pool management and release temperatures to the San Joaquin River.

Results from this evaluation also demonstrated that multiple water supply beneficiaries (Friant Division contractors, CVP SOD agricultural contractors, and SWP SOD M&I contractors) would likely be necessary for the project to be economically and financially feasible.

Refinement of Operation Assumptions

Building on findings developed in the previous evaluation, reservoir operation assumptions were refined and grouped into 10 scenarios, with varying priorities placed on the primary planning objectives. Analyses included varying the volume of new water supplies delivered to beneficiaries, and routing new supplies via the Friant-Kern and Madera canals as well as the San Joaquin River and Mendota Pool (to be conveyed to CVP SOD contractors or wildlife refuges or exchanged for SWP deliveries via the California Aqueduct).

Consideration was given to Level 2 refuge diversification and providing Incremental Level 4 refuge supplies during this stage, but Incremental Level 4 deliveries were not included in the action alternatives formulated in subsequent stages of operations development. Annual acquisitions of Incremental Level 4 water will continue to vary from year to year, depending on annual hydrology, water availability, water market pricing, and funding. Each year, Reclamation strives to provide as much Incremental Level 4 water as possible. Section 3406 (d)(2) of the CVPIA specifies that Reclamation must acquire this Incremental Level 4 water "…through voluntary measures such as water conservation, conjunctive use, purchase, lease, donations, or similar activities, or a combination of such activities which do not require involuntary

reallocations of project yield." Therefore, it would be speculative to predict or assume quantities and locations of annual Incremental Level 4 acquisitions from willing sellers. Without that information, it could not be incorporated into the CalSim II modeling assumptions or other analyses.

The scenarios in this evaluation also included three levels of Temperance Flat RM 274 Reservoir minimum carryover storage targets to better characterize potential water supply reliability and ecosystem benefits. An SLIS was incorporated in several scenarios to improve control over river temperatures, with varying operations and timing. During this evaluation the ecosystem benefits assessment was expanded from inferring salmon habitat improvements from river temperature improvements to explicit modeling of spring-run Chinook salmon habitat improvements due to flow and temperature changes.

Range of Operation Assumptions Included in Action Alternatives

There are a number of operations assumptions and variations in implementing each assumption that affect the performance of the action alternatives in meeting planning objectives and criteria. The action alternatives formulated through the operations refinement process represent a range of (1) planning objective achievements and opportunities, (2) reservoir-balancing and water management actions between Millerton Lake and Temperance RM 274 Flat Reservoir, and (3) potential new water supply beneficiaries (multiple).

This section contains details of operation assumptions in the action alternative and how they could affect project accomplishments. These major operations variables relate to Millerton Lake/Friant Dam operations, Temperance Flat RM 274 Reservoir and Dam operations, new water supply beneficiaries, and new water supply routing. Operational rules for management of storage levels between Millerton Lake and Temperance Flat RM 274 Reservoir could significantly affect all project accomplishments. As described in this section, water supply reliability and flood damage reduction would be influenced by total carryover storage in the two reservoirs; and river release temperature, hydropower management, and recreation would be strongly influenced not only by total carryover storage, but by the balancing of storage between the two reservoirs.

Millerton Lake/Friant Dam Operations Millerton Lake has historically been operated as an annual reservoir, with annual fluctuations of up to 110 feet between the Friant-Kern Canal outlet near elevation 470 feet msl (approximately 130 TAF) and the top of active storage at elevation 580 feet msl (approximately 520 TAF, or 450 TAF with Temperance Flat RM 274 Dam in place), depending on timing of inflow and demands. Evaluation of operations studies demonstrated that operations with stable Millerton Lake levels would result in multiple benefits, including cold water pool management, increased hydropower production at Friant Dam, and enhanced recreation opportunities, while only slightly decreasing water supply reliability. Alternative Plans 1, 2, 3, and 4 consider one Millerton Lake fixed carryover storage target at elevation 550 feet msl (340 TAF target storage), and Alternative Plan 5 considers a preference for keeping Millerton Lake storage at 340 TAF, but allows for Millerton Lake to be drawn down to 130 TAF when needed for water supply delivery.

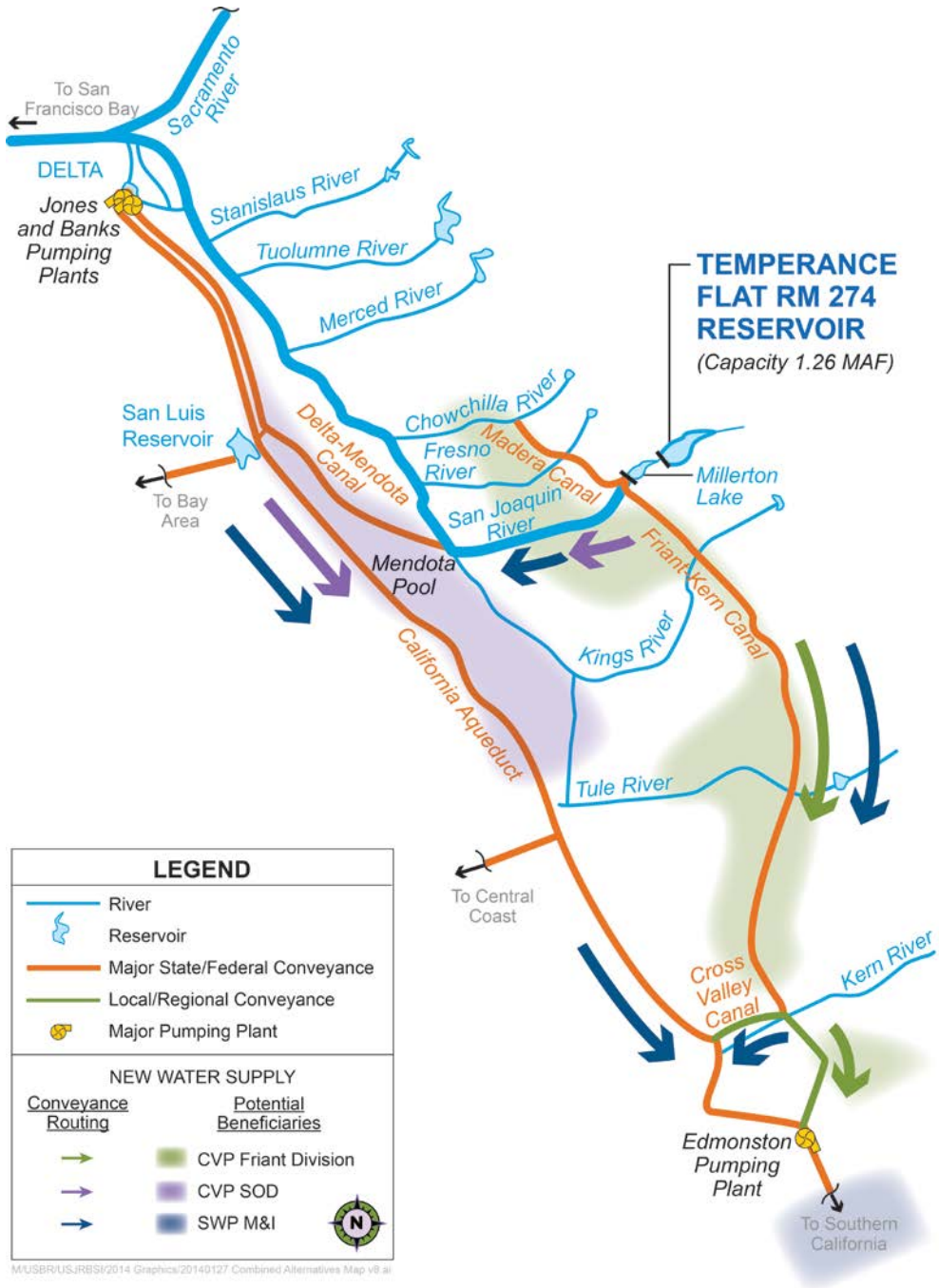
Temperance Flat RM 274 Reservoir Operations
Constructing Temperance Flat RM 274 Dam and Reservoir would create a storage capacity of 1,331 TAF, reduce the storage capacity of Millerton Lake by about 75 TAF, and create additional net storage capacity of about 1,260 TAF. The top of active storage in Temperance Flat RM 274 Reservoir would be at elevation 985 feet msl. A range of minimum carryover storage target volumes from 100 TAF to 325 TAF (elevation 606 to 731 feet msl) is represented in the action alternatives. The action alternatives with greater than 100 TAF carryover in Temperance Flat RM 274 Reservoir support a minimum pool for cold water management, emergency water supply, recreation opportunities, and hydropower generation. Water levels in Temperance Flat RM 274 Reservoir would fluctuate significantly above the minimum carryover target level, depending on the time of year and water year type (see Modeling Appendix).

New Water Supply Beneficiaries Temperance Flat RM 274 Reservoir could influence SOD water management by increasing water supply deliveries through various conveyance options, including the Friant-Kern Canal and the Cross Valley Canal to the Friant Division of the CVP, and SWP contractors and the San Joaquin River to Mendota Pool. Potential beneficiaries of the Temperance Flat RM 274 Reservoir new water supply include the Friant Division of the CVP, CVP SOD agricultural contractors, and SWP SOD M&I contractors. San Joaquin Valley CVP wildlife refuges could also benefit by

diversifying or increasing the number of sources of Level 2 refuge water supplies, thereby delivering higher quality San Joaquin River water supplies.

General options for routing water supply to different beneficiaries are shown in Figure 2-5. Delivery of new supplies to the Friant Division of the CVP considered long-term contract rules, conveyance capacities, delivery patterns, and changes due to the Settlement. The Friant Division of the CVP would experience improved water supply reliability due to shifting Section 215 water to Class 2 supplies. Delivery of new supplies to CVP SOD contractors was limited to current CVP SOD contract allocation limits, and to contractors with access to Mendota Pool, the Delta-Mendota Canal (DMC), or the California Aqueduct. Delivery to SWP SOD M&I contractors was based on the assumption that they would have demand for any amount of water supply delivered from Temperance Flat RM 274 Reservoir, within existing conveyance constraints.

New Water Supply Routing New water supply to the Friant Division of the CVP would be delivered via the Friant-Kern and Madera canals. Supply to the CVP SOD contractors and to wildlife refuges could be delivered via the San Joaquin River to Mendota Pool for delivery or exchange to contractors with access to Mendota Pool, the DMC, or the California Aqueduct. SWP SOD M&I water supply could be directly delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. SWP SOD M&I supply could also be delivered via the San Joaquin River and Mendota Pool, exchanged with Level 2 refuge supplies or exchanged with CVP SOD deliveries, and then via the California Aqueduct. Delivery of Temperance Flat RM 274 Reservoir water supplies to SWP SOD M&I contractors could require modifications to the CVP consolidated place of use. Alternatively, Temperance Flat RM 274 Reservoir could be developed jointly between the CVP and another partner.



Key:
CVP = Central Valley Project
M&I = municipal and industrial
SOD = South-of-Delta
SWP = State Water Project

Figure 2-5. Potential Temperance Flat RM 274 Reservoir Water Supply Beneficiaries and Routing Options

Carryover Storage Action alternatives were formulated to balance traditional water supply reliability accomplishments (dependent on active storage capacity) with accomplishments

tied to ecosystem and other public benefits (many of which are influenced by minimum carryover storage). This approach also is intended to maximize net benefits consistent with the P&G, maximize potential public benefits consistent with the Safe, Clean and Reliable Drinking Water Supply Act of 2010 (Senate Bill X7-2), and incorporate the various planning objectives for the Investigation.

Long-term average water supply reliability would increase with greater active storage and smaller volumes of minimum carryover storage, which would capture more San Joaquin River flood flows for delivery. Table 2-5 summarizes analyses performed to illustrate the sensitivity of Temperance Flat RM 274 Reservoir new water supply to changes in minimum carryover storage.

Table 2-5. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir with Varying Minimum Carryover Storage Target

Minimum Carryover Storage in Millerton Lake and Temperance Flat RM 274 Reservoir (TAF)[1]	**230**	**320**	**440**	**540**	**665**
Active Storage Capacity in Millerton Lake and Temperance Flat RM 274 Reservoir (TAF)[2]	1,550	1,460	1,340	1,240	1,115
Average Annual Change in Deliveries (TAF)[3,4,5,6]	98	91	85	70 – 76[7]	61[8]

Notes:
[1] Combined total storage capacity = 520 TAF Millerton (existing) + 1,260 TAF Temperance Flat (net additional) = 1,780 TAF.
[2] Active storage capacity = total storage capacity minus minimum carryover storage.
[3] Does not include deliveries pursuant to Paragraph 16(b) of the Stipulation of Settlement in in *NRDC, et al., v. Kirk Rodgers, et al*.
[4] Alternatives compared to No Action Alternative.
[5] All estimates of new water supply/change in deliveries based on CVP and SWP operating conditions with the 2008 USFWS and 2009 NMFS BOs (USFWS 2008, NMFS 2009).
[6] The values represent the net change in CVP/SWP systemwide deliveries, accounting for new deliveries from Temperance Flat RM 274 Reservoir and decreases in Delta exports due to the decrease in San Joaquin River flood flows. These sensitivity scenarios are based on storage of San Joaquin River supplies only and do not include operations integration with the broader CVP and SWP.
[7] Values represent the range of new water supply for Alternative Plans 1, 2, and 3, which include the same minimum carryover.
[8] Value for new water supply represents Alternative Plan 4.

Key:
BO = Biological Opinion
CVP = Central Valley Project
NMFS = U.S. Department of Commerce, National Marine Fisheries Service
RM = river mile
SWP = State Water Project
TAF = thousand acre-feet
USFWS = U.S. Department of the Interior, Fish and Wildlife Service

For ecosystem enhancements, greater active storage would correlate to more new water supply and therefore more potential flow-related improvements, while greater carryover storage could support more temperature-related improvements. San Joaquin River ecosystem enhancement for anadromous

fish would also be related to water supply routing when using the river as a conveyance route to Mendota Pool.

CVP and SWP Operating Conditions and Conveyance The magnitude of new water supply that could be developed by Temperance Flat RM 274 Reservoir would be strongly influenced by CVP and SWP operating conditions and conveyance. Analysis of Temperance Flat RM 274 Reservoir in the draft feasibility phase with operating conditions under the 2008 USFWS and 2009 NMFS Biological Opinions (BO) (USFWS 2008, NMFS 2009) focuses on developing new water supply by storing wet year water supplies from the San Joaquin River that would otherwise be released from Friant Dam as flood flows. Operations conditions may be sensitive to uncertain future conditions related to integration with the broader CVP and SWP SOD export and storage system and/or increased flexibility for CVP and SWP SOD export operations.

No Action Alternative

The No Action Alternative is the basis for comparison with the action alternatives, consistent with NEPA and CEQA guidelines and the Federal P&G (WRC 1983) and *Principles and Requirements for Federal Investments in Water Resources* (CEQ 2013). The No Action Alternative constitutes the No Project Alternative under CEQA, which represents “what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services” (State CEQA Guidelines Section 15126.6(e)(2)). The existing conditions are also a basis of comparison for determining potential effects of the action alternatives on the affected environment, consistent with State CEQA Guidelines (Section 15126.6(e)(2)). For Federal feasibility studies of potential water resources projects, the No Action Alternative is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions in the Study Area. Reasonably foreseeable actions include actions with current authorization, secured funding for design and construction, and environmental permitting and compliance activities that are substantially complete.

If the action alternatives are not determined to be feasible, the project would not be implemented. The No Action Alternative reflects projected conditions in 2030 if the project is not implemented (2030 is the future level of development for

which water resources are simulated in the Reclamation March 2012 California Water Resources Simulation Model [CalSim II] Benchmark). Plan formulation efforts and analysis of the action alternatives and the No Action Alternative described in this Draft EIS are based on CVP and SWP operational conditions described in the 2008 USFWS and 2009 NMFS BOs (USFWS 2008, NMFS 2009).

The sections below describe reasonably foreseeable SJRRP actions included in the No Action Alternative, and the potential consequences of implementing the No Action Alternative, as they relate to the objectives of the Investigation. The Modeling Appendix further describes the No Action Alternative, showing which actions and projects are assumed to be part of the future condition in the Reclamation March 2012 CalSim II Benchmark model for feasibility study operations modeling efforts.

San Joaquin River Restoration Program Reasonably Foreseeable Actions Included in No Action Alternative

SJRRP actions implemented as of January 2014 are considered part of the existing conditions evaluated in this Draft EIS, as shown in Table 2-6. These actions include the management and release of Restoration Flows pursuant to Paragraph 13 of the San Joaquin River Stipulation of Settlement (Settlement), recapture of Restoration Flows at existing facilities on the San Joaquin River, and recirculation of those flows to the Friant Division of the CVP, pursuant to Paragraph 16 of the Settlement (NRDC et al. 2006).

Table 2-6. SJRRP Actions Included in Existing and Future Conditions

Settlement Paragraph	Action	Existing Conditions	Future Conditions
11a	Construct Mendota Pool Bypass and modify Reach 2B to convey at least 4,500 cfs	No	Yes
11a	Modify Reach 4B1 to convey at least 475 cfs	No	Yes[1]
11a	Modify San Joaquin River Headgate Structure to enable fish passage and flow routing	No	Yes
11a	Modify Sand Slough Control Structure to enable fish passage	No	Yes
11a	Screen Arroyo Canal and provide fish passage at Sack Dam	No	Yes
11a	Modify Eastside and Mariposa Bypasses for fish passage	No	Yes
11a	Enable deployment of seasonal barriers at Mud and Salt sloughs	No	Yes
11b	Modify Chowchilla Bypass Bifurcation Structure	No	Yes
11b	Fill or isolate gravel pits	No	Yes
11b	Modify Reach 4B1 to convey at least 4,500 cfs	No	No[1]
12	Enhance spawning gravel	No	Yes
12	Reduce potential for redd superimposition and/or hybridization	No	Yes
12	Supplement the salmon population	No	Yes
12	Modify floodplain and side-channel habitat	No	Yes
12	Enhance in-channel habitat	No	Yes
12	Reduce potential for aquatic predation of juvenile salmonids	No	Yes
12	Reduce potential for fish entrainment	No	Yes
12	Enable fish passage	No	Yes
12	Modify flood flow control structures	No	Yes
12	Apply various conservation measures to actions above	No	Yes
13a	Release of Restoration Flows (Base Flows, Buffer Flows, and application of provisions to flexibly manage releases for the best achievement of the Restoration Goal pursuant to Exhibit B)	Yes	Yes
13b	Riparian releases, downstream diversions, seepage losses	Yes	Yes
13c	Acquire and release additional water supplies to address seepage losses	Yes	Yes
13d	Minimize increases in flood risk in the Restoration Area as a result of Restoration flows	Yes	Yes
13e	Changes in releases for maintenance of CVP facilities	Yes	Yes
13f	Steps to prevent/address unexpected diversions or seepage	Yes	Yes
13g	Measurement of flows within Restoration Area	Yes	Yes
13h	Protection of water rights	Yes	Yes
13i	Manage unreleased Restoration Flows	Yes	No
13j	Establish Restoration Flow Guidelines	Yes	Yes
14	Reintroduce salmon	No	Yes
16a	Recapture Restoration Flows in Restoration Area at Mendota Pool and wildlife refuges	Yes	No[2]
16a	Recapture Restoration Flows in Delta at existing CVP/SWP facilities	No[2]	Yes
16a	Recapture Restoration Flows at existing facilities on San Joaquin River with potential in-district modifications to existing facilities	No[2]	Yes
16a	Recirculate recaptured Restoration Flows	Yes	Yes
16b	Establish a Recovered Water Account and manage Friant Dam to make water supplies available to Friant Division long-term contractors at a preestablished rate	Yes	Yes

Table 2-6. SJRRP Actions Included in Existing and Future Conditions (contd.)

Settlement Paragraph	Action	Existing Conditions	Future Conditions
20	Changes to the Restoration Flows after December 31, 2025	No	No
SA	Implement capacity restoration for the Friant-Kern and Madera canals	No	Yes[3]
SA	Construct permanent reverse flow pump-back facilities on the Friant-Kern Canal	No	Yes[3]
SA	Develop groundwater banking projects in the Friant Division of the CVP	No	Yes[3]

Notes:
[1] As described in the Selected Alternative in the SJRRP PEIS/R ROD.
[2] Channel constraints temporarily limit conveyance of Restoration Flows
[3] Included in the Settlement Act: Part III – Friant Division Improvements(Public Law 111-11); addressed qualitatively in No Action and all action alternatives
Key:
cfs = cubic feet per second
CVP = Central Valley Project
Settlement = San Joaquin River Stipulation of Settlement
SJRRP = San Joaquin River Restoration Program
SWP = State Water Project

Actions from the SJRRP PEIS/R ROD Preferred Alternative are included in the future conditions evaluated in this Draft EIS. All actions included under the existing conditions are also included in the future conditions. Additional SJRRP actions anticipated to be implemented in the future are reasonably foreseeable under the No Action Alternative, and are included in the future conditions as shown in Table 2-6. These actions include physical modifications to the San Joaquin River pursuant to Paragraphs 11 and 12 of the Settlement; reintroduction of salmonids to the San Joaquin River, pursuant to Paragraph 14 of the Settlement; additional actions to recapture Restoration Flows at existing, modified, or new facilities on the San Joaquin River, pursuant to Paragraph 16; and improvements in the Friant Division of the CVP pursuant to Part III of Public Law 111-11.

Where relevant and quantifiable, SJRRP actions shown in Table 2-6 are included in the existing condition and/or future condition of the Reclamation March 2012 CalSim II Benchmark model. The No Action Alternative does not include any changes to Restoration Flows pursuant to Paragraph 13 or Paragraph 20 of the Settlement.

Water Temperature and Flow Conditions

The No Action Alternative includes release of full Restoration Flows from Friant Dam to the San Joaquin River as provided in the Settlement. No actions other than SJRRP actions listed in Table 2-6 would be taken to enhance water temperature and

flow conditions in the San Joaquin River under the No Action Alternative.

Water Supply Reliability and System Operational Flexibility

Demands for water in the Central Valley and throughout California exceed available supplies, and the need for additional supplies is expected to grow. The population of California and the Central Valley is expected to increase by approximately 19 percent and 35 percent, respectively, by 2030 (California Department of Finance 2013). As this occurs, along with the need to maintain a healthy and vibrant industrial and agricultural economy, the demand for adequate and reliable water supplies will become more acute. Competition for available water supplies will intensify as water demands increase to support M&I, and associated urban growth relative to agricultural uses. Delivering water supplies SOD for agricultural and M&I users has also become increasingly constrained and complex. Increases in population, land-use changes, regulatory requirements, and limitations on storage and conveyance facilities will further strain available water supplies and infrastructure to meet water demands.

Water conservation and reuse efforts are increasing and mandatory conservation resulting from increasing shortages will continue. In the past, during drought years, many water conservation measures were implemented to reduce the effects of the drought. In the future, as more water conservation measures become necessary to help meet even average year demands, the impacts of droughts will be much more severe. Besides mandatory conservation, without developing cost-efficient new sources, more reliance will be placed on shifting uses from such areas as agricultural production to urban uses. It is likely that with continued and deepening shortages in available water supplies, increasing adverse economic impacts will occur over time in the Central Valley and elsewhere in California. One possible impact is an increase in water costs, resulting in a further shift in agricultural production to areas outside California and/or outside the United States or the conversion to higher value permanent crops.

Under the No Action Alternative, Friant Dam would continue operating similarly to existing conditions (with implementation of the Settlement, including Restoration Flows). The No Action Alternative would continue to meet water supply demands at levels similar to existing conditions.

Flood Management, Hydropower Attributes, Recreation, San Joaquin River Water Quality, Urban Water Quality

Flood system improvements along the San Joaquin River downstream from Friant Dam are currently underway or will be initiated in the future by the USACE, DWR, and local/regional flood management districts. Additionally, modifications to San Joaquin River flow conveyance features downstream from Friant Dam will be initiated in the future by Reclamation under the SJRRP.

California's demand for electricity is expected to substantially increase in the future. Under the No Action Alternative, PG&E is assumed to relicense the existing Kerckhoff Hydroelectric Project under the FERC in 2022. PG&E will have decommissioned the No. 2 unit in the Kerckhoff Powerhouse (PG&E 2012), which would decrease the powerhouse capacity below the 30-megawatt (MW) Renewable Portfolio Standard limit.

As California's population continues to grow, demands for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley would grow significantly. Regional population growth in the vicinity of Millerton Lake is expected to result in increased demand for recreation and increased visitation at Millerton Lake (Reclamation and State Parks 2010).

Several activities to improve San Joaquin River water quality conditions through reducing pollutant concentrations and/or reducing pollutant loading to the river are underway, including continued implementation of the Westside Regional Drainage Plan and the Grassland Bypass Project.

A complementary action recommended for continued study in the CALFED ROD under the Conveyance and Water Quality programs was to facilitate water quality exchanges and similar programs to make available high-quality Sierra Nevada water in the eastern San Joaquin Valley to urban interests receiving water from the Delta (CALFED 2000b). Under the No Action Alternative, there would be no actions to increase storage in the upper San Joaquin River Basin that could enhance CVP and/or SWP operational flexibility to meet water quality goals in the Delta or facilitate water quality exchanges and similar programs to improve urban water quality.

Action Alternatives

The action alternatives are described in the following sections. Features common to all action alternatives are described in detail, including environmental commitments. Detailed discussions of potential effects and proposed mitigation measures for each action alternative are included in Chapters 4 through 7 and 9 through 26 of this Draft EIS. If any action alternative is authorized by Congress, Reclamation would implement the features, operations, environmental commitments, mitigation measures, and permit and approval conditions, as described throughout this Draft EIS, Final EIS, ROD, and in permits or approvals issued for implementation.

Description of Action Alternatives

Alternative Plan 1

Alternative Plan 1 would provide new water supplies to Friant Division and SWP SOD M&I contractors. New supplies to SWP SOD M&I contractors would be delivered via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water could be delivered to SWP SOD M&I contractors via the California Aqueduct. Alternative Plan 1 would include minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF.

Alternative Plan 1 would include a fixed LLIS on Temperance Flat RM 274 Reservoir. The LLIS would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The LLIS would consist of two, low-level fixed-wheel gates sized in combination to pass 20,000 cfs during high-flow conditions. Water through each gate would flow directly into the outlet works tunnel. Because the lower gates would also function to release higher flood flows, both would be necessary but only one gate would be opened, as needed, for normal releases.

Alternative Plan 2

Alternative Plan 2 would provide new water supplies to Friant Division contractors, SWP SOD M&I contractors, and CVP SOD contractors. New supplies to SWP SOD M&I contractors would be delivered via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, where an equivalent

amount of Delta water could be delivered to SWP SOD M&I contractors via the California Aqueduct.

New water supplies to CVP SOD contractors would be developed by delivering CVPIA Level 2 refuge water from Temperance Flat RM 274 Reservoir. The water would be released to the San Joaquin River for refuge deliveries from Mendota Pool, which would make Delta supplies available at Mendota Pool for direct access or exchange with Delta supplies for delivery to CVP SOD contractors.

Similar to Alternative Plan 1, Alternative Plan 2 would have minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF. Alternative Plan 2 would include a fixed LLIS on Temperance Flat RM 274 Reservoir, as described for Alternative Plan 1.

Alternative Plan 3

Alternative Plan 3 would provide new water supplies to Friant Division contractors, SWP SOD M&I contractors, and CVP SOD contractors. New supplies to SWP SOD M&I contractors would be delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. New water supplies to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool for direct access or exchange with Delta supplies.

Similar to Alternative Plans 1 and 2, Alternative Plan 3 would have minimum carryover storage targets 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF. Alternative Plan 3 would include a fixed LLIS on Temperance Flat RM 274 Reservoir, as described for Alternative Plan 1.

Alternative Plan 4

Alternative Plan 4 would provide new water supplies to Friant Division contractors, SWP SOD M&I contractors, and CVP SOD contractors. New supplies to SWP SOD M&I contractors and CVP SOD contractors would be delivered via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water could be delivered to SWP SOD M&I contractors via the California Aqueduct. New water supplies to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool, for direct access or exchange with Delta supplies. Alternative Plan 4 would have minimum carryover storage targets of 340 TAF

in Millerton Lake and 325 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 625 TAF.

Alternative Plan 4 would include an SLIS on Temperance Flat RM 274 Reservoir. The SLIS would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The SLIS would consist of two low-level fixed-wheel gates sized in combination to pass 20,000 cfs during high-flow conditions, and three 6,000 cfs upper-level fixed-wheel gates to allow withdrawal from different temperature zones in the reservoir. Water through each lower gate would flow directly into the outlet works tunnel. Because the lower gates would also function to release higher flood flows, both would be necessary but only one gate would be opened, when needed, for low-elevation releases to meet water temperature objectives.

Alternative Plan 5

Alternative Plan 5 would provide new water supplies to Friant Division and CVP SOD contractors. New water supplies to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool for direct access or exchange with Delta supplies.

Alternative Plan 5 would have minimum carryover storage targets of 130 TAF in Millerton Lake and 100 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 230 TAF. Alternative Plan 5 considers an operational preference for keeping Millerton Lake storage at 340 TAF, but allows for Millerton Lake to be drawn down to 130 TAF when needed for water supply delivery, and to fill completely (to 450 TAF) after Temperance Flat RM 274 Reservoir fills. This action alternative also considers additional dry year carryover, where some new water supply that could be delivered in wetter years is held over for delivery in subsequent drier years. This operation slightly decreases the magnitude of long-term average new water supply, but increases deliveries in drier years. Alternative Plan 5 would include a fixed LLIS on Temperance Flat RM 274 Reservoir, as described for Alternative Plan 1.

Features Common to All Action Alternatives

The following features are common to all action alternatives and are assumed for impact analyses in this Draft EIS. Physical features common to all action alternatives are shown in Figures

2-6 through 2-9. Variations in physical features, such as dam location, design and construction approach, hydropower features, and location of outlet works/diversion tunnels, were considered during the development of feasibility designs and cost estimates, but the preferred approaches were identified during feasibility design and are reflected consistently in the action alternatives.

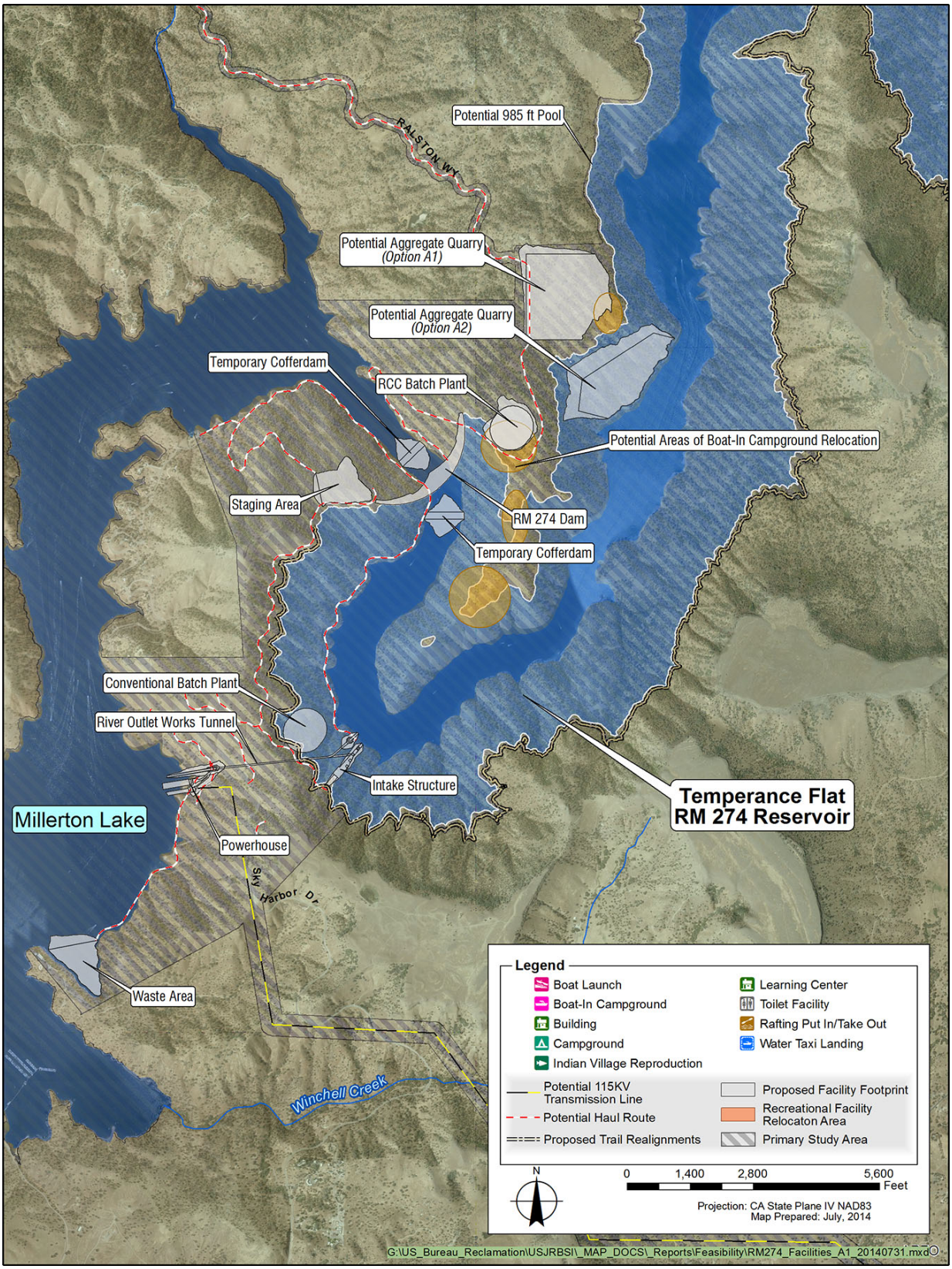


Figure 2-6. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option A

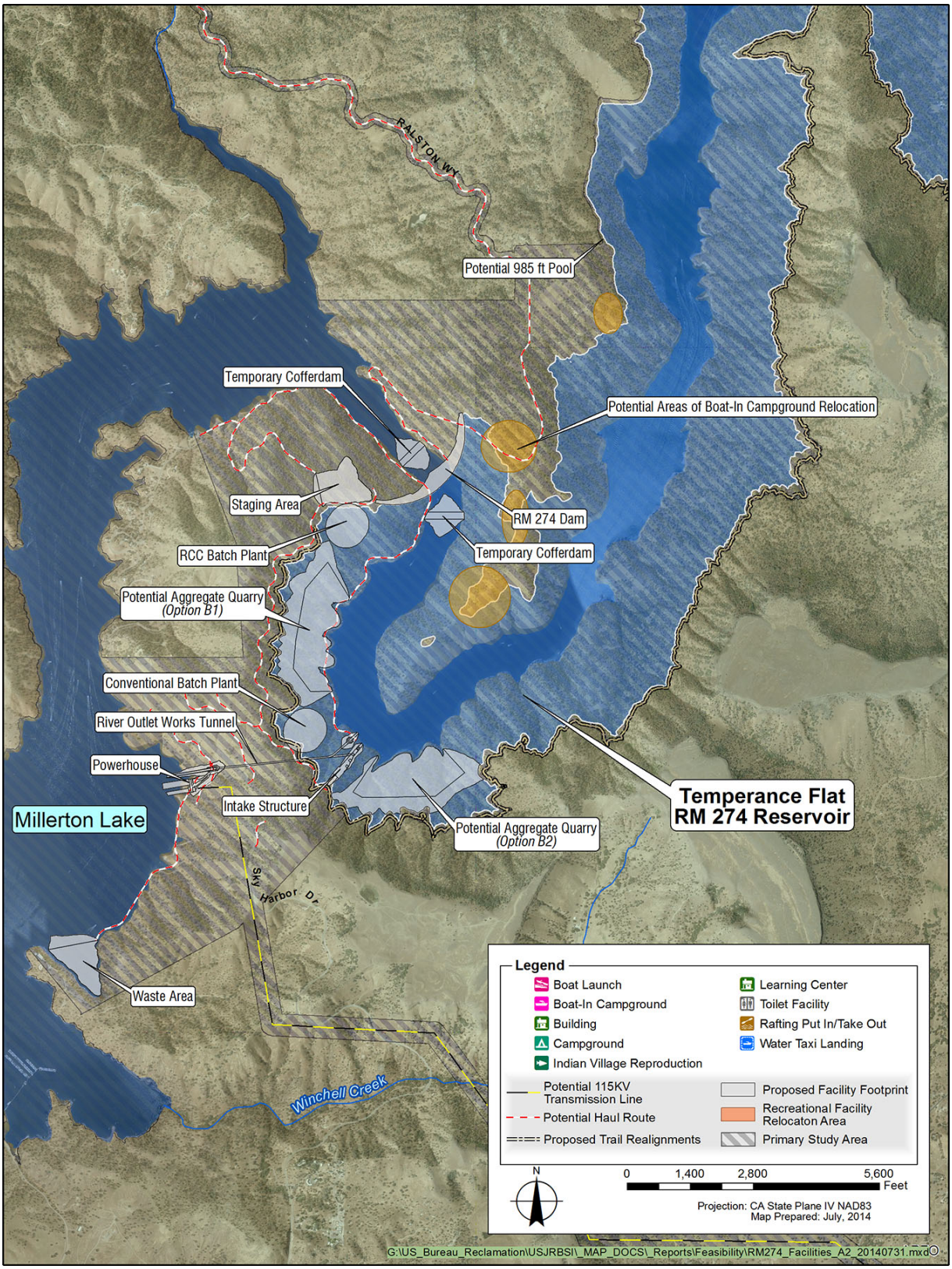


Figure 2-7. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option B

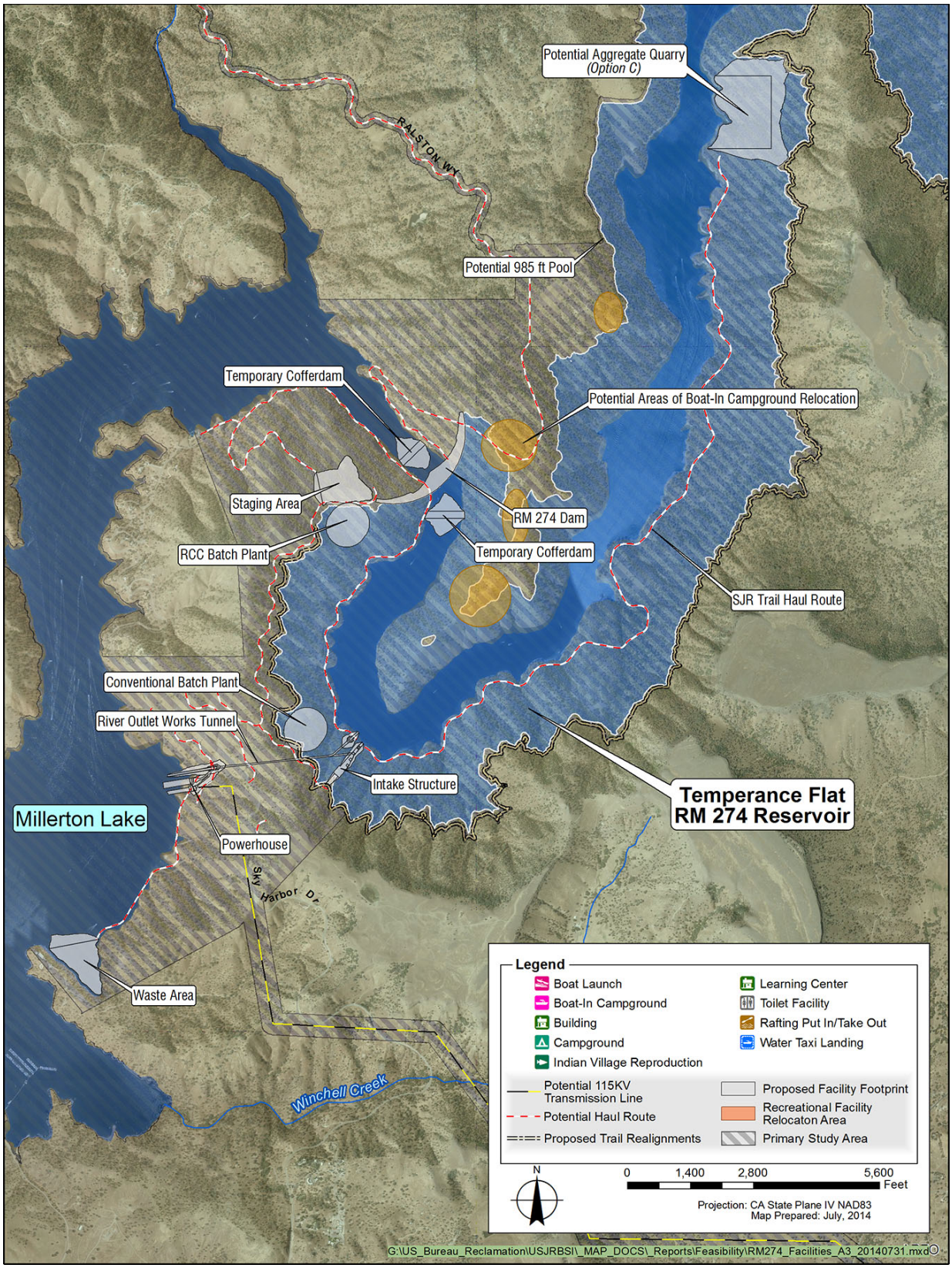


Figure 2-8. Proposed Temperance Flat RM 274 Reservoir Project Features for Quarry, Batch Plant, and Haul Road Option C

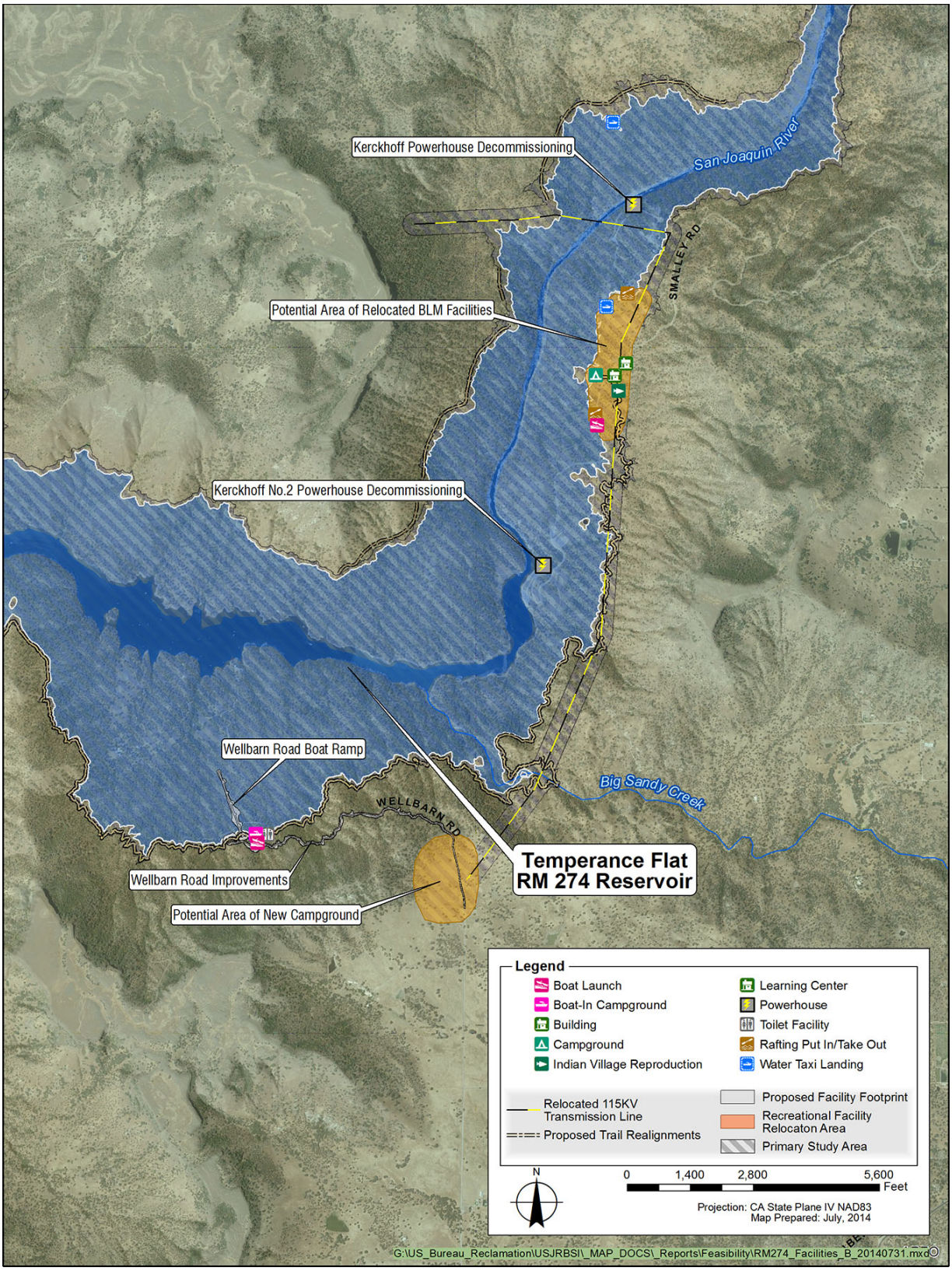


Figure 2-9. Proposed Temperance Flat RM 274 Reservoir Upstream Project Features

Dam and Reservoir

The proposed dam at Temperance Flat RM 274 would be a RCC arch gravity dam. This dam site would be located 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake. The dam would be approximately 665 feet high, from a base elevation of 340 feet msl in the bottom of Millerton Lake (San Joaquin River channel) at the upstream face to the dam crest at 1,005 feet msl. The width of the dam crest would be approximately 3,360 feet. The overflow section of Temperance Flat RM 274 Dam would consist of a 665-foot-wide uncontrolled ogee crest spillway at elevation 985 feet msl.

At a top-of-active-storage elevation of 985 feet msl, Temperance Flat RM 274 Reservoir would provide about 1,260 TAF additional storage (1,331 TAF total storage, of which 75 TAF would overlap with the existing Millerton Lake), and would have a surface area of about 5,700 acres. Temperance Flat RM 274 Reservoir would reduce the Millerton Lake storage volume to 449 TAF and surface area to 3,890 acres. The reservoir would extend about 18.5 miles upstream from RM 274 to Kerckhoff Dam. At the top of active storage, the new reservoir would reach to about 12 feet below the crest of Kerckhoff Dam.

Temperance Flat RM 274 Reservoir would inundate varying areas of vegetated shoreline, riparian, and upland habitat. Vegetation would be cleared from about 3,580 acres within the inundation area to keep debris clear of dam operations, and for the safety of recreational users and habitat concerns.

Extensive alternatives analysis was performed as part of the plan formulation process for the Investigation since 2002, with 22 reservoir sites evaluated for their ability to meet basic project purposes and objectives, and in consideration of environmental effects, cost-effectiveness, and overall feasibility. Alternative dam and reservoir sites included options suggested during the scoping process. The number of alternative reservoir sites was reduced through a phased evaluation process considering the ability to achieve site-specific project objectives and/or the purpose and need. Other potential alternatives failed to meet the basic project purpose and need, and had substantial impacts on biological resources, hydropower, and other resources.

While the plan formulation process following the P&G and documented in the 2008 PFR considers NEPA, it is not the

direct vehicle for NEPA compliance. A NEPA document must provide specific information related to the process to develop, screen and evaluate alternatives. All reasonable alternatives should be screened, and those that meet the basic project purposes should be carried through the analysis of the NEPA document. The CEQ Section 1502.14 states that agencies shall "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated." Agencies have discretion in determining the range of reasonable alternatives to include in the rigorous analysis of a NEPA document.

In *Northern Alaska Environmental Center v. Kempthorne*, U.S. 9th Circuit 457 F.3d 969, 978 (9th Cir. 2006), NEPA requirements for a range of reasonable alternatives are summarized succinctly:

> *…an agency's consideration of alternatives is sufficient if it considers an appropriate range of alternatives, even if it does not consider every available alternative. Headwaters, Inc. v. Bureau of Land Mgmt., 914 F.2d 1174, 1181 (9th Cir.1990). An agency need not, therefore, discuss alternatives similar to alternatives actually considered, or alternatives which are "infeasible, ineffective, or inconsistent with the basic policy objectives for the management of the area." Id. at 1180-81 (citing California v. Block, 690 F.2d 753, 767 (9th Cir.1982)).*

Reclamation has thoroughly explained its process for developing the range of alternatives carried forward in the EIS and explained why alternatives and management measures were rejected from detailed discussion in the EIS, consistent with the alternatives development processes upheld in recent case law (see *Protect Our Communities Foundation v. Salazar*, 2013 U.S. Dist. LEXIS 159281 [S.D. Cal. 2013]; and *La Cuna De Aztlan Sacred Sites Protection Circle Advisory Committee v. Interior*, 2013 U.S. Dist. LEXIS 123331 [E.D. Cal. 2013]).

Reclamation is required to examine a range of reasonable alternatives, and provide a detailed analysis of the action alternatives and No Action Alternative, but is not obligated to undertake a detailed examination of every conceivable measure that could benefit water supply reliability and operational flexibility or enhancements to water temperature and flow

conditions in the San Joaquin River downstream from Friant Dam. For these reasons, Temperance Flat RM 274 was retained as the preferred dam and reservoir location in this Draft EIS. Additional discussion of the plan formulation and screening processes is provided in the Plan Formulation Appendix.

Cofferdams

Upstream and downstream cofferdams would be required to divert stream flows during construction and to prevent inundation of the site from Millerton Lake. Both cofferdams would require a minimum crest elevation of 580 feet msl and height of 240 feet to accommodate normal reservoir operation of Millerton Lake and to pass diversion flows. After completion of the RCC arch gravity dam, cofferdams would be removed to elevation 525 feet msl.

Diversion Tunnel

A 30-foot-diameter and approximately 2,900-foot-long concrete-lined tunnel would be constructed through the left abutment, approximately 1.5 miles upstream from the main dam. The tunnel would later serve as the outlet works tunnel for the reservoir.

Relation of the Outlet Tunnel and Intake Structures

The diversion tunnel would be used to divert the San Joaquin River around the Temperance Flat RM 274 Dam site during dam construction. After the dam is completed, the diversion tunnel would serve as the outlet works tunnel for the reservoir. An intake structure on the outlet tunnel (either a Selective Level Intake Structure or a Low Level Intake Structure, depending on the action alternative) would direct water into the tunnel. Finally, water in the tunnel would be diverted through the powerhouse and/or valve house, depending on operations.

Intake Structure

All action alternatives would include an inclined, reinforced-concrete intake structure located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The length, width, and slope of the intake structure, along with number, location, and operability of inlet gates, would vary among the action alternatives. Descriptions for the intake structure configurations specific to each action alternative are included in the alternative-specific sections later in this chapter.

Powerhouse and Transmission Facilities

The Temperance Flat RM 274 Reservoir powerhouse would be located approximately 750 feet southwest from the diversion tunnel outlet portal and consist of an 85-foot-deep reinforced-concrete substructure and 64-foot-high steel superstructure. The powerhouse would contain two 80 MW turbines, which in combination are sized to pass a design flow of 6,000 cubic feet per second (cfs). After passing through the turbine units, water would then flow through an approximately 490-foot-long tailrace tunnel into an open channel to Millerton Lake, regulated by a concrete weir to maintain a minimum tailwater elevation of 550 feet msl. An aboveground switchyard would connect to a new Temperance Flat transmission line, which

would traverse approximately 5 miles southeast to the existing Kerckhoff–Sanger transmission line.

Valve House

The Temperance Flat RM 274 Reservoir valve house would be sized to pass up to 20,000 cfs. Water would be directed from the outlet works tunnel in a 30-foot-diameter penstock and then diverted through the valve house and/or powerhouse, depending on operations. The valve house would be an at-grade, reinforced-concrete structure connected to the powerhouse superstructure, located approximately 650 feet southwest from the diversion tunnel portal. External features would include a river outlet works chute, approximately 600 feet long, which would release into Millerton Lake.

Quarry, Batch Plant, and Haul Road Options

The aggregate quarry would supply aggregate for the main dam and cofferdams. Because of uncertainties in the adequacy of rock for aggregate, three quarry options with varying locations are being considered within each action alterative. The main dam batch plant location and haul road, connecting the potential quarry site to the main dam batch plant, would also vary depending on quarry option. The specific locations of aggregate quarry sites, batch plants, and haul roads are subject to change based on further engineering and geotechnical analyses. Only one quarry site, batch plant, and haul road option, however, would be selected to support construction activities under any of the action alternatives.

Regardless of the quarry option selected, final quarry development would typically include benched or terraced rock faces in sound rock, with 40-foot vertical faces and 20-foot horizontal bench widths. The quarried area would be closed to the public and include access barriers. In addition, long-term slope inspection and maintenance would be required. Appropriate signage and restrictions for reservoir recreation would be required for quarry options within the reservoir. The three quarry, batch plant, and haul road options are described in the following sections.

Quarry, Batch Plant, and Haul Road Option A

Aggregate Quarry Quarry, batch plant, and haul road Option A includes two potential quarry sites. Potential quarry site A1 would be located approximately 2,500 feet northeast of the dam’s right abutment on the Madera County side of Millerton Lake, outside the proposed inundation area. Potential quarry site A2 would be located directly southwest of quarry site A1

within the inundation area, also on the Madera County side of Millerton Lake. Both quarry sites would be approximately 92 acres in size. Only one quarry site would ultimately be constructed. An estimated 10 million cubic yards of material would be excavated from the proposed quarry site, and excavated to approximately elevation 600 feet msl. The specific location, size, and geometry of the site would be subject to change based on further engineering and geotechnical analyses.

Batch Plants The main dam potential batch plant site would be located approximately 800 feet east of the dam's right abutment. This batch plant site would be about 19 acres in size and most of the site would be outside the proposed inundation area. This dam batch plant site is the same for both quarry sites (A1 and A2) under Option A. The potential batch plant for the diversion tunnel, powerhouse, valve house, and intake structure would be located east of Sky Harbour Road between the powerhouse and intake structure sites (just east of the intersection of Access Road Nos. 1 and 2 within the inundation area). This second batch plant would be about 19 acres in size. Cement and pozzolan would likely be delivered by truck to both batch plants, most likely from railroad terminals near Fresno, California. The specific locations of the batch plants are subject to change based on further engineering and geotechnical analyses.

Haul Roads Five temporary haul roads would provide construction access to the aggregate quarry, batch plant, dam and cofferdams, staging area, intake structures, and diversion tunnel waste area. The total length of temporary haul roads would be approximately 10 miles with two lanes, with each lane width ranging from 12 to 20 feet. The specific locations of the haul roads are subject to change based on further engineering and geotechnical analyses.

Quarry, Batch Plant, and Haul Road Option B

Aggregate Quarry Quarry, batch plant, and haul road Option B includes two potential quarry sites. Potential quarry site B1 would be located within the inundation area on the Fresno County side of Millerton Lake, between the main dam and intake structure. Potential quarry site B2 would be located southeast of potential quarry site B1, also within the inundation area, upstream from the intake structure. An estimated 10 million cubic yards of material would be excavated from either quarry site or a combination of both of the proposed quarry sites, and the quarry site(s) would be excavated to

approximately elevation 600 feet msl. The specific location(s), size, and geometry of the site(s) would be subject to change based on further engineering and geotechnical analyses.

Batch Plants The main dam potential batch plant site would be located directly south of the staging area on the dam's left abutment. This batch plant site would be about 19 acres in size and would be inside the proposed inundation area. The potential batch plant for the diversion tunnel, powerhouse, valve house, and intake structure would be located east of Sky Harbour Road between the powerhouse and intake structure sites (just east of the intersection of Access Road Nos. 1 and 2 within the inundation area). This second batch plant would be about 19 acres in size. Cement and pozzolan would likely be delivered by truck to both batch plants, most likely from railroad terminals near Fresno, California. The specific locations of the batch plants are subject to change based on further engineering and geotechnical analyses.

Haul Road Four temporary haul roads would provide construction access to the aggregate quarry/quarries, batch plant, dam and cofferdams, staging area, intake structures, and diversion tunnel waste area. The total length of temporary haul roads would be approximately 7 miles with two lanes, with each lane width ranging from 12 to 20 feet. The haul road from potential quarry site B2 would approximately follow the existing San Joaquin River Trail. The specific locations of the haul roads are subject to change based on further engineering and geotechnical analyses.

Quarry, Batch Plant, and Haul Road Option C

Aggregate Quarry The proposed quarry site under quarry, batch plant, and haul road Option C would be located within the inundation area on the Fresno County side of Millerton Lake at River Mile 279. The quarry site would be approximately 92 acres in size. An estimated 10 million cubic yards of material would be excavated from the proposed quarry site, and excavated to approximately elevation 600 feet msl. The specific location, size, and geometry of the site would be subject to change based on further engineering and geotechnical analyses.

Batch Plants Potential batch plants for quarry, batch plant, and haul road Option C would be the same as described under Option B. The specific locations of the batch plants are subject to change based on further engineering and geotechnical analyses.

Haul Road Five temporary haul roads would provide construction access to the aggregate quarry, batch plant, dam and cofferdams, staging area, intake structures, and diversion tunnel waste area. The total length of temporary haul roads would be approximately 14 miles with two lanes, with each lane width ranging from 12 to 20 feet. The haul road between Option C and the dam batch plant would approximately follow the existing San Joaquin River Trail. The specific locations of the haul roads are subject to change based on further engineering and geotechnical analyses.

Staging Area

The dam staging area would be located directly above the dam's left abutment, outside the proposed inundation area, and be approximately 21 acres in size. This area would be used for construction staging and aggregate stockpiling. Trucks would be used to transport stockpiled aggregate to the dam site.

A marine staging area for constructing the cofferdams would be located between the proposed haul roads and Millerton Lake shoreline downstream from the downstream cofferdam. Additional area, between the cofferdams and in the inundation area slightly upstream from the upstream cofferdam, would also be used to stage and construct the cofferdams. Excavated material from the marine staging area would be used in the cofferdams.

Access Roads

Three permanent access roads would provide O&M staff with access to the dam, intake structures, and valve house/powerhouse. Permanent access roads would leave Sky Harbour Road near the valve house and have a total length of approximately 3.5 miles. These roads would consist of two 12-foot wide lanes.

Waste Area

The waste area would be located approximately 3,200 feet southwest of the powerhouse within the existing inundation area of Millerton Lake and be approximately 21.5 acres in size. This area would be used for permanent disposal of remaining waste rock from diversion tunnel and powerhouse excavation.

Kerckhoff Hydroelectric Project Facilities

Temperance Flat RM 274 Reservoir, with a top-of-active storage at elevation 985 feet msl, would inundate the existing Kerckhoff Project powerhouses, Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse. Kerckhoff Powerhouse is an

aboveground facility and would be removed and restored to near-natural conditions. Kerckhoff No. 2 Powerhouse is an underground facility and would be abandoned in place. The majority of mechanical and electrical equipment for both powerhouses would be removed and salvaged. Temperance Flat RM 274 Reservoir top-of-active storage would be just a few feet below the top of the Kerckhoff Dam spillway gates. The top of Kerckhoff Dam would be modified to accommodate higher tailwater elevations, including modifications to mechanical operators and gates to the existing deck. Inundated sections of the Kerckhoff–Le Grand and Kerckhoff–Sanger transmission lines (approximately 4 miles) would be reconstructed as the Le Grand–Sanger transmission line.

Recreational Facilities

Temperance Flat RM 274 Reservoir would affect several recreational features found along the existing Millerton Lake shoreline. Recreational facilities upstream from RM 274 include the Temperance Flat Boat-In Campground within the Millerton Lake State Recreation Area (SRA), and the San Joaquin River Trail, which connects the SRA and the BLM San Joaquin River Gorge (SJRG) Special Recreation Management Area (SRMA). Within the SJRG SRMA are hiking, biking, and equestrian trails, including an extension of the San Joaquin River Trail; two footbridges; primitive campgrounds; and a cultural heritage learning center, which includes a reproduction of a Native American village, simulated archaeological dig, authentic bedrock mortars, and a nature trail. Reclamation would protect such facilities from inundation, modify existing facilities to replace affected areas (i.e., relocate facilities on site), or abandon existing facilities and replace them at other suitable sites to the extent feasible (i.e., relocate facilities off site and upslope). Reclamation would seek to maintain the quality of visitor experiences by replacing affected recreational facility capacity with facilities providing equivalent visual resource quality, amenities, and access to the Millerton Lake SRA and SJRG SRMA, as well as Temperance Flat RM 274 Reservoir (e.g., new Wellbarn Road and Smalley Road boat ramps and associated upgrades to access roads, and a San Joaquin River and Pa'san Ridge trails seasonal water taxi). Inundated recreational facilities and associated utilities would be relocated before demolition, with the exception of facilities identified for abandonment. Additional detail on recreational facilities can be found in the Draft Feasibility Report (Reclamation 2014).

Reservoir Area Utilities

A majority of the infrastructure adjacent to Millerton Lake above RM 274 is located in the Temperance Flat area off Wellbarn Road, and PG&E and BLM facilities off Smalley Road. Utilities in the area include potable water, power distribution, telecommunications, and wastewater facilities. If utilities are impacted by inundation, they would be demolished and relocated (if associated facility is relocated or required to maintain distribution).

Coordination with San Joaquin River Restoration Program

Temperance Flat RM 274 Reservoir would capture San Joaquin River flood flows that would be released from Friant Dam under the No Action Alternative. Reclamation's ability to meet Restoration Flow targets would not change; flood flows that meet Restoration Flow targets in the No Action Alternative would be replaced with managed releases from Friant Dam to meet Restoration Flow targets. Additional managed releases of Restoration Flows from Friant Dam would increase opportunities for downstream recapture pursuant to paragraph 16(a) and reduce the availability of water supply pursuant to paragraph 16(b). All action alternatives include operations of Friant Dam for delivery of new water supplies via the San Joaquin River to Mendota Pool. Under all action alternatives, the following coordination actions with the SJRRP would be included:

- Revise Restoration Flow Guidelines, as necessary
- Revise the Recapture and Recirculation Plan, as necessary
- Revise accounting for Recovered Water Account (RWA) and delivery of water under Paragraph 16b, as necessary
- Coordinate scheduling of releases from Friant Dam for downstream delivery of additional water supply developed by Temperance Flat RM 274 Reservoir
- Coordinate with floodplain habitat planning efforts for Reach 2B and Reach 4B

Reservoir Flood Storage Operations

The existing Flood Control Diagram at Friant Dam specifies that rain flood space increases from zero on October 1 to 170 TAF on November 1, and decreases from 170 TAF on

February 1 to zero on April 1 (USACE 1980). From November 1 to February 1, rain flood space in excess of 85 TAF may be replaced by an equal amount of space in Mammoth Pool. The required total available rain flood control storage and operation rules at Millerton Lake were used for the combined Temperance Flat RM 274 and Millerton Lake analysis to maintain the same level of regulatory rain flood control. The assumption was made that the available rain flood control storage could be in either reservoir, provided the required rain flood control storage space was always available between the two reservoirs. With Millerton Lake generally operated at elevation 550 feet msl (340 TAF) or lower in the action alternatives, the rain flood space requirement of 170 TAF would generally be maintained in Millerton Lake (operated in conjunction with Mammoth Pool). Temperance Flat RM 274 Reservoir could provide incidental additional rain flood storage space if space was available during a rain flood event.

CVP and SWP Operations Criteria

The operations modeling of the action alternatives was based on the Reclamation March 2012 CalSim II Benchmark, which represents operations of the CVP and SWP in accordance with the 2008 USFWS and 2009 NMFS BOs (USFWS 2008, NMFS 2009), and modified to include Temperance Flat RM 274 Reservoir and operations. The operations and requirements under the 2008 USFWS and 2009 NMFS BOs are described in Chapter 3, “Considerations for Describing the Affected Environment and Environmental Consequences,” and in the Modeling Appendix.

Conveyance Facilities Operations

The action alternatives include modifying the timing and quantity of water diverted to Madera and Friant-Kern canals, which would increase water supply reliability to Friant Division contractors and provide opportunities for groundwater banking. Additionally, the action alternatives would improve conjunctive management in the Friant Division of the CVP by increasing incidental groundwater storage and/or recharge with additional Class 2 deliveries.

The action alternatives include existing and foreseeable available cross-valley conveyance capacity in the Cross Valley Canal, Shafter-Wasco/Semitropic Interconnection, and Arvin Edison South Canal. Total capacity is shown in the conveyance schematic in Figure 2-10.

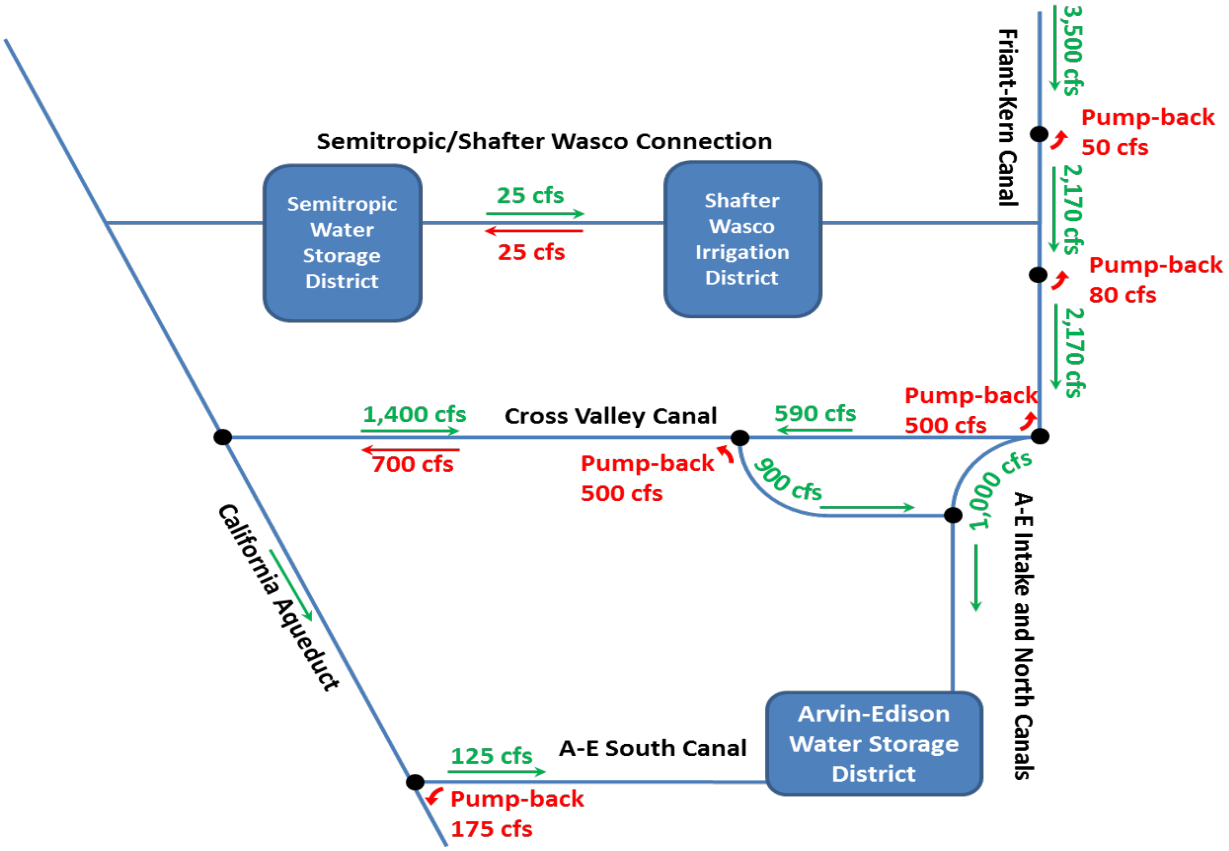
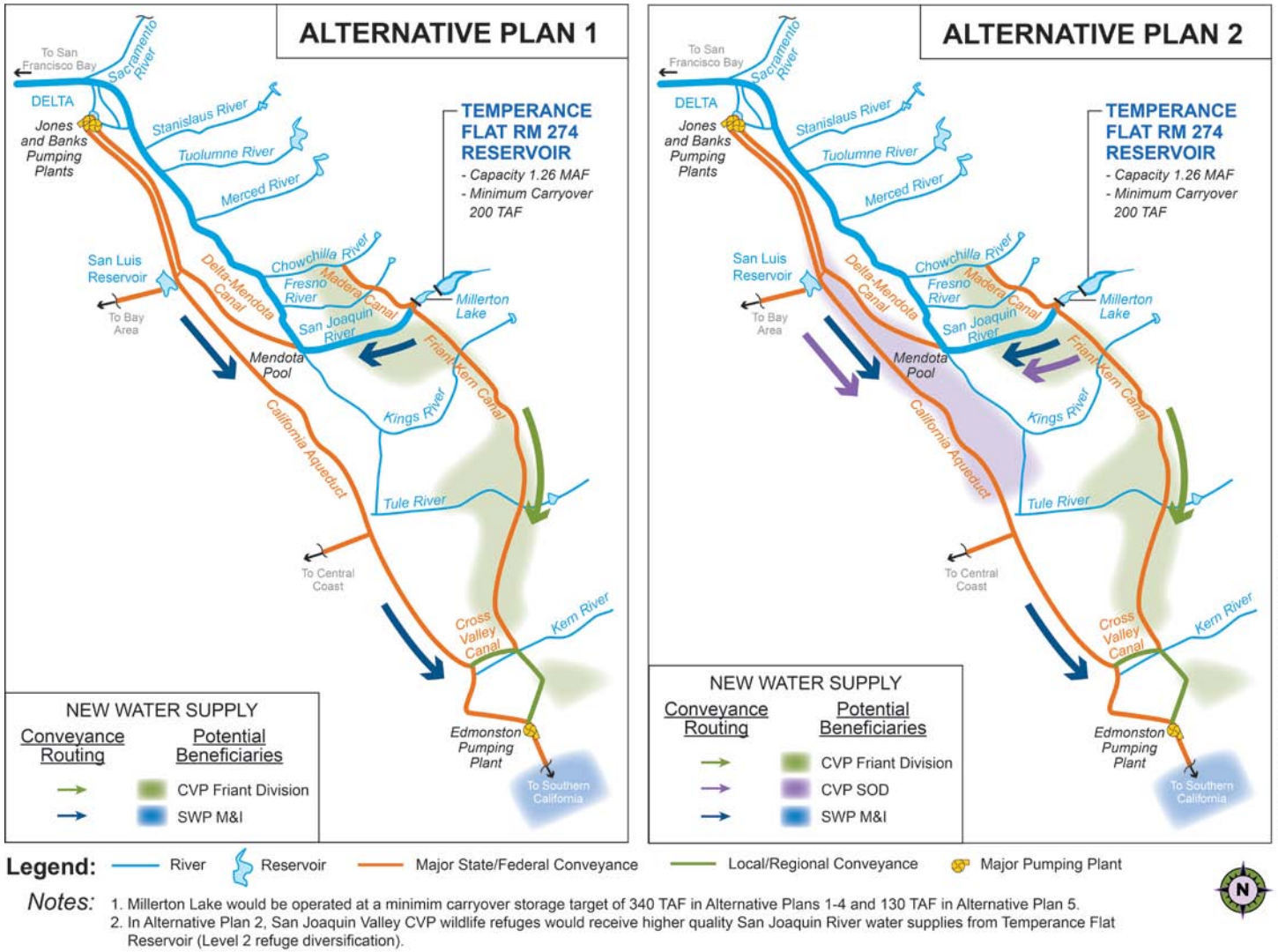


Figure 2-10. Schematic of Major Cross-Valley Conveyance Capacities

Features and Operations Varying Between Action Alternatives

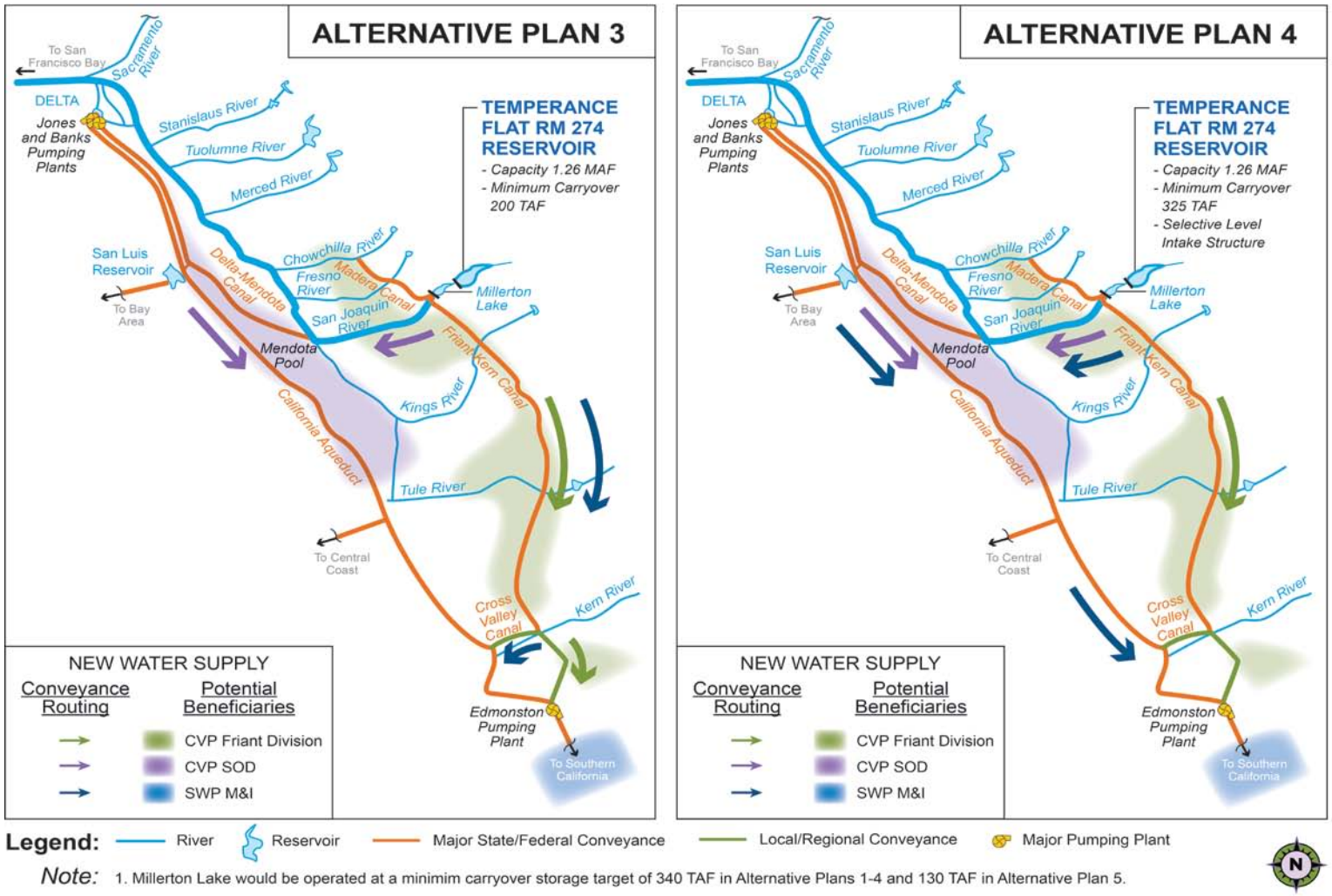
The action alternatives mainly differ in five ways: carryover storage target for Millerton Lake, carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and type of intake structure. Operations for the action alternatives are summarized in Figures 2-11 through 2-13, and Table 2-7.



Key:

Banks Pumping Plant = Harvey O. Banks Pumping Plant
CVP = Central Valley Project
Friant Division = Friant Division of the CVP
Jones Pumping Plant = C.W. "Bill" Jones Pumping Plant
M&I = municipal and industrial
MAF = million acre-feet
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet

Figure 2-11. South-of-Delta Systemwide Operations of Alternative Plans 1 and 2



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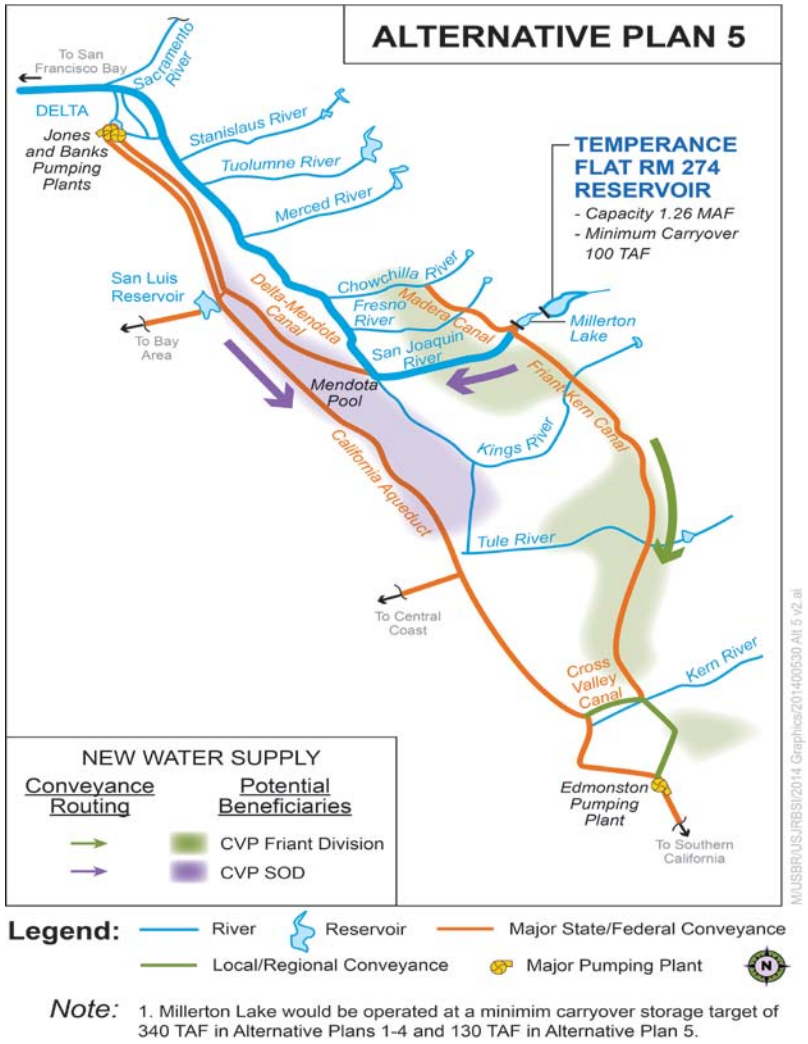
Jones Pumping Plant = C.W. "Bill" Jones Pumping Plant
M&I = municipal and industrial
MAF = million acre-feet
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet

Figure 2-12. South-of-Delta Systemwide Operations of Alternative Plans 3 and 4



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Jones Pumping Plant = C.W. "Bill" Jones Pumping Plant
M&I = municipal and industrial
MAF = million acre-feet
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet

Figure 2-13. South-of-Delta Systemwide Operations of Alternative Plan 5

Table 2-7. Summary of Operations of Action Alternatives

Action Alternative	Conveyance Route to Friant Division of the CVP	Conveyance Route to CVP SOD Contractors	Conveyance Route to SWP SOD M&I Contractors	Millerton Lake Carryover Storage (TAF)	Temperance Flat RM 274 Carryover Storage (TAF)	Intake Structure Type[1]
Alternative Plan 1	Friant-Kern/ Madera Canals	N/A	San Joaquin River[2]	340 TAF	200 TAF	LLIS
Alternative Plan 2	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	San Joaquin River[2]	340 TAF	200 TAF	LLIS
Alternative Plan 3	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	Friant-Kern Canal	340 TAF	200 TAF	LLIS
Alternative Plan 4	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	San Joaquin River[2]	340 TAF	325 TAF	SLIS
Alternative Plan 5	Friant-Kern/ Madera Canals	San Joaquin River[2, 3]	N/A	130 TAF[4]	100 TAF	LLIS

Notes:

[1] SLIS may be used for water temperature management.

[2] Water supply delivered via the San Joaquin River to Mendota Pool could be available for exchange with CVP SOD contractors, CVPIA Level 2 refuge supplies, or San Joaquin River Exchange Contractor supplies.

[3] Alternative Plans 2 through 5 would exchange Temperance Flat RM 274 Reservoir water supply for Level 2 refuges supplies delivered from the Delta, diversifying the CVPIA Level 2 water supply, and freeing up Delta supplies to be delivered to CVP SOD contractors.

[4] Millerton Lake would be operated with a preference for maintaining minimum storage at 340 TAF (when Temperance Flat is not full), but allows for Millerton Lake to be drawn down to 130 TAF when needed for water supply delivery.

Key:

CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
LLIS = low-level intake structure
M&I = municipal and industrial
N/A = not applicable
SWP = State Water Project
SLIS = selective-level intake structure
SOD = South-of-Delta
TAF = thousand acre-feet

Carryover Storage Target for Millerton Lake

The target water surface elevation for Millerton Lake for Alternative Plans 1, 2, 3, and 4 is elevation 550 feet msl (equating to a carryover storage target of 340 TAF). In Alternative Plan 5, Millerton Lake carryover storage is also maintained at 340 TAF, but could be drawn down to 130 TAF as needed for water supply. In all action alternatives, Millerton Lake could still fill all the way to the top of active storage capacity at elevation 580.6 feet msl (450 TAF) when needed in wet years and when Temperance Flat RM 274 Reservoir would also be full. Millerton Lake and Temperance Flat RM 274 Reservoir could be operated jointly and changes in Millerton Lake operations would not affect the ability to manage the joint Millerton Lake Temperance Flat RM 274 Reservoir system for water supply (including providing Restoration Flows) and flood damage reduction.

Carryover Storage Target for Temperance Flat RM 274 Reservoir

The carryover storage target for Temperance Flat RM 274 Reservoir is 200 TAF for Alternative Plans 1 to 3; 325 TAF for Alternative Plan 4; and 100 TAF for Alternative Plan 5.

Beneficiaries of New Water Supply

Temperance Flat RM 274 Reservoir could provide water supply to a range of beneficiaries. The action alternatives illustrate some representative combinations of anticipated beneficiaries based on the strategic location of Temperance Flat RM 274 Reservoir and the Investigation problems, needs, and objectives. Friant Division contractors, other CVP SOD contractors, and SWP SOD M&I contractors are considered beneficiaries in the action alternatives. All action alternatives would deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to the Friant Division of the CVP. Alternative Plans 1, 2, 3, and 4 would also deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to SWP SOD M&I contractors. Alternative Plans 2, 3, 4, and 5 would also deliver new supply to CVP SOD contractors.

Routing of New Water Supply

New supplies to the Friant Division of the CVP would be conveyed via the Friant-Kern and Madera canals in all action alternatives. New water supplies to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool. At Mendota Pool, water would be exchanged with DMC deliveries of Delta supply to Mendota Pool, freeing Delta supplies for delivery to CVP SOD contractors. New water supplies would be delivered to CVP SOD contractors in Alternative Plans 2, 3, 4 and 5. In Alternative Plans 1, 2, and 4, new water supplies to SWP SOD M&I contractors would be routed via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, allowing an equivalent amount of Delta water to be delivered to SWP SOD M&I contractors via the California Aqueduct through another exchange at the San Luis Reservoir Forebay. In Alternative Plan 3, new water supplies to SWP SOD M&I contractors would be delivered through the Friant-Kern Canal and cross-valley conveyance to the California Aqueduct. Water delivered via the San Joaquin River for CVP SOD or SWP SOD M&I exchange with Delta supplies would create flexibility and source diversification for any contractors with access to Mendota Pool (wildlife refuges, CVP SOD contractors, Exchange Contractors).

Intake Structure Configuration

While Alternative Plans 1, 2, 3, and 5 include an LLIS, an SLIS is included in Alternative Plan 4 to provide additional flexibility to manage the cold-water pool and Temperance Flat RM 274 Reservoir release temperatures.

Environmental Commitments Common to All Action Alternatives

Reclamation, its contractors, and/or its construction partners would incorporate certain environmental commitments and best management practices (BMP) into any action alternative identified for implementation to avoid or minimize potential impacts. Reclamation would also coordinate planning, engineering, design and construction, operation, and maintenance phases of any authorized project modifications with applicable resource agencies.

The following environmental commitments are included in all of the action alternatives for project-related construction activities.

Develop and Implement Construction Management Plans

Reclamation, its contractors, and/or its construction partners would develop and implement construction management plans to avoid or minimize potential impacts on public health and safety during project construction, to the greatest extent feasible. The construction management plans would inform contractors and subcontractors of work hours; modes and locations of transportation and parking for construction workers; location of overhead and underground utilities; worker health and safety requirements; truck routes; stockpiling and staging procedures; public access routes; terms and conditions of all project permits and approvals; and emergency response services contact information.

The construction management plans would also include construction notification procedures for the police, public works, and fire department in the cities and counties where construction would occur. Notices would also be distributed to neighboring property owners. The health and safety component of the construction management plans would be monitored for the implementation of the plan on a day-to-day basis by Certified Industrial Hygienists.

Comply with Permit Terms and Conditions

If any action alternative was approved and authorized for construction, Reclamation would require its contractors and

suppliers, its general contractor, and all of the general contractor's subcontractors and suppliers to comply with all of the terms and conditions of all required project permits, approvals, and conditions attached thereto. If necessary, additional information (e.g., detailed designs and additional documentation) would be prepared and provided for review by decision makers and the public. Reclamation would ultimately be responsible for the actions of its contractors in complying with permit conditions. Compliance with applicable laws, policies, and plans for this project is discussed in Chapter 1, "Introduction," and Chapter 28, "Other NEPA and CEQA Conditions."

Provide Relocation Assistance through Federal Relocation Assistance Program

All Federal, State, and local government agencies, and others receiving Federal financial assistance for public programs and projects that require the acquisition of real property must comply with the policies and provisions set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act) (49 CFR 24). All relocation and property acquisition activities, such as those associated with temporary easements during construction or condemnation for permanent changes in the Study Area, would be performed in compliance with the Uniform Act. Any individual, family, or business displaced by implementation of any action alternative would be offered relocation assistance services for the purpose of locating a suitable replacement property, to the extent consistent with the Uniform Act.

Under the Uniform Act, relocation services for residences would include providing a determination of the housing needs and desires, a determination of the amount of replacement housing each individual or family qualifies for, a list of comparable properties, transportation to inspect housing referrals, and reimbursement of moving costs and related expenses. For business relocation activities, relocation services would include providing a determination of the relocation needs and requirements; a determination of the need for outside specialists to plan, move, and reinstall personal property; advice as to possible sources of funding and assistance from other local, State, and Federal agencies; listings of commercial properties, and reimbursement for costs incurred in relocating and reestablishing the business. No relocation payment received would be considered as income for the purpose of the Internal Revenue Code.

Develop and Implement Comprehensive Mitigation Strategy

Reclamation would develop and implement a comprehensive mitigation strategy (CMS) to minimize potential impacts to physical, biological, and socioeconomic resources described in this Draft EIS. The CMS described in this section is still under development at this stage in the planning process. The CMS is being developed consistent with the guidance provided in CEQ Regulations for Implementing Procedural Provisions of NEPA (40 CFR Parts 1500–1508). The CMS is intended to minimize the potential adverse impacts associated with action alternatives described in this chapter, as required under NEPA.

The CMS will be multi-faceted in terms of spatial and temporal scales. Based on the nature of some impacts described in this DEIS, the CMS may include one or more of the following types of mitigation as defined under CEQ Guidelines, Section 1508.20–Mitigation:

- Avoiding the impact altogether by not taking a certain action or parts of an action
- Minimizing the impact by limiting the degree or magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

At this stage in the planning process, the following components are being considered for the CMS:

- Land acquisition
- Conservation easements
- Upland habitat improvements
- Wetland mitigation
- Riparian habitat improvements (riparian reserves)

- Aquatic habitat improvements (river and tributaries)
- Water quality actions (metals, temperature, sediment)
- Visuals and aesthetics actions

Reclamation will address CEQ's guidance on establishing, implementing, and monitoring mitigation, which specifies that when environmental analyses are premised on commitments to mitigate environmental impacts of action alternatives, agencies should adhere to those commitments during project implementation and monitor the implementation and effectiveness of mitigation (CEQ 2011). The CMS will incorporate elements intended to comply with these requirements, specifically those requirements directing agencies to also publicly report on these efforts. The CMS, including a framework for mitigation implementation and monitoring, will be included in the Final EIS.

Develop and Implement Resource Management Plan

Reclamation would lead development of an RMP, in collaboration with BLM and State Parks, for the Temperance Flat RM 274 Reservoir area and lands potentially affected by implementation of action alternatives. The RMP would be prepared as a long-term plan to coordinate management of resources in the area and define the roles and responsibilities of each agency. The RMP would include establishment of management objectives, guidelines, and actions to achieve an integrated long-term vision for recreation and development, as well as resource protection and enhancement, within the reservoir area.

Example management objectives currently addressed by the Millerton Lake RMP/General Plan (Reclamation and State Parks 2010) that may be applicable for implementation of the action alternatives include:

- Enhancing natural resources and recreational opportunities without interruption of reservoir operations
- Providing recreational opportunities to meet the demands of a growing, diverse population
- Ensuring recreational diversity and quality

- Protecting natural, cultural, and recreational resources, and providing resource education opportunities and good stewardship

- Providing management considerations for establishing management agreements

Cultural Resources

If a project was authorized, Reclamation would implement regulations at 36 CFR Part 800 to identify historic properties (including traditional cultural properties, sacred sites, and sacred areas, as appropriate), assess effects, and resolve adverse effects through the consultation process. Consulting parties for the National Historic Preservation Act Section 106 process would include the State Historic Preservation Office (SHPO), the Advisory Council on Historic Preservation (if it chose to participate), other Federal agencies where applicable, tribal representatives, and other interested parties (including non-Federally recognized Native Americans, members of the public, and other State or local agencies) to develop methods to avoid, minimize, or mitigate adverse effects. Measures to avoid, minimize, or mitigate adverse effects would be funded through the project. Reclamation could enter into a Programmatic Agreement with the Advisory Council on Historic Preservation (if it chose to participate), the SHPO, and other consulting parties that would identify how the Section 106 process would be completed for the authorized project. The Programmatic Agreement could include alternative methods for compliance or phased identification efforts/phased finding of effects efforts, as agreed upon with the consulting parties. Any human remains, funerary objects, sacred objects, or objects of cultural patrimony that were removed from federally managed or tribal lands during any project activities would be treated consistent with the Native American Graves Protection and Repatriation Act (NAGPRA). If human remains were removed from non-federally managed lands, they would be subject to the PRC regarding the treatment of human remains outside a dedicated cemetery.

To further avoid, minimize, or mitigate adverse effects to cultural resources, Reclamation would implement the following actions, as part of the Section 106 process or independently:

- Develop a Cultural Resources Data Recovery Plan.

- Conduct subsurface archaeological investigations before ground disturbing activities.
- Stop work for discovery of previously undiscovered cultural resources during project construction.
- Stop potentially damaging work if human remains are uncovered during construction.
- Reduce through the Secretary of the Interior Standards to Heritage Documentation Programs (HDP) standards for buildings that are listed, or are eligible for listing, on the National Register of Historic Places.

These actions are further described below.

Develop a Cultural Resources Data Recovery Plan If feasible, Reclamation would protect cultural resources in place. If resources cannot be protected in place, Reclamation would implement data recovery consistent with 14 CCR Section 15126.4(b)(3)(c) and with the guidelines set forth in the Secretary of Interior's standards and guidelines (Standards I through IV). CCR Section 15126.4(b)(3)(c) states that a data recovery plan shall be prepared and adopted before any excavation is undertaken. Because the historical significance of most archaeological sites lies in their potential to contribute to scientific research, the data recovery plan would make provision for adequately recovering the scientifically consequential data from and about the historical resource.

The Secretary of Interior's standards include following an explicit statement of objectives and employing methods that respond to needs identified in the planning process; using methods and techniques of archaeological documentation (data recovery) selected to obtain the information required by the statement of objectives; assessing the results of the archaeological documentation against the statement of objectives and integrating them into the planning process; and reporting and making public the results of the archaeological documentation. To this end, data recovery findings would be documented in a data recovery report, which would follow guidelines set forth by SHPO for such reports.

Conduct Subsurface Archaeological Investigations Before Ground Disturbing Activities Before ground disturbing activities, Reclamation would conduct subsurface investigations (i.e., archeological testing) for undiscovered

cultural resources in the portions of the primary study area for the project elements that are identified as having moderate to high potential for undiscovered subsurface cultural resources.

The Archaeological Resources Protection Act of 1979 (Public Law 95-96) would be followed to protect archaeological resources and sites that are located on public lands. The act makes it unlawful to excavate, remove or deface archaeological resources, to sell, purchase, or exchange those resources without applicable permit, and establishes criminal and civil penalties for any such violation.

In accordance with the Archaeological and Historic Preservation Act, Reclamation would prevent irreparable loss or destruction of significant scientific, prehistorical, historical, or archeological data involving activities in connection with any Federal construction project or federally-licensed project, activity, or program through the recovery, protection, and preservation of such data, including preliminary survey or other investigation as needed.

Stop Work for Discovery of Previously Undiscovered Cultural Resources During Project Construction If previously undiscovered cultural resources (e.g., unusual amounts of shell, animal bone, bottle glass, ceramics, structure/building remains, etc.) are discovered during ground-disturbing activities, Reclamation would authorize the construction contractor to stop work in that area and within 100 feet of the find until a qualified archaeologist can assess the significance of the find according to NRHP and, if applicable, CEQA (including CRHR) criteria. If necessary, Reclamation would develop appropriate treatment measures for significant and potentially significant resources which may include, but would not be limited to, no action (i.e., resources determined not to be significant), avoidance of the resource through changes in construction methods or project design, and implementing a program of testing and data recovery, in accordance with PRC Section 21083.2. This action would ensure proper identification and treatment of any significant cultural resources uncovered as a result of project-related ground disturbance and would reduce the potential impact resulting from inadvertent damage or destruction of unknown cultural resources during construction.

Stop Potentially Damaging Work if Human Remains are Uncovered During Construction Any human remains, funerary objects, sacred objects, or objects of cultural

patrimony that were uncovered on federally managed lands during any project activities would be treated consistent with the NAGPRA. If human remains or associated items of patrimony were uncovered on non-federally managed lands, they would be subject to the California Health and Safety Code Section 7050.5 and Section 7052 and California PRC Section 5097, regarding the treatment of human remains outside a dedicated cemetery.

In accordance with the NAGPRA, if any human remains, funerary objects, sacred objects, or objects of cultural patrimony are uncovered on federally managed lands during ground-disturbing activities, including construction, all such activity would cease in the area of the discovery. Reclamation would make a reasonable effort to protect the items discovered before resuming such activity, and provide notice in writing to the Secretary of the department having primary management authority of the land. Following the notification, and upon certification by the Secretary of the department or the appropriate Indian tribe that notification has been received, the activity may resume after 30 days of the certification.

Reclamation would provide any Native American human remains uncovered on federally management lands to the lineal descendants of the Native American. If such lineal descendants cannot be ascertained, and in the case of unassociated funerary objects, sacred objects, and objects of cultural patrimony, Reclamation would provide the remains or objects to the Indian tribe which has the closest cultural or aboriginal affiliation with such remains or objects and which states a claim for such remains or objects. Native American cultural items not claimed would be disposed of in accordance with regulations promulgated by the Secretary, Native American groups, representatives of museums, and the scientific community.

California law recognizes the need to protect interred human remains, particularly Native American burials and associated items of patrimony, from vandalism and inadvertent destruction. The procedures for the treatment of discovered human remains are contained in California Health and Safety Code Section 7050.5 and Section 7052 and California PRC Section 5097.

In accordance with the California Health and Safety Code, if human remains are uncovered on non-federally managed lands during ground-disturbing activities, including construction, and all such activities within a 100-foot radius of the find would be

halted immediately and a designated representative would be notified. The representative would immediately notify the county coroner and a qualified professional archaeologist. The coroner is required to examine all discoveries of human remains within 48 hours of receiving notice of a discovery on private or state lands (Health and Safety Code Section 7050.5[b]).

If the coroner determines that the remains are those of a Native American, he or she must contact the Native American Heritage Commission (NAHC) by phone within 24 hours of making that determination (Health and Safety Code Section 7050[c]). The NAHC would contact the persons it believes to be most likely descended from the deceased Native American. The most likely descendant, in cooperation with the property owner and Reclamation, shall determine the ultimate disposition of the remains in accord with the provisions of California PRC Section 5097.98. If NAHC cannot identify any likely descendants, if the most likely descendant fails to make a recommendation, or Reclamation disagrees with the recommendation and mediation fails to resolve the issue, then Reclamation would reinter the human remains with appropriate dignity on a part of the property not subject to further subsurface disturbance, as is specified in Section 5097.98(b) and 14 CCR Section 1064.5(e)(2).

Reduce through the Secretary of the Interior Standards to HDPs standards for buildings that are listed, or are eligible for listing, on the National Register of Historic Places. Under the provisions of Sections 106 and 110b of the amended National Historic Preservation Act of 1966, Federal agencies must produce documentation to HDPs standards for buildings that are listed, or are eligible for listing, on the National Register of Historic Places, to reduce the adverse effects of federal actions such as demolition or substantial alteration. National Park Service regional offices oversee this aspect of HDP documentation, which is submitted to the Washington, D.C., office for final review and inclusion in the collections for the Historic American Buildings Survey, Historic American Engineering Record and the Historic American Landscapes Survey.

Develop and Implement Stormwater Pollution Prevention Plan

Any project authorized for construction would be subject to construction-related stormwater permit requirements of the Federal CWA National Pollutant Discharge Elimination

System program. Reclamation would obtain any required permits through the Central Valley Water Board before conducting any ground-disturbing construction activity. According to the requirements of Section 402 of the CWA, Reclamation, its contractors, and/or its construction partners would prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) before construction, identifying BMPs to prevent or minimize erosion and the discharge of sediments and other contaminants with the potential to affect beneficial uses or lead to violations of water quality objectives of surface waters.

The SWPPP would include site-specific structural and operational BMPs to prevent and control impacts on runoff quality, and measures to be implemented before, during, and after each storm event. BMPs would also control short-term and long-term erosion and sedimentation effects, and stabilize soils and vegetation in areas affected by construction activities (i.e., erosion and sediment control plan). The SWPPP would contain a site map that shows the construction site perimeter, existing and proposed buildings, lots, roadways, stormwater collection and discharge points, general topography both before and after construction, and drainage patterns across the project. Additionally, the SWPPP would need to contain a visual monitoring program, a chemical monitoring program for "nonvisible" pollutants to be implemented if a BMP fails, and a sediment monitoring plan if the site discharges directly to a water body listed on the CWA 303(d) list for sediment. BMPs for the project could include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, sediment basins, sandbag barriers, silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

Develop and Implement Spill Prevention and Hazardous Materials Management Measures As part of the SWPPP, Reclamation, its contractors, and/or its construction partners would develop and implement a spill prevention and control plan to minimize effects from spills of hazardous, toxic, or petroleum substances for project-related construction activities occurring in or near waterways. The accidental release of chemicals, fuels, lubricants, and nonstorm drainage water into water bodies would be prevented to the extent feasible. Spill prevention kits would always be in close proximity when hazardous materials would be used (e.g., crew trucks and other logical locations). Feasible measures would be implemented so that hazardous materials would be properly handled and the

quality of aquatic resources would be protected by all reasonable means during work in or near any waterway. No fueling would be done within the ordinary high-water mark, immediate floodplain, or full pool inundation area, unless equipment stationed in these locations could not be readily relocated. Any equipment that could be readily moved out of the water body would not be fueled in the water body or immediate floodplain. As for stationary equipment, for all fueling done at the construction site, containments would be installed so that any spill would not enter the water, contaminate sediments that may come in contact with the water, or damage wetland or riparian vegetation. Any equipment that could be readily moved out of the water body would not be serviced within the ordinary high-water mark or immediate floodplain.

Additional BMPs designed to avoid spills from construction equipment and subsequent contamination of waterways would also be implemented. These could include, but would not be limited to, the following:

- Storage of hazardous materials in double-containment and, if possible, under a roof or other enclosure
- Disposal of all hazardous and nonhazardous products in a proper manner
- Monitoring of on-site vehicles for fluid leaks and regular maintenance to reduce the chance of leakage
- Containment (using a prefabricated temporary containment mat, a temporary earthen berm, or other measure can provide containment) of bulk storage tanks

Haulers delivering materials to the project site would be required to comply with regulations on the transport of hazardous materials codified in 49 CFR 173, 49 CFR 177, and CCR Title 26, Division 6. These regulations provide specific packaging requirements, define unacceptable hazardous materials shipments, and prescribe safe-transit practices, including route restrictions, by carriers of hazardous materials.

Fisheries Conservation

The measures discussed below would be implemented to minimize potential adverse effects on fish species.

Implement In-Water Construction Work Windows
Reclamation would identify and implement feasible in-water construction work windows in consultation with USFWS and CDFW. In-water work windows would be timed to occur when sensitive fish species were not present or would be least susceptible to disturbance (e.g., July through September).

Monitor Construction Activities A qualified biologist would monitor potential impacts to important fishery resources throughout all phases of project construction. Monitoring might not be necessary during the entire duration of the project if, based on the monitor's professional judgment (and with concurrence from Reclamation), a designated onsite contractor would suffice to monitor such activities and would agree to notify a biologist if aquatic organisms are in danger of harm. However, the qualified biologist would need to be available by phone and Internet and be able to respond promptly to any problems that arose.

Perform Fish Rescue/Salvage If spawning activities for sensitive fish species were encountered during construction activities, the biologist would be authorized to stop construction activities until appropriate corrective measures were completed or it was determined that the fish would not be harmed.

A qualified biologist would identify any fish species that may be affected by the project. The biologist would facilitate rescue and salvage of fish and other aquatic organisms that become entrapped within construction structures and cofferdam enclosures in the construction area, as appropriate. Any rescue, salvage, and handling of listed species would be conducted under appropriate authorization (i.e., incidental take statement/permit for the project, Federal ESA Section 4(d) scientific collection take permit, or a Memorandum of Understanding). If fish were identified as threatened with entrapment in construction structures, construction would be stopped and efforts made to allow fish to leave the project area before resuming work. If fish were unable to leave the project area of their own volition, then fish would be collected and released outside the work area. Fish entrapped in cofferdam enclosures would be rescued and salvaged, as appropriate, before the cofferdam area was completely dewatered. Appropriately sized fish screens would be installed on the suction side of any pumps used to dewater in-water enclosures.

Reporting A qualified biologist would prepare a letter report detailing the methodologies used and the findings of fish monitoring and rescue efforts. Monitoring logs would be maintained and provided, with monitoring reports. The reports would contain, but not be limited to, the following: summary of activities; methodology for fish capture and release; table with dates, numbers, and species captured and released; photographs of the enclosure structure and project site conditions affecting fish; and recommendations for limiting impacts during subsequent construction phases, if appropriate.

Water Quality Protection

The measures discussed below would be implemented to minimize potential adverse effects to water quality.

Implement In-Water Construction Work Windows All in-water construction activities along the San Joaquin River would be conducted during months when instream flows were managed outside the flood season (e.g., July to September).

Comply with All Water Quality Permits and Regulations Project activities would be conducted to comply with all additional requirements specified in permits relating to water quality protection. Relevant permits anticipated to be obtained for the proposed action include a California Fish and Game Code 1602 Lake and Streambed Alteration Agreement, CWA Section 401 certification, and CWA Section 404 compliance through USACE.

Implement Water Quality Best Management Practices BMPs that would be implemented to avoid and/or minimize potential impacts associated with dam construction are described below.

Minimize Potential Impacts Associated with Equipment Contaminants For in-river work, all equipment would be steam-cleaned daily to remove hazardous materials before the equipment entered the water.

Minimize Potential Impacts Associated with Access and Staging Existing access roads would be used to the greatest extent possible. Equipment staging areas would be located outside of the San Joaquin River ordinary high water mark or the Friant Dam full pool inundation area, and away from sensitive resources.

Remove Temporary Fills as Appropriate Temporary fill for access, side channel diversions, and/or side channel cofferdams, would be completely removed after completion of construction.

Remove Equipment from River Overnight and During High Flows Construction contractors would remove all equipment from the river at the end of the workday. Construction contractors would also monitor Reclamation's Central Valley Operations Office Web site daily for forecasted flows posted there to determine and anticipate any potential changes in releases. If flows were anticipated to inundate a work area that would normally be dry, the contractor would immediately remove all equipment from the work area.

Revegetation Plan

Reclamation, in conjunction with cooperating agencies and private landowners, would prepare a comprehensive revegetation plan to be implemented in conjunction with other management plans (e.g., SWPPP). This plan would apply to any area included as part of an action alternative, such as inundation, relocation, or mitigation activities. Overall objectives of the revegetation plan would be to reestablish native vegetation to control erosion, provide effective ground cover, minimize opportunities for nonnative plant species to establish or expand, and provide habitat diversity over time. Reclamation would work closely with cooperating agencies, private landowners, and revegetation specialists to develop the sources of native vegetation, site-specific planting patterns and species assemblages necessary for a revegetation effort of this magnitude.

Invasive Species Management

Reclamation would develop and implement a control plan to prevent the introduction of zebra/quagga mussels (*Dreissena rostriformis bugensis*), invasive plants, and other invasive species to project areas. The control plan would cover all workers, vehicles, watercraft, and equipment (both land and aquatic) that would come into contact with Millerton Reservoir, the shoreline of Millerton Reservoir, the San Joaquin River, and any riverbanks, floodplains, or riparian areas (Reclamation 2012). Plan activities could include, but would not be limited to, the following:

- Pre-inspection and cleaning of all construction vehicles, watercraft, and equipment before being shipped to project areas

- Reinspection of all construction vehicles, watercraft, and equipment on arrival at project areas

- Inspection and cleaning of all personnel before work in project areas

All inspections would be conducted by trained personnel and would include both visual and hands-on inspection methods of all vehicle and equipment surfaces, up to and including internal surfaces that have contacted raw water.

Approved cleaning methods would include a combination of the following:

- **Precleaning** – Draining, brushing, vacuuming, high-pressure water treatment, thermal treatment

- **Cleaning** – Freezing, desiccation, thermal treatment, high-pressure water treatment, chemical treatment

Onsite cleanings would require capture, treatment, and/or disposal of any and all water needed to conduct cleaning activities.

Construction Material Disposal

Reclamation's contractors would take measures to recycle or reuse demolished materials, such as steel or copper wire, concrete, asphalt, and reinforcing steel, as required and where practical. Other demolished materials would be disposed of in local or other identified permitted landfills in compliance with applicable requirements.

To reduce the risk to construction workers, the public, and the environment associated with exposure to hazardous materials and waste, Reclamation would implement the following:

- A Hazardous Materials Business Plan would be developed and implemented to provide information regarding hazardous materials to be used for project implementation and hazardous waste that would be generated. The Hazardous Materials Business Plan would also define employee training, use of protective equipment, and other procedures that provide an adequate basis for proper handling of hazardous materials to limit the potential for accidental releases of and exposure to hazardous materials. All procedures for

handling hazardous materials would comply with all Federal, State, and local regulations.

- Soil to be disposed of at a landfill or recycling facility shall be transported by a licensed waste hauler.

- All relevant available asbestos survey and abatement reports and supplemental asbestos surveys would be reviewed. Removal and disposal of asbestos-containing materials would be performed in accordance with applicable Federal, State, and local regulations.

- A lead-based paint survey would be conducted to determine areas where lead-based paint is present and the possible need for abatement before construction or demolition.

Asphalt Removal

Per California Fish and Game Code 5650 Section (a), all asphaltic roadways and parking lots inundated by project implementation would be demolished and removed according to Fresno County or Madera County standards, as applicable. Asphalt would be disposed of at an approved and permitted waste facility. Dirt roads inundated by project implementation may remain in place.

Reduce Fugitive Dust Emissions

Reclamation, its contractors, and/or its construction partners would comply with Regulation VIII. Construction activities would not commence until SJVAPCD has approved the plan. Reclamation, its contractors, and/or its construction partners would also implement the following SJVAPCD-recommended enhanced and additional control measures to further reduce fugitive dust emissions:

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from adjacent project areas with a slope greater than 1 percent

- Suspend excavation and grading activity when winds exceed 20 miles per hour

- Limit area subject to excavation, grading, and other construction activity at any one time

Fire Protection and Prevention Plan

Reclamation, its contractors, and/or its construction partners would prepare and implement a fire protection and prevention plan, addressing the following topics (found in 29 CFR 1926.150), to minimize the risk of wildfire or threat to workers, property, and the public:

- Dispensing of flammable/combustible liquids
- Welding and cutting
- Use, storage, and transport of compressed gas cylinders
- Managing open and enclosed storage yards or facilities
- Fire prevention measures
- Fire emergency response

Action Alternative Construction Activities and Schedule

Various technical assessments of activities, methods, and material production rates were conducted to support the construction schedule for project features. Construction activities and schedules were based on design drawings, quantities, and cost estimate information documented in the Draft Feasibility Report (Reclamation 2014). The activities and schedule described in this section give specific attention to high-risk activities and sequencing related to the diversion works needed to start and complete dam construction.

Construction activities under all action alternatives would include the following work breakdown phases:

- **Phase 1** – Site work, tunnel, and marine phase. A subcategory of Phase 1, Phase 1b, would include a mitigation period, if needed, to address significant risk related to establishing stable and sufficiently tight cofferdams.
- **Phase 2** – Powerhouse/valve house and intake phase
- **Phase 3** – Dam/reservoir phase

Construction phases are based on construction timing and feature proximity. The detailed breakdown for each phase is

shown in Figure 2-14. Additional details are in the Draft Feasibility Report (Reclamation 2014).

The schedule for phases and activities is preliminary and was developed to analyze the technical, economic, and financial feasibility in the separate Draft Feasibility Report, and for the analysis of impacts and development of mitigation measures for this Draft EIS. Revisions may occur through the planning, environmental, permitting, final design, and contracting processes.

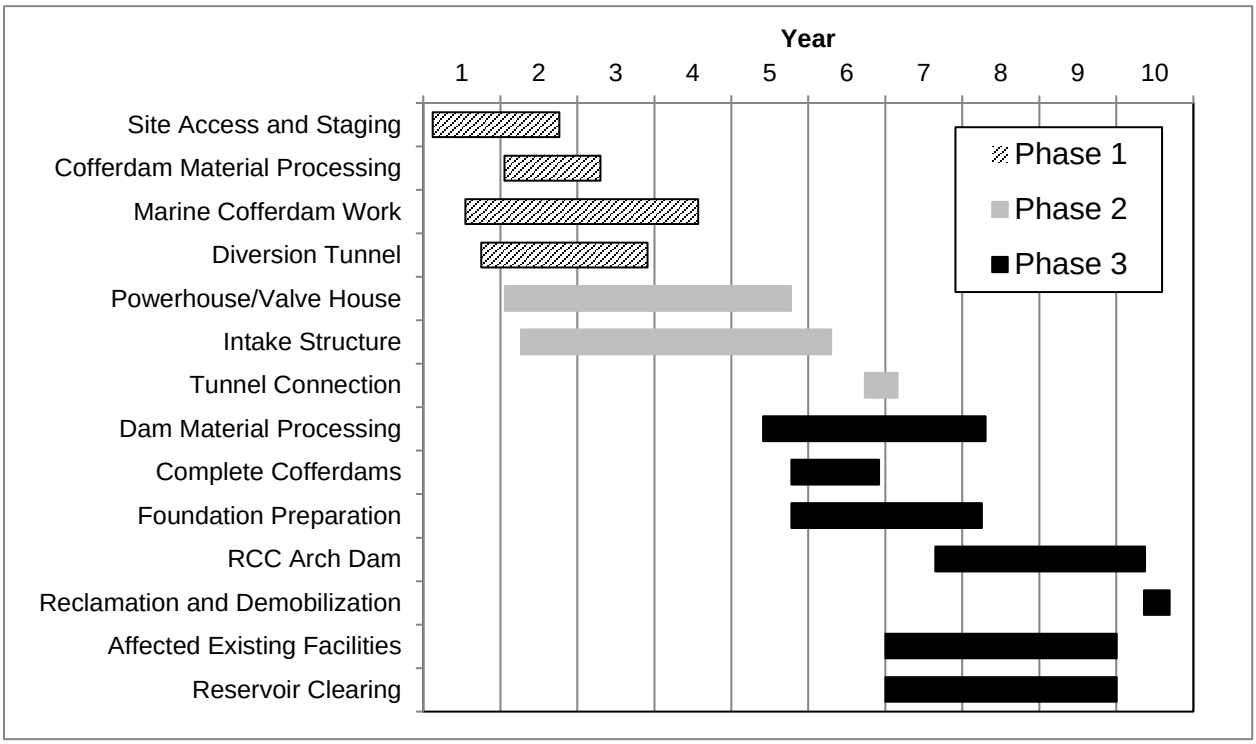

Figure 2-14. Preliminary Construction Activities and Schedule

Phase 1 – Sitework, Marine Phase, and Tunnel

Phase 1 would include activities preceding the main dam construction such as initial site access and contractor use area staging, material processing, and underwater cofferdam construction, and diversion tunnel construction. Estimates of fuel use, equipment use, and truck trips for Phase 1 activities are in the Draft Feasibility Report (Reclamation 2014).

Site Access and Staging This activity would include constructing haul and access roads, and developing the quarry, batch plant sites, and staging area. Embankment material would consist of excavation material, with the remaining waste

excavation being stored at the quarry, staging area, or tunnel waste area. As scheduled, site access and staging construction activities would last 16 months.

The new Temperance Flat transmission line would be constructed along approximately 4.42 miles from the existing Kerckhoff-Sanger 115 kilovolt (kV) line to the proposed Temperance Flat powerhouse switch yard. The line would be constructed using 31 predominately steel monopoles with steel-reinforced, drilled concrete piers. A temporary transmission line would be built from the powerhouse site east to the inundation area. Temporary lines would then run through the inundation area to provide power at the quarry, batch plant sites, and other construction areas.

Cofferdam Material Processing Quarry operations in Phase 1 would include processing 2,691 thousand cubic yards of material for the rockfill cofferdams. Processing would include crushing rock to obtain the fine rockfill, and quarrying to a maximum size, to obtain the larger rockfill. Material with impervious characteristics could be borrowed from the area or, alternatively, a clayey import may be blended with some quarried and crushed well-graded gravel. Cofferdam material processing would last 15 months.

Marine Cofferdam Work Phase 1 would include marine or underwater construction of both cofferdams. The cofferdam foundations and trenches would be constructed and prepared using clamshell barges and underwater drill-and-blast techniques. Waste material would be placed in the quarry via truck and potentially processed into construction material.

Below elevation 535 feet msl, materials would be placed using clamshell placement supplemented by higher production bottom-dump barges. Trucks would transport material from the quarry to the clamshells/barges. Central low zones 300 to 500 feet wide across the river and at elevation 528 feet msl, would allow river passage through Millerton Lake until a cofferdam closure was made and the river was diverted. Once the cofferdams were at elevation 535 feet msl and the diversion tunnel was complete, including the approach and discharge chute excavations, the cofferdam closures would be placed to above elevation 535 feet msl, thereby diverting the river through the diversion tunnel. The diversion would only be initiated at this point if the water surface was low enough in the September-through-January low-level period.

Upon successfully diverting the river through the diversion tunnel, the area between the partial cofferdams would be unwatered and observed for stability and seepage. Marine cofferdam excavation and material placement would last 13 months. Total marine cofferdam activities, including staging, construction, dewatering, observation, and cleanup, would last 37 months.

Diversion Tunnel The diversion tunnel and portals would be constructed using excavators and drill-and-blast techniques. Waste material would be placed in the tunnel waste area via truck. The tunnel would then be lined with concrete. Until the tunnel was completed and the project was prepared for diversion, the reservoir banks upstream from the intake portal and downstream from the tunnel discharge portal would be left in place to protect the diversion tunnel from flooding during construction. Other assumptions are detailed in the Draft Feasibility Report (Reclamation 2014). Diversion tunnel construction would last 26 months.

Phase 2 – Powerhouse/Valve House and Intake Construction

Phase 2 would include activities to construct the Temperance Flat Powerhouse/Valve House and intake structure (LLIS or SLIS). All structures would then be connected to the diversion tunnel to complete the river outlet works. Estimates of fuel use, equipment use, and truck trips for Phase 2 activities are in the Draft Feasibility Report (Reclamation 2014).

Powerhouse/Valve House A 200-square-foot work pad would be constructed next to the powerhouse excavation for staging. A small access road would be built to tie into proposed access/haul roads. Excavation construction of the powerhouse and valve house would occur simultaneously. A small cofferdam would be used for powerhouse tailrace and valve house chute construction. The bottom of the powerhouse would be constructed during low-water periods in Millerton Lake. The higher portion of the powerhouse (above elevation 580 feet msl) and most of the valve house are outside the influence of Millerton Lake levels and would be constructed during remaining periods of the year.

Construction would include extensive excavation for both structures and access road. Excavated material would be either disposed of in the diversion tunnel waste area or be used for infill or aggregate in powerhouse and valve house construction. Reinforced, cast-in-place concrete would be used for

powerhouse and valve house structures. Cement, penstock steel, and other materials would be trucked from Fresno, California railyards via North Friant, Millerton, and Sky Harbor roads.

After construction was completed, riprap would be placed along the upstream and downstream sides of the structure to topographically tie existing ground contours to the structure, and to aid in erosion control. Temporary features that would be decommissioned once construction was complete include scaffolding and the construction staging pad. The area would be restored and revegetated. Powerhouse/valve house construction would last 45 months.

Intake Structure A 200-square-foot work pad would be constructed at the ridge above the intake (LLIS or SLIS) for staging. A small access road would be built to tie into proposed access/haul roads. The cofferdam used to construct the diversion tunnel was anticipated to be used for intake construction. The bottom of the intake would be constructed during low-water periods in Millerton Lake. The higher portion of the intake (above elevation 580 feet msl) would be outside the influence of Millerton Lake levels and would be constructed during remaining periods of the year.

Intake construction would include extensive excavation for both the structure and access road. Excavated material would be either disposed of in the inundation area or be used for construction aggregate. Cement, rebar, and other materials would be trucked from Fresno, California, rail yards via North Friant, Millerton, and Sky Harbour roads.

After intake construction was complete, riprap would be placed along the upstream and downstream sides of the structure to topographically tie the existing ground contours to the structure and to aid in erosion control. Temporary features that would require decommissioning once construction is complete would include scaffolding and the construction staging pad, which would be removed and the area restored and revegetated. Intake structure construction would last 49 months.

Tunnel Connection A crossover tunnel would be constructed once the dam was completed to connect the intake structure with the diversion tunnel. A concrete tunnel plug would be installed in the upstream end of the diversion tunnel, followed by controlled blasting techniques to excavate a tunnel from the base of the intake structure to the diversion/power tunnel

downstream from the concrete plug. Excavation would be followed by concrete lining of the tunnel. The powerhouse/valve house penstock would also be connected to the diversion tunnel at this time. The tunnel connection work would last 5 months.

Phase 3 – Dam and Reservoir Construction

Phase 3 would include activities to process construction materials, such as aggregate from the quarry, complete the cofferdams to elevation 580 feet msl, prepare the dam foundation, construct the RCC dam, and reclaim and demobilize the construction site. Estimates of fuel use, equipment use, and truck trips for Phase 3 activities are in the Draft Feasibility Report (Reclamation 2014).

Dam Material Processing Quarry operations in Phase 3 would include processing 6.9 million tons of aggregate. Large primary, multiple secondary, and multiple tertiary crushing units would be needed both for production and for particle shaping and sizing. Aggregate would be transported to the batch plant via truck for all quarry, batch plant, and haul road options. Aggregate production would last 25 months, but total material processing, from mobilization to shutdown, would be 35 months.

Complete Cofferdams Dry cofferdam construction would complete the cofferdams to elevation 580 feet msl. Trucks would transport material from the quarry to the cofferdams. Final cofferdam construction would last 14 months.

Foundation Preparation The dam foundation would be prepared using excavators and drill-and-blast techniques. Waste material would be placed and potentially processed into construction material in the quarry area via trucks. Cement, pozzolan, and metal for the foundation and dam would be trucked from Fresno, California, rail yards via Highway 41, County Road 200/210, and the proposed haul road. Foundation preparation would last 30 months.

RCC Arch Dam A cement batch plant site would be located near the dam's right or left abutment depending on the quarry, batch plant, and haul road option. Multiple RCC plants, with multiple mixing units on each plant, would be likely at the batch plant site. Trucks would deliver aggregates, stockpiled high at the quarry, to the batch plant site. RCC delivery could be made with a custom conveyor or multiple conveyor system with a combined capacity meeting or exceeding the RCC plant

capacity. The dam height could limit delivery to variable locations, as well as steady raising. Trucks could be used on the fill in lieu of conveyors to deliver materials to the spreading location. RCC placement would take 26 months presuming a 6-day/week placement. A total of 33 months would be needed to complete the RCC dam, including the dam crest and spillway.

Reclamation and Demobilization All disturbed sites, including contractor use areas and temporary roads outside of the reservoir area, would be reclaimed using the remaining excavated material stored at the quarry. Permanent access roads would be resurfaced. The downstream cofferdam would be demolished to elevation 500 feet msl, with waste material being placed at the toe of the cofferdam or at the quarry via truck. Reclamation and final demobilization would last 4 months.

Affected Existing Facilities – Kerckhoff Project Decommissioning All hydraulic, lubricating, and insulating oils would be drained and disposed. In addition, any refrigerants, storage batteries, or compressed gas would require disposal. Asbestos and equipment containing mercury, along with transformers and oil circuit breakers would be removed and disposed. Overhead conductors from the powerhouses to the switchyards would be removed. Transformers to be disposed of would be hauled to a licensed disposal facility in Los Angeles, 250 miles away. Construction waste would be disposed of in a Fresno, California, landfill or scrapyard. Several pieces of equipment would be salvaged and transported to the PG&E yard in Auberry, 9 miles from the Kerckhoff No. 2 site. Concrete plugs would be placed in the intake and draft tubes. The Kerckhoff penstock tunnel and surge chambers would also be plugged and backfilled. Kerckhoff Project decommissioning would last 36 months.

Inundated sections of the Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines (approximately 4 miles in length) would be reconstructed as the Le Grand–Sanger transmission line. The line would be constructed using 20 predominately steel monopoles with steel-reinforced, drilled concrete piers.

Affected Existing Facilities – Recreation Trail construction would use "full bench" construction whenever possible, locate trail switchbacks to reduce shortcutting, and protect environmentally sensitive areas and erodible slopes. Disturbed areas would be restored after construction. If buildings would be inundated, structures and foundations would be demolished.

Asbestos material, if discovered, would be removed and taken to an approved landfill for disposal per permit requirements. General demolition waste would also be removed and trucked to an approved landfill. Pavement in parking areas would be removed, the underlying soil ripped to 6 inches depth, and then the area would be hydroseeded. Whenever possible, new recreational structures would use renewable, local, and/or recycled content materials; use natural lighting, renewable energy, and high-efficiency utilities; and protect sensitive areas and erodible slopes.

Roadway construction activities would involve, but not be limited to, demolition of existing roadways as required; clearing, grubbing, and site preparation of work areas, as required; grading road alignments to meet finished grades; placing road subgrade; paving operations; installing storm drain culverts; constructing retaining wall systems; installing road appurtenances such as guardrails; and performing construction-related traffic control. Boat ramp construction activities would involve, but not be limited to, clearing, grubbing and site preparation of work areas; and heavy earthwork operations. Recreations facility demolition and relocations would last 36 months.

Affected Existing Facilities – Utilities All utilities associated with demolished buildings would be disconnected (typically 6 inches deep), capped, and/or removed per permit requirements and governing utility standards. Potable water and wastewater lines that would be relocated would use trenching and backfilling. Water removed from the construction area would be treated to remove sediment and discharged to the closest drainage way.

Relocated potable water wells would require a rotary drill rig. A concrete pad would be constructed at the top of the well to keep contaminated water away from the well. The concrete pad would also typically accommodate a small pump and small bladder tank. Power would need to be routed to the new well to power the pump.

Relocating wastewater septic systems would include excavating a pit approximately 17 feet long, 11 feet wide, and 9 feet deep for the septic tank. The tank would be placed and backfilled to grade. A trench approximately 100 feet long, 3 feet wide, and 3 feet deep would be excavated for the leach field. The perforated leach pipe and approved backfill would be added to the trench and the trench backfilled to grade.

Power distribution poles and wires affected by inundation would be removed and disposed of at an approved landfill. Relocated wood-pole or steel-pole foundations could be directly embedded in the ground (typically 6 feet) with crushed rock or concrete backfill, or installed using reinforced-concrete caissons and anchor bolts. Utilities demolition and relocations would last 36 months.

Reservoir Clearing Three vegetation removal prescriptions would be applied to the inundation area. Complete removal (331 acres) would clear all existing vegetation and would generally be applied to areas adjacent to proposed recreation developments to reduce water recreation hazards. Overstory removal (3,249 acres) would remove all trees greater than 10 inches in diameter at breast height or greater than 15 feet in height, and would be applied to most areas outside of complete removal areas. No treatment (1,066 acres) would generally be applied to areas assumed to support little to no vegetation, and would also apply to special habitat areas to maximize habitat benefits of inundated and residual vegetation.

For complete removal and overstory removal areas, timber would be harvested by standard or specialized logging machinery and hand crews. Lumber would be removed via existing roads or proposed haul and access roads. Understory vegetation (for complete removal areas) and waste would be disposed of using self-contained incinerators.

Summary of Potential Accomplishments of Action Alternatives

This section summarizes the potential accomplishments of all action alternatives. Model simulations completed to assess the physical accomplishments are described in detail in the Modeling Appendix. The physical characteristics and potential physical accomplishments of the action alternatives are summarized in Table 2-8 and Table 2-9.

Table 2-8. Physical Characteristics for Temperance Flat RM 274 Reservoir

Physical Characteristics	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Temperance Flat RM 274 Reservoir Net Additional Storage Capacity (TAF)[1]	1,260	1,260	1,260	1,260	1,260
Total Carryover Storage Capacity (Millerton and Temperance Flat RM 274) (TAF)	540	540	540	665	230
Temperance Flat Carryover Storage Capacity (TAF)	200	200	200	325	100
Millerton Lake Carryover Storage Capacity (TAF)	340	340	340	340	130
Powerhouse Tailrace Elevation and Millerton Lake Carryover Storage Elevation (feet)[2]	550	550	550	550	550

Notes:
[1] Total storage in Temperance Flat RM 274 Reservoir would be 1331 TAF, with 75 TAF overlapping with existing Millerton Lake.
[2] Elevation reported in North American Vertical Datum 88.
Key:
RM = river mile
TAF = thousand acre-feet

Table 2-9. Potential Physical Accomplishments for Temperance Flat RM 274 Reservoir

Potential Physical Accomplishments[1,2]	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Dry and Critical Year Increase in Total Delivery (TAF)	19	24	30	21	121
Long-Term Average Annual Increase in Agricultural Delivery (TAF)[3]	30	49	52	41	94
Long-Term Average Annual Increase in M&I Delivery (TAF)	40	22	24	20	-7
Long-Term Average Annual Increase in Total Delivery (TAF)	70	71	76	61	87
Long-Term Average Annual Spring-Run Chinook Abundance Increase–High SAR (percent)[4]	2.8%	2.8%	0.6%	4.9%	-8.8%
Dry and Critical Year Spring-Run Chinook Abundance Increase–High SAR (percent)[4]	15.9%	13.2%	14.7%	13.2%	18.3%
Long-Term Average Annual Spring-Run Chinook Abundance Increase–Low SAR (percent)[4]	0.6%	0.4%	-0.6%	2.8%	-13.1%
Dry and Critical Year Spring-Run Chinook Abundance Increase–Low SAR (percent)[4]	14.0%	9.2%	13.3%	11.1%	16.3%
Net Increase in Friant Dam Hydropower Generation (GWh/year)	15.7	15.6	15.6	15.7	14.0
Replacement of Kerckhoff Hydroelectric Project Value (percent)[6]	83.8%	83.8%	83.8%	91.2%	73.4%
Increase in Recreation (thousands of visitor-days)[7]	108	109	106	120	69
Increase in Incidental Flood Space (TAF)[8]	354 – 481	353 – 479	351 – 470	243 – 347	406 – 555

Notes:

[1] Operations based on Reclamation March 2012 CalSim II Benchmark with Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP (USFWS 2008) and Biological Opinion and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009).

[2] Accomplishments are reported as changes in comparison to No Action Alternative.

[3] Simulated water demands in the Friant Division of the CVP are based on existing Class 1 and Class 2 contracts.

[4] Action alternatives are compared to the No Action Alternative, which varies depending on the SAR.

[5] Emergency water supply represented by supply available for disruption due to 10-island levee breach.

[6] Impacts to Kerckhoff Hydroelectric Project will be mitigated. Costs include additional reimbursement required after onsite replacement.

[7] Sum of potential annual visitor days at Millerton Lake and Temperance Flat RM 274 Reservoir.

[8] Incidental flood space is the flood space available during November through March at the 90 percent exceedance.

Key:
CVP = Central Valley Project
GWh/year = gigawatt hours per year
M&I = municipal and industrial
RM = river mile
SAR = smolt-to-adult return rate
SWP = State Water Project
TAF = thousand acre-feet

Increase Water Supply Reliability and System Operational Flexibility

The primary planning objective to increase water supply reliability and system operational flexibility could address water supplies and demands for CVP agricultural and SWP M&I water contractors. In addition to providing long-term average or dry-year water supply reliability, Temperance Flat RM 274 Reservoir could provide emergency water supplies to SOD M&I water users during emergency Delta pumping outages. Both water supply reliability and emergency water supplies are considered to meet this planning objective.

Water Supply Reliability

In the Draft Feasibility and Plan Refinement Phase, analyses of Temperance Flat RM 274 Reservoir conditions and operations under the 2008 USFWS and 2009 NMFS BOs (USFWS 2008, NMFS 2009) focused on storing and managing water that would otherwise have been released from Friant Dam as flood releases or Section 215 deliveries. This operation would provide water supply reliability and operational flexibility to the CVP and SWP systems. The action alternatives were analyzed for water supplies to the Friant Division contractors, SWP SOD M&I contractors, CVP SOD contractors, and CVP San Joaquin Valley wildlife refuges, based on CalSim II simulations. Table 2-10 summarizes the long-term average annual change in deliveries to the beneficiaries in each action alternative compared to the No Action Alternative. Table 2-11 lists the long-term average annual change in deliveries systemwide for all water year types for all action alternatives compared to the No Action Alternative.

The long-term average annual change in systemwide deliveries accounted for reduced Delta pumping to SWP and CVP SOD contractors due to the reduction in Delta inflows during wet years (flood flows) from the San Joaquin River. On average, the action alternatives would provide between 61 to 87 TAF per year of additional CVP and SWP systemwide water deliveries, depending on operations for a particular action alternative. The CalSim II modeling shows some infrequent, minor changes to CVP and SWP water operations north of the Delta. These changes are a result of the model response to reductions in San Joaquin River inflow to the Delta and implementation of the complex system of Delta inflows, exports, regulations, hydrodynamic and salinity interaction rules and their interactions with the Coordinated Operations Agreement on how water supply and regulatory responsibility are shared by the CVP and SWP north of the Delta in the

model. The model follows the built in rules governing these interactions and cannot deviate from these rules when new or unexpected interactions occur.

These minor changes indicated in the modeling, and any potential impacts from these changes, are expected to be consistent between alternatives, and would not make any difference in the comparative analysis performed using the CalSim II simulation results. During project implementation corrective actions could be included in the project operating plan so that these potential impacts would be avoided in real-time operations. Because these small upstream changes are not expected to occur in real-time, would be small and infrequent, could have a positive or negative impact on SOD deliveries, and would be expected to be consistent between simulations, they are ignored for the purposes of this document.

In addition to carryover storage targets, the magnitude of long-term water supply reliability accomplishments was strongly influenced by CVP and SWP operating conditions. Evaluation of Temperance Flat RM 274 Reservoir, integrated with the broader CVP and SWP SOD exports and storage systems under potential future conditions with increased flexibility for CVP and SWP Delta export operations, would likely result in significantly greater estimates of water supply reliability by capturing additional Delta water supply in wet years through exchange.

Table 2-10. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir (in TAF)

Average Annual Change in Delivery[1]	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Friant Division of the CVP	43	36	38	27	48
CVP SOD Ag[2]	-10	16	16	16	48
SWP SOD M&I[2]	40	22	25	21	-7
Total CVP and SWP Change In Deliveries[3]	**70**	**71**	**76**	**61**	**87**

Notes:
[1] Action alternatives are compared to the No Action Alternative.
[2] Because Temperance Flat RM 274 Reservoir would increase the capacity to capture San Joaquin River flood flows, Delta inflows from the San Joaquin River would be reduced, therefore reducing CVP and SWP deliveries from the Delta in some years. In some action alternatives, the long-term annual average delivery to CVP SOD would be slightly less than the No Action Alternative.
[3] Total CVP and SWP delivery includes SWP Ag and CVP M&I, which are not included as water supply beneficiaries; consequently, line items may not sum to totals.

Key:
Ag = agricultural
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
M&I = municipal and industrial
RM = river mile
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet

Table 2-11. Long-Term Average Annual Change in Deliveries for Action Alternatives[1] (in TAF)

Action Alternative	WY Type San Joaquin Index[2]	Change in Systemwide Delivery[3]	Total Friant Ag	Class 1	Class 2	Section 215	Total SWP SOD	SWP SOD Ag	SWP SOD M&I	Total CVP SOD[2]	CVP SOD Ag	CVP SOD M&I
Alternative Plan 1	Wet	112	102	(1)	239	(137)	33	(10)	44	(23)	(22)	(1)
	Above Normal	152	82	2	133	(53)	79	(3)	82	(9)	(9)	0
	Below Normal	1	(49)	(3)	(14)	(32)	53	7	46	(3)	(3)	0
	Dry and Critical	19	12	4	23	(15)	13	0	13	(5)	(5)	(1)
	All Years	**70**	**43**	**1**	**103**	**(61)**	**38**	**(3)**	**40**	**(11)**	**(10)**	**0**
Alternative Plan 2	Wet	115	99	(1)	237	(137)	0	(10)	10	16	17	(1)
	Above Normal	145	65	1	117	(53)	43	(3)	46	36	37	0
	Below Normal	(4)	(65)	(3)	(30)	(32)	42	7	35	19	19	0
	Dry and Critical	24	8	6	18	(15)	15	1	13	1	1	(1)
	All Years	**71**	**36**	**1**	**95**	**(61)**	**20**	**(2)**	**22**	**16**	**16**	**0**
Alternative Plan 3	Wet	116	86	(1)	224	(138)	22	(10)	33	9	10	0
	Above Normal	152	62	1	113	(53)	48	(3)	51	42	43	0
	Below Normal	7	(38)	(3)	(2)	(32)	21	6	15	23	23	0
	Dry and Critical	30	18	7	27	(15)	8	1	7	3	3	(1)
	All Years	**76**	**38**	**2**	**98**	**(62)**	**22**	**(2)**	**25**	**15**	**16**	**0**
Alternative Plan 4	Wet	99	91	(1)	220	(128)	(2)	(10)	8	10	11	0
	Above Normal	122	39	2	90	(53)	40	(3)	43	42	42	0
	Below Normal	2	(62)	(3)	(27)	(32)	40	6	34	23	23	0
	Dry and Critical	21	6	6	15	(15)	14	1	12	2	3	0
	All Years	**61**	**27**	**2**	**85**	**(59)**	**18**	**(2)**	**21**	**16**	**16**	**0**
Alternative Plan 5	Wet	0	20	(1)	158	(137)	(45)	(11)	(35)	26	27	0
	Above Normal	152	84	(1)	138	(53)	(8)	(3)	(4)	76	76	0
	Below Normal	89	(6)	(29)	55	(32)	18	7	11	78	78	0
	Dry and Critical	121	75	25	66	(15)	8	1	6	39	39	(1)
	All Years	**87**	**48**	**4**	**106**	**(61)**	**(10)**	**(2)**	**(7)**	**48**	**48**	**0**

Notes:

[1] Changes in deliveries as simulated with CalSim II March 2012 Benchmark with future (2030) level of development and 82-year hydrologic period of record from October 1921 to September 2003.

[2] San Joaquin Year Type or 60-20-20 Year Type – This classification system is based on the historical and forecasted unimpaired inflows of the Stanislaus, Tuolumne, Merced, and San Joaquin rivers to the San Joaquin River Basin, as defined in State Water Resources Control Board Decision 1641. The classification consists of five year types: wet, above normal, below normal, dry, and critical. Average for all years is weighted average based on proportion of each year type out of 82-year period of record.

[3] Action Alternatives are compared to the No Action Alternative.

Key:
Ag = agricultural
CVP = Central Valley Project
M&I = municipal and industrial
SOD = South-of-Delta
SWP = State Water Project
TAF = thousand acre-feet
WY = water year

Enhance Water Temperature and Flow Conditions

A primary planning objective is to enhance water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

Ecosystem – Cold-Water Pool and River Release Temperature

The action alternatives could improve the capability, reliability, and flexibility to release water at suitable temperatures for anadromous fish downstream from Friant Dam. Reservoir and river water temperature simulations were performed for all action alternatives. Alternative Plan 4 also includes an SLIS to better manage reservoir cold-water pool and San Joaquin River release temperatures for anadromous fish.

All action alternatives would increase the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in action alternatives with higher carryover storage. The SLIS included in Alternative Plan 4 would also allow for better management of the cold-water pool resulting in improved temperature conditions for anadromous fish in the San Joaquin River.

The action alternatives could improve San Joaquin River release temperatures from the critical September through December spawning period, as shown in Figure 2-15, at the cost of slightly warmer winter releases than in the No Action Alternative. However, in the winter months, release temperatures would still be cooler than required for successful anadromous fish survival (see Modeling Appendix for further detail on reservoir and river temperatures). Inclusion of an SLIS in Alternative Plan 4 would reduce release temperatures by up to 5 degrees Fahrenheit (°F) more than without the SLIS during falls months. The colder release temperatures would also slightly extend the distance downstream from Friant Dam where mean daily river temperatures would stay below 55°F, a critical temperature for anadromous fish (Figure 2-16).

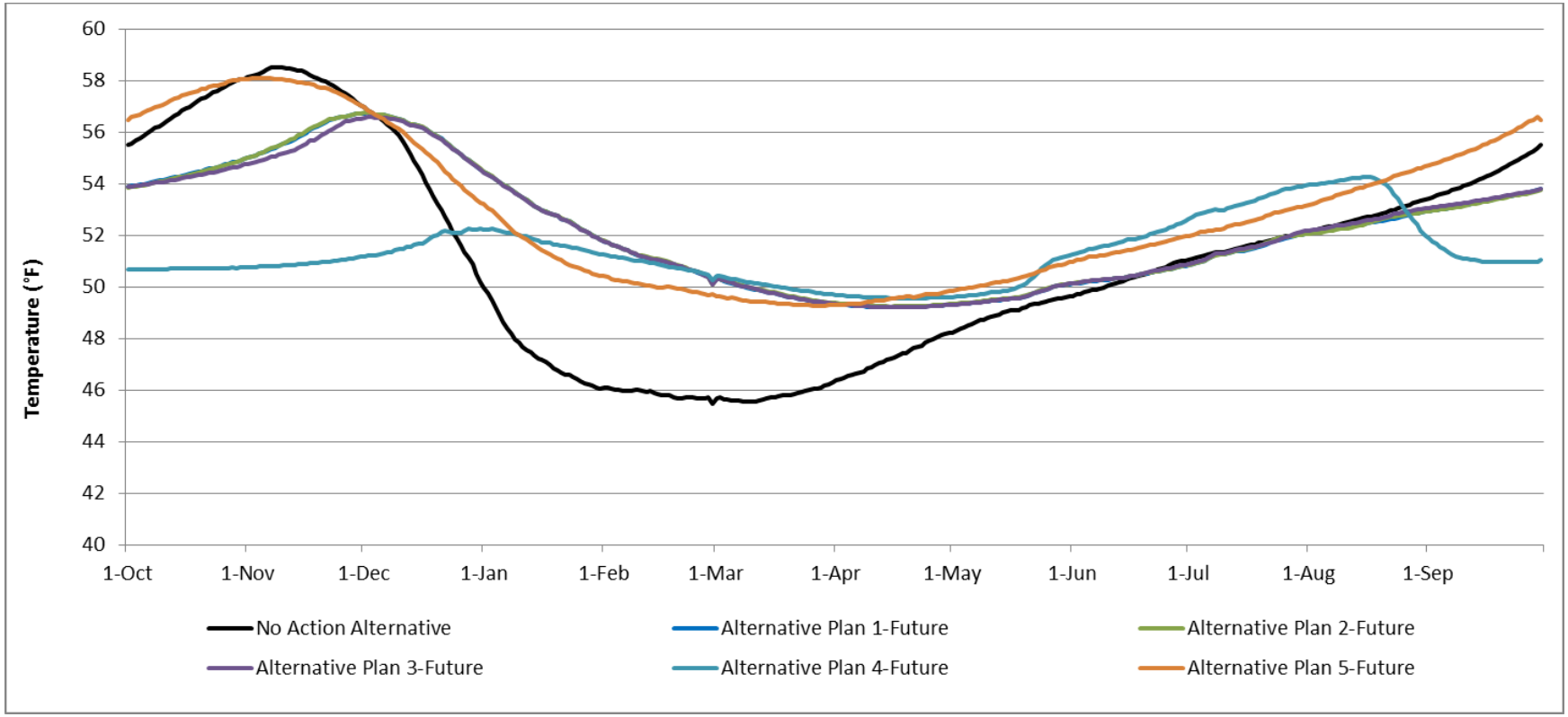

Figure 2-15. Mean Daily Temperature (°F) of Friant Dam Release to San Joaquin River – All Years

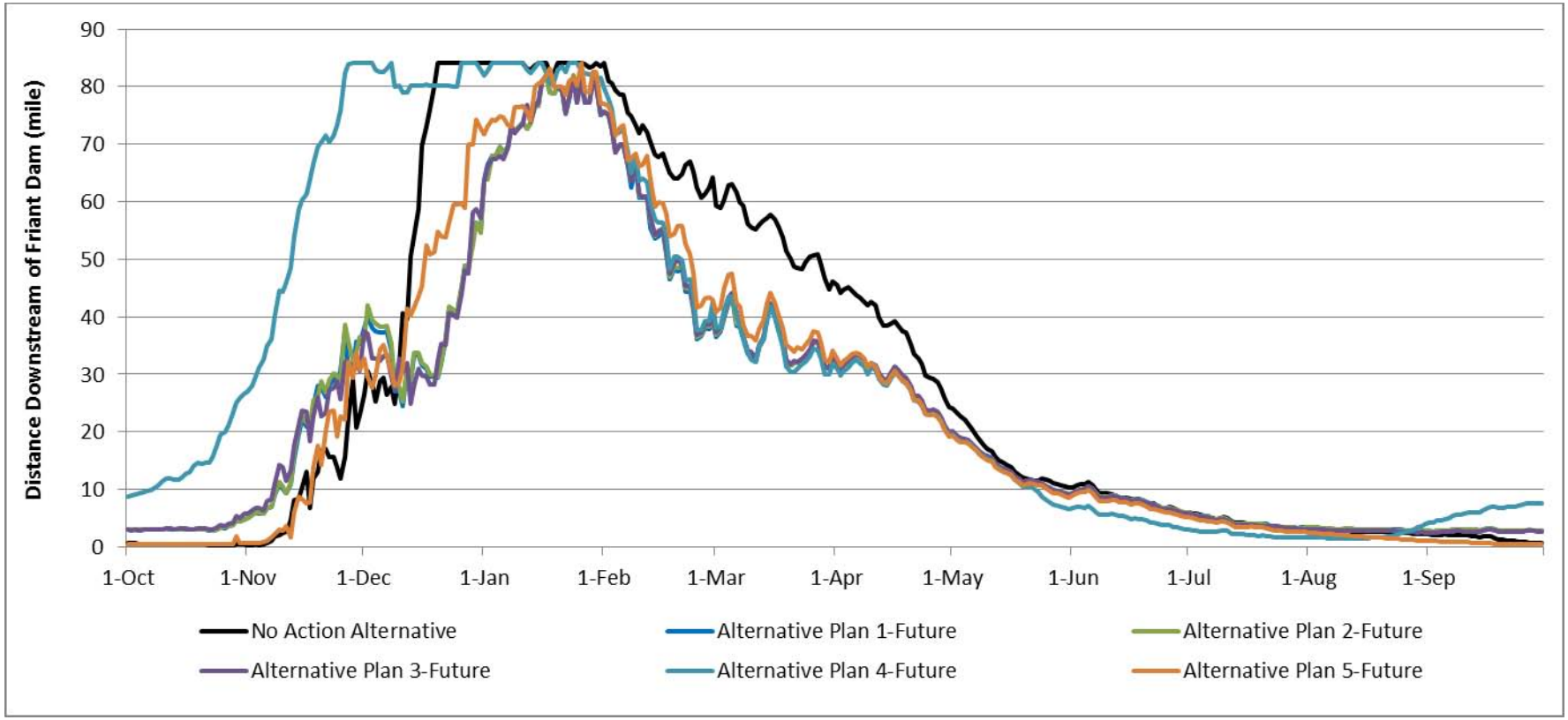

Figure 2-16. Distance Downstream from Friant Dam Where Mean Daily San Joaquin River Temperature <= 55° F – All Years

Ecosystem – Improvement in Spring-Run Chinook Salmon Abundance

The Ecosystem Diagnosis and Treatment (EDT) model (Mobrand et al. 1997, Blair et al. 2009) was used to estimate potential improvements to San Joaquin River spring-run Chinook salmon habitat that could be achieved by action alternatives. EDT output included variables describing the productivity and capacity of fish habitat that could develop under flow and temperature regimes for each action alternative. Productivity and capacity were both represented in the abundance metric estimated by the EDT model, representing the number of spawning fish the habitat could sustain. Productivity represented habitat quality, was based on the density-independent survival rate (i.e., survival without competition), and was a function of temperature, water quality, and food. Capacity was the maximum abundance that could be supported by the quantity of suitable habitat and the density of fish in that habitat, and it was a function of the quantity of habitat, productivity, and food. Due to uncertainty and limited data regarding the survival of salmon as they migrate below the Merced River to the ocean and then returned to spawn, results were developed to demonstrate a range of potential results for a low and high potential smolt-to-adult return rate (SAR). EDT modeling is described in further detail in the Modeling Appendix.

Potential improvements due to Temperance Flat RM 274 Reservoir operations for spring-run Chinook salmon habitat were measured by comparing the abundance for each action alternative to that of the No Action Alternative as a percent improvement in abundance. Equilibrium abundance was the best estimate for maximum number of returning/spawning adult fish that could be supported considering both habitat quantity and quality. Table 2-12 shows the change in abundance of spring-run Chinook salmon habitat in the San Joaquin River due to improvements in flow and water temperature for weighted long-term average annual and dry year types. Alternative Plan 4, which includes an SLIS, would provide the highest long-term average annual improvement in equilibrium abundance. Improvements in abundance due to the action alternatives were related to a combination of temperature improvements from additional flow or cold-water pool management through carryover storage and/or an SLIS, and additional flow in the San Joaquin River from Friant Dam to Mendota Pool (for water supply deliveries and/or exchanges).

Table 2-12. Percent Change in Abundance of Spring-Run Chinook Salmon for Action Alternatives

SAR	Measured Timeframe	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
High	Long-Term Average	2.8%	2.8%	0.6%	4.9%	-8.8%
	Dry Year	15.9%	13.2%	14.7%	13.2%	18.3%
Low	Long-Term Average	0.6%	0.4%	-0.6%	2.8%	-13.1%
	Dry Year	14.0%	9.2%	13.3%	11.1%	16.3%

Notes:
Further details are presented in the Modeling Appendix.
[1] Action alternatives are compared to the No Action Alternative, which varies depending on the smolt-to-adult return rate.
Key:
SAR = smolt-to-adult return rate

Flood Damage Reduction, Hydropower, Recreation, San Joaquin River Water Quality, Urban Water Quality

Physical accomplishments of the action alternatives regarding flood management, hydropower generation, and recreation are described below. San Joaquin River and urban water quality accomplishments other than temperature would be minor and therefore are not discussed.

Increase in Incidental Flood Space

Incidental flood storage was evaluated as the total storage between Millerton Lake and Temperance Flat RM 274 Reservoir available 90 percent of the time on a monthly basis. Increased storage with Temperance Flat RM 274 Reservoir would allow greater ability to capture flood flows. Figure 2-17 shows the 90 percent exceedence flood storage availability for action alternatives compared to the No Action Alternative. Available storage in November through March also assumed that up to 85 TAF of flood storage was available above Temperance Flat RM 274 Reservoir in Mammoth Pool. Action alternatives with lower carryover storage targets (Alternative Plans 1, 2, 3, and 5) would have more active storage available for flood management, but all action alternatives, including Alternative Plan 4, would have at least 200 TAF more flood storage availability in the rain flood season from October to March, compared to the No Action Alternative.

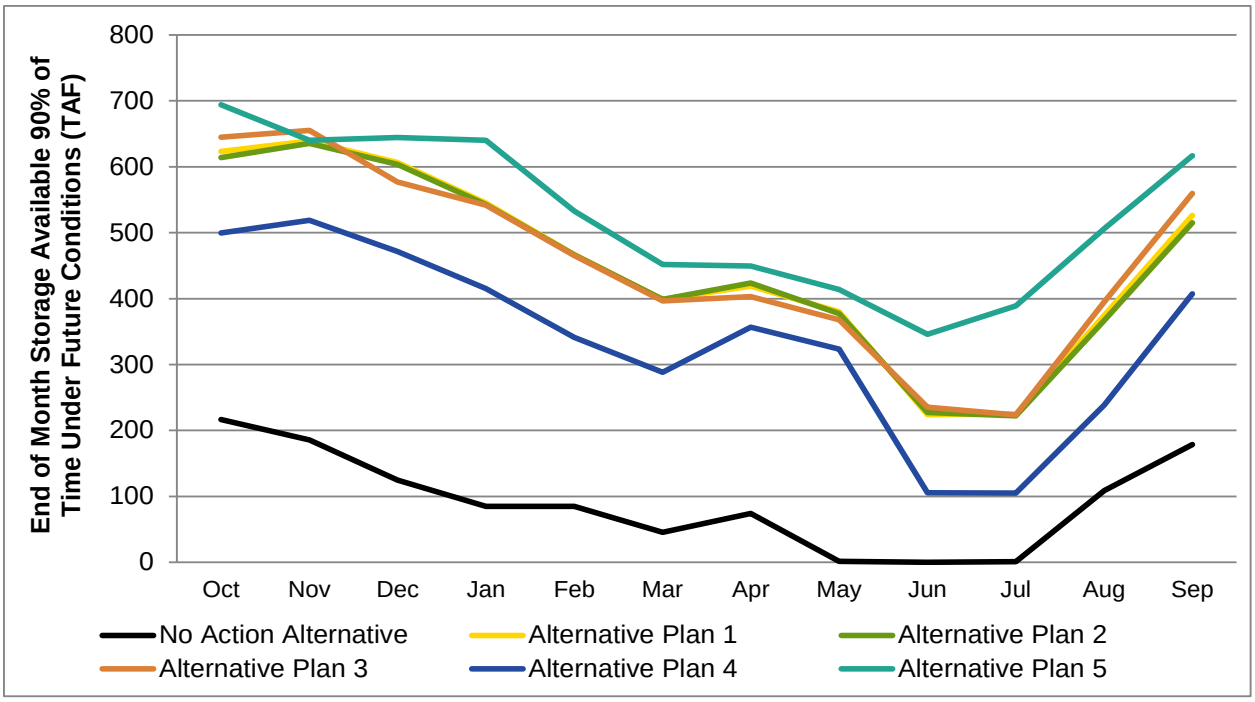

Figure 2-17. 90 Percent Exceedence Flood Storage Availability by Month for All Scenarios

Hydropower and Replacement of Impacted Hydropower Value

The ability of action alternatives to replace the value of the Kerckhoff Hydroelectric Project powerhouses would vary greatly, depending on how carryover storage was managed in Millerton Lake and Temperance Flat RM 274 Reservoir. Alternative Plans 1, 2, and 3 could replace all but 101 gigawatt-hours (GWh) per year (GWh/year) (83.8 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower generation. Alternative Plan 4 could replace all but 54 GWh/year (91.2 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower generation because of higher carryover storage in Alternative Plan 4 allowing for higher head for power generation. Alternative Plan 5 could replace all but 164 GWh/year (73.4 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower generation. The Alternative Plan 5 carryover storage targets in both Millerton Lake and Temperance Flat RM 274 Reservoir would create a wider range of head and would inhibit hydropower generation more than other action alternatives.

Table 2-13 shows the simulated long-term average hydropower generation change from the No Action Alternative. Alternative

Plans 1 through 4 would operate Millerton Lake with a fixed water surface at elevation 550 (carryover storage target of 340 TAF). The fixed elevation would allow Friant Dam powerhouses to generate an additional 15.7 to 15.8 GWh/year, on average, compared to the No Action Alternative. Alternative Plan 5 would operate Millerton Lake with a variable water surface elevation, resulting in smaller increases in generation at Friant Dam relative to the other action alternatives.

Table 2-13. Friant Dam Hydropower Generation and Kerckhoff Hydroelectric Project Onsite Generation

Hydropower Generation Parameter	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Change in Hydropower Generation (GWh/year) (Kerckhoff Hydroelectric Project generation minus Temperance Flat RM 274 Powerhouse generation)[1]	-100.1	-100.1	-100.1	-54.3	-163.8
Percent Generation Replacement of Kerckhoff Hydroelectric Project[1]	83.8	83.8	83.8	91.2	73.4
Change in Hydropower Generation at Friant Dam from No Action Alternative (GWh/year)[1]	15.7	15.6	15.6	15.7	14.0

Note:
[1] Action alternatives are compared to No Action Alternative. Remaining requirements for Kerckhoff Hydroelectric Project are addressed in project costs.
Key:
GWh = gigawatt-hour
RM = river mile

Recreational Opportunities

Opportunities for recreational development would vary, depending on balancing of reservoir storage levels between Millerton Lake and Temperance Flat RM 274 Reservoir and water supply beneficiaries. Operating the reservoir balancing to generally keep Millerton Lake at a fixed elevation could improve early- and late-season boating opportunities in Millerton Lake, but at lower elevations, could allow vehicular access that would degrade shoreline use conditions. Operating Millerton Lake with a fixed elevation between elevations 540 to 560 feet msl would allow the best balance of shoreline and reservoir use. All action alternatives would be operated with a fixed Millerton Lake elevation of 550 feet msl. Boating and waterskiing activities would generate the highest economic value for Millerton Lake, followed by picnicking.

Temperance Flat RM 274 Reservoir could also support recreation, particularly boating activities. Recreational

visitation at Temperance Flat RM 274 Reservoir was estimated as proportionate to Millerton Lake average visitation, considering the simulated 50 percent exceedence Temperance Flat RM 274 Reservoir surface area as compared to the historical 50 percent exceedence Millerton Lake surface area. As a much larger reservoir, Temperance Flat RM 274 Reservoir under Alternative Plan 4 could support 96,400 new visitor-days. Potential Temperance Flat RM 274 Reservoir recreational visitation might be understated because only peak recreational season boating activity participation was estimated, no land-based activity or camping participation was estimated, and no off-season participation was considered. Table 2-14 summarizes the increase in recreational visitor-days for action alternatives, considering recreation at Millerton Lake and Temperance Flat RM 274 Reservoir. Estimates of annual increases in recreation visitor-days range from 113,600 to 130,400.

Table 2-14. Estimated Increase in Recreation Visitor-Days Compared to No Action Alternative

Recreational Parameter	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Potential Annual Increase in Visitation at Millerton Lake[1] (1,000 visitor-days/year)	34	34	34	34	32
Potential Annual Visitation at Temperance Flat RM 274 Reservoir[1,2,3] (1,000 visitor-days/year)	74	75	72	86	37
Total Potential Annual Increase in Recreation Visitation (1,000 visitor-days/year)	**108**	**109**	**106**	**120**	**69**

Notes:
[1] Action alternatives are compared to No Action Alternative. Visitor-day values are net increases.
[2] Potential annual visitation at Temperance Flat RM 274 Reservoir is based solely on boating activities and peak recreational season Temperance Flat RM 274 Reservoir surface acres. Boating activities include waterskiing/wakeboarding, personal water craft, boat fishing, and general boating. This is considered a conservative estimate because with creation of Temperance Flat RM 274 Reservoir it is expected that new land-based recreation and camping facilities would be developed and support these recreational activities.
Key:
RM = river mile

Preferred Alternative and Rationale for Selection

This Draft EIS does not identify a preferred alternative for implementation. Consistent with CEQ Regulations, 40 CFR Part 46.425, a preferred alternative (or alternatives, if there is more than one) will be identified in the Final EIS. The preferred alternative(s) will be identified in the Final EIS based on the information presented in this Draft EIS, in light of any potential revisions made in response to comments received on this Draft EIS. After the Final EIS is published, Reclamation may prepare and adopt a ROD. The ROD, which is the final step in the NEPA process, will document the Secretary of the Interior's determination of whether the requirements of NEPA have been met and which actions, if any, to recommend. It will also describe other alternative plans considered, identify any mitigation plans, and describe factors and comments taken into consideration when making its recommendation. Congress will make the final decision on authorizing a project for implementation, or not.

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Chapter 3
Considerations for Describing Affected Environment and Environmental Consequences

Chapters 4 through 7 and 9 through 26 of this Draft EIS are organized by environmental resource area. Each chapter describes the affected environment and potential environmental consequences that could result from implementing the proposed action alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

The potential cumulative effects of implementing the action alternatives are described in Chapter 27, "Cumulative Effects."

Chapter Contents and Definition of Terms

Chapters 4 through 27 are organized into the following resource and issue areas:

- **Chapter 4** – Air Quality and Greenhouse Gas Emissions
- **Chapter 5** – Biological Resources – Fisheries and Aquatic Ecosystems
- **Chapter 6** – Biological Resources – Botanical and Wetlands
- **Chapter 7** – Biological Resources – Wildlife
- **Chapter 8** – Climate Change
- **Chapter 9** – Cultural Resources
- **Chapter 10** – Environmental Justice
- **Chapter 11** – Geology and Soils

- **Chapter 12** – Hydrology – Flood Management
- **Chapter 13** – Hydrology – Groundwater
- **Chapter 14** – Hydrology – Surface Water Supplies and Facilities Operations
- **Chapter 15** – Hydrology – Surface Water Quality
- **Chapter 16** – Indian Trust Assets
- **Chapter 17** – Land Use Planning and Agricultural Resources
- **Chapter 18** – Noise and Vibration
- **Chapter 19** – Paleontological Resources
- **Chapter 20** – Power and Energy
- **Chapter 21** – Public Health and Hazardous Materials
- **Chapter 22** – Recreation
- **Chapter 23** – Socioeconomics, Population, and Housing
- **Chapter 24** – Transportation, Circulation, and Infrastructure
- **Chapter 25** – Utilities and Service Systems
- **Chapter 26** – Visual Resources
- **Chapter 27** – Cumulative Effects

For some of these resource and issue areas, additional information pertaining to the analyses is contained in the appendices to this Draft EIS: the Modeling Appendix, Physical Resources Appendix, and Plan Formulation Appendix.

NEPA Requirements

CEQ regulations for implementing NEPA include the following requirements for an EIS (40 CFR 1502.15):

> *[An] EIS shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced.*

Approach to Affected Environment

Chapters 4 through 26 provide a description of the existing physical environment and socioeconomic conditions that could be affected by the No Action Alternative and action alternatives considered in this Draft EIS. This information was obtained from published environmental and planning documents, books, Web sites, journal articles, field surveys, and communications with technical experts. Descriptions of the affected environment are organized by geographic region. Conditions in the primary study area – San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the proposed Temperance Flat RM 274 Reservoir; and areas that could be directly affected by construction-related activities, including the footprint of proposed temporary and permanent facilities upstream from Friant Dam – are described first, followed by descriptions of conditions in the extended study area. The extended study area consists of the San Joaquin River downstream from Friant Dam, including the Delta; lands served by San Joaquin River water rights; the Friant Division of the CVP, including underlying groundwater basins in the eastern San Joaquin Valley; and SOD water service areas of the CVP and SWP. In certain resource areas, the geographic regions are organized slightly differently than how they are defined in Chapter 1, “Introduction.”

Methods and Assumptions

Chapters 4 through 7 and 9 through 26 also document the analysis of the direct and indirect effects of the alternatives for each environmental resource area. Direct effects are those that would be caused by the action and would occur at the same time and place. Indirect effects are reasonably foreseeable consequences that may occur at a later time or at a distance

from the project area. Examples of indirect effects are growth inducement or other effects related to changes in land use patterns, population density, or growth rate, and related effects on the physical environment.

The effects of the alternatives were determined by comparing estimates of resulting conditions with baseline conditions. These baseline conditions differ between NEPA and CEQA. Under NEPA, the No Action Alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared; the No Action Alternative is also compared to existing conditions. Under CEQA, existing conditions are the baseline to which alternatives are compared.

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is a determining factor in whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. As stated in Section 15382 of the State CEQA Guidelines, a significant effect on the environment means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project."

CVP and SWP Operational Assumptions

Reclamation uses CalSim II (a specific application of the Water Resources Integrated Modeling System [WRIMS] to Central Valley water operations), to comparatively study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. In this Draft EIS, the quantitative assessment of actions related to water resources relied primarily on two CalSim II baselines for CEQA and NEPA:

- "Existing Conditions," based on a 2005 level of land use development and current facilities in place as of January 2014.

- "Future Conditions (No Action Alternative)," expected future conditions without the project, based on a mix of forecasted 2020 and 2030 land use development and reasonably foreseeable future projects and facilities anticipated to be in place by 2030 (including actions with current authorization, secured funding for design

and construction, and environmental permitting and compliance activities that are substantially complete as of the date of preparation of this Draft EIS). This is the most recent "future" level hydrology available for use with the CalSim II model, and is referred to throughout this document as the 2030 land use level of development.

Operational assumptions for refinement, modeling, and evaluation of potential effects of the No Action Alternative and action alternatives included in this Draft EIS were derived from the following sources:

- The 2008 Long-Term Operations BA (Reclamation 2008)
- The 2008 USFWS BO (USFWS 2008)
- The 2009 NMFS BO (NMFS 2009)
- Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, signed in 1986 and ratified by Congress through Public Law 99-546.

As Reclamation has advanced the Investigation, the environmental, hydrologic, and regulatory conditions in the San Joaquin River basin and Delta have changed considerably. Among these changes have been substantial declines in the populations of delta smelt within the Delta. These changes have led to a series of documents and decisions that have affected CVP and SWP operations. This section describes historical decisions related to CVP and SWP operations and the ways in which they have influenced the Investigation.

In 2008, Reclamation initiated formal Section 7 consultation and provided the USFWS and NMFS a BA on the continued long-term operation of the CVP and SWP (Reclamation 2008).USFWS and NMFS released their BOs in 2008 and 2009, respectively (USFWS 2008, NMFS 2009). In the 2008 USFWS BO, the USFWS concluded that the long-term operations of the CVP and SWP would jeopardize the continued existence of and destroy or adversely modify critical habitat for delta smelt (*Hypomesus transpacificus*). Consequently, the USFWS developed a Reasonable and Prudent Alternative (RPA) to avoid jeopardy. In the 2009 NMFS BO, NMFS similarly concluded that the long-term

operations of the CVP and SWP would jeopardize populations of listed salmonids, steelhead (*Oncorhynchus mykiss*), green sturgeon (*Acipenser medirostris*), and killer whales (*Orcinus orca*); and destroy or adversely modify critical habitat for listed species of salmonids, steelhead, and green sturgeon. It also developed an RPA to avoid jeopardy to the species. The RPA included conditions for revised water operations, habitat restoration and enhancement actions, and fish passage actions, and are considered reasonably foreseeable future actions for the purposes of this Draft EIS. Water operations defined in RPAs were included in the modeling evaluations in this Draft EIS for both existing and future conditions, and therefore were included in the cumulative effects analyses presented in Chapter 27, "Cumulative Impacts." Other actions included in the RPAs were not included in the modeling evaluations, but were assessed qualitatively in the cumulative effects analyses presented in Chapter 27, "Cumulative Impacts."

Actions were brought challenging the NMFS and USFWS BOs (2008 and 2009) under ESA and the Administrative Procedure Act concerning the effects of the CVP and SWP on endangered fish species.

In September 2011, the District Court remanded the 2009 NMFS BO to NMFS, without vacatur, finding in favor of the Federal government on some counts and in favor of water contractor plaintiffs on other counts. The District Court ordered NMFS to prepare a draft BO no later than October 1, 2016, and a final BO by February 1, 2018. Reclamation must prepare an EIS on any RPA included in the draft NMFS BO by February 1, 2018; NMFS must release a final BO by that same date. Reclamation must issue a ROD, deciding whether to accept the RPA or an alternative, by April 29, 2018. The United States has appealed the District Court's decision, and that appeal is still pending in the Ninth Circuit Court of Appeals.

On December 27, 2010, the District Court entered an "Amended Order on Cross-Motions for Summary Judgment" (Doc. 761), remanding the 2008 USFWS BO to the USFWS without vacatur.

On May 4, 2011, the District Court issued an amended Final Judgment, ordering the USFWS to complete a final revised BO by December 1, 2013.

In August 2011, the District Court enjoined implementation of USFWS RPA Component 3 (Action 4), the fall X2

requirements, which require a monthly average position of not greater than 74 km in wet years or 81 km in above normal water years eastward of the Golden Gate Bridge. That injunction is no longer in-effect.

The United States and NRDC appealed the District Court's decision invalidating the 2008 USFWS BO. NRDC also challenged the District Court's finding that Reclamation was required to prepare an EIS on its provisional acceptance of the RPA included in the 2008 USFWS BO. Water user plaintiffs cross-appealed the District Court's opinion. On March 13, 2014, the Ninth Circuit Court of Appeals reversed that part of the District Court's opinion that questioned the validity of the 2008 USFWS BO, but affirmed the District Court's finding that Reclamation violated NEPA in failing to prepare an EIS on its provisional acceptance of the RPA included in the 2008 USFWS BO. Water user plaintiffs have petitioned for *en banc* review by the Ninth Circuit Court of Appeals.

In February 2013, Reclamation requested reinitiation of ESA Section 7 consultation, to which USFWS and NMFS agreed. Currently, although the Ninth Circuit upheld the validity of the 2008 USFWS BO, the USFWS is obligated to issue (or reissue) a BO by December 1, 2015. On that same date, Reclamation must issue a final EIS analyzing the environmental impacts associated with operating the CVP and SWP under the USFWS BO. NMFS must issue a draft BO to Reclamation no later than October 1, 2016. Reclamation must issue a draft NEPA document evaluating the environmental impacts associated with implementing the draft NMFS BO by April 1, 2017 (six months after receiving the draft BO), and a final NEPA document no later than February 1, 2018. On that same date, February 1, 2018, NMFS must release a final BO. Reclamation has until April 29, 2018 to issue a ROD. At this time, both the court-ordered remands and litigation over the 2008 USFWS BO and 2009 NMFS BO continue.

In 2012, Reclamation updated the operational assumptions and modeling to reflect operations described in the 2008 Long-Term Operations BA, the 2008 USFWS BO, and the 2009 NMFS BO. These assumptions were used to guide refinement, modeling, and evaluation of alternatives and were used as the basis of analysis in this Draft EIS. Despite the uncertainty resulting from the ongoing reconsultation process, the 2008 Long-Term Operations BA and the 2008 and 2009 BOs issued by the fishery agencies contain the most recent estimate of potential changes in water operations that could occur in the

near future. Furthermore, it is currently anticipated that the final BOs issued by the resource agencies will contain similar RPAs.

Water Year Types and Indices

Throughout this Draft EIS, data are reported using water year types that correspond to various indices. The indices used in this Draft EIS include the following:

- **Sacramento Valley Water Year Index** – Water year type classification is based on unimpaired runoff in the Sacramento Valley, as published annually by DWR in Bulletin 120.

- **San Joaquin Valley Water Year Index** – Water year type classification is based on unimpaired runoff in the San Joaquin Valley, as published annually by DWR in Bulletin 120.

- **Restoration Water Year Index** – Water year type classification is based on historical unimpaired runoff at Friant Dam during water years 1922-2004, as defined in the Settlement.

Unless otherwise noted in the text, water year type classification in this Draft EIS is under the Restoration Water Year Index. The criteria used to assign water year type classifications for each index are shown in Table 3-1.

Table 3-1. Water Year Type Classification Criteria for Three Water Year Type Indices

Water Year Type Index	Water Year Type	Classification Criteria
Sacramento Valley	Wet	Equal to or greater than 9.2 MAF unimpaired runoff
	Above Normal	Less than 9.2 and greater than 7.8 MAF unimpaired runoff
	Below Normal	Equal to or less than 7.8 and greater than 6.5 MAF unimpaired runoff
	Dry	Equal to or less than 6.5 and greater than 5.4 MAF unimpaired runoff
	Critical	Equal to or less than 5.4 MAF unimpaired runoff

Table 3-1. Water Year Type Classification Criteria for Three Water Year Type Indices (contd.)

Water Year Type Index	Water Year Type	Classification Criteria
San Joaquin Valley	Wet	Equal to or greater than 3.8 MAF unimpaired runoff
	Above Normal	Less than 3.8 and greater than 3.1 MAF unimpaired runoff
	Below Normal	Equal to or less than 3.1 and greater than 2.5 MAF unimpaired runoff
	Dry	Equal to or less than 2.5 and greater than 2.1 MAF unimpaired runoff
	Critical	Equal to or less than 2.1 MAF unimpaired runoff
Restoration	Wet	Greater than 2,500 TAF unimpaired runoff
	Normal-Wet	Equal to or less than 2,500 and greater than 1,450 TAF unimpaired runoff
	Normal-Dry	Equal to or less than 1,450 and greater than 930 TAF unimpaired runoff
	Dry	Equal to or less than 930 and greater than 670 TAF unimpaired runoff
	Critical-High	Equal to or less than 670 and greater than 400 TAF unimpaired runoff
	Critical-Low	Less than 400 TAF unimpaired runoff

Key:
MAF = million acre-feet
TAF = thousand acre-feet

Consideration of San Joaquin River Restoration Program Water Management Actions

As described in Chapter 2, "Alternatives," SJRRP actions implemented as of January 2014 are considered part of the existing conditions evaluated in this Draft EIS. Additional SJRRP actions are considered reasonably foreseeable under the No Action Alternative and are included in the future conditions as well. These actions include physical modifications to the San Joaquin River for the Restoration Goal pursuant to Paragraphs 11 and 12 of the Settlement; reintroduction of salmonids to the San Joaquin River, pursuant to Paragraph 14 of the Settlement; additional actions to recapture Restoration Flows at existing facilities on the San Joaquin River, pursuant to Paragraph 16; and improvements in the Friant Division of the CVP pursuant to Part III of Public Law 111-11.

Some SJRRP actions included in the future conditions are assessed qualitatively in the analyses in this document, and are not included in CalSim II or other modeling used to assess the impacts of the alternatives. These include actions to achieve the

Water Management Goal, such as recapture of Restoration Flows at existing, modified, or new facilities on the San Joaquin River or existing facilities in the Delta pursuant to Paragraph 16, and improvements in the Friant Division of the CVP pursuant to Part III of Public Law 111-11. This analysis provides a conservative assessment of potential environmental effects for resource areas evaluated in this Draft EIS.

Effects of Project Implementation with Climate Change

On February 18, 2010, CEQ issued guidance on including GHG emissions and climate change impacts in environmental review documents under NEPA. CEQ guidance suggests that Federal agencies consider opportunities to reduce GHG emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in agency NEPA procedures. The following are the two main factors to consider when addressing climate change in environmental documentation:

- Effects of a proposed action and alternative actions on GHG emissions
- Impacts of climate change on a proposed action or alternatives

CEQ notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies.

The GHG emissions effects of the alternatives are described in Chapter 4, "Air Quality and Greenhouse Gas Emissions." Chapter 8, "Climate Change," includes an assessment of the relationship of climate change effects to the action alternatives, focusing on the potential for the environmental impacts and needed mitigation measures described in Chapters 4 through 7, and 9 through 26 to change under potential future climate conditions.

The Modeling Appendix provides a summary of global climate forecasts and a discussion of the implications of climate change for California water resources. This appendix also includes quantitative analyses of climate change for the Investigation.

The discussion of climate change implications provided in the Modeling Appendix provides context for the assessment presented in Chapter 8, "Climate Change."

Significance Criteria

Significance criteria for each resource area are provided in each resource chapter of this Draft EIS. These criteria are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, and local agencies. These criteria also encompass the factors taken into account under NEPA to determine the significance of an action in terms of the context and the intensity of its effects.

Impact Comparisons and Definitions

Mechanisms that could cause impacts are documented for each resource area. General categories of impact mechanisms are construction and activities related to future operation and maintenance, as described in Chapter 2, "Alternatives." Project-related impacts are categorized as follows, to describe the intensity or duration of the impact:

- A **temporary** impact would last less than 3–4 years and typically would occur only during construction.
- A **short-term** impact could occur during construction and could last from the time construction ceases to within 3–5 years after construction.
- A **long-term** impact would last longer than 5 years after the completion of construction. In some cases, a long-term impact could be a permanent impact.
- A **direct** impact is an impact that would be caused by an action and would occur at the same time and place as the action.
- An **indirect** impact is an impact that would be caused by an action but would occur later in time or at another location, yet is reasonably foreseeable in the future.
- A **cumulative** impact is an impact which results from the incremental impact of the action when added to

other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR 1508.7, 1508.25, and 43 CFR 46.155). The incremental impacts of a project are not "cumulatively considerable" solely because other projects would have a significant cumulative impact; rather, the project would also need to contribute considerably to a significant cumulative impact (State CEQA Guidelines, Section 15064(h)(1)).

Impact Levels

The terminology listed below is used to denote the significance of environmental impacts of the No Action Alternative and action alternatives. The use of this specific terminology is intended to allow the use of this Draft EIS for CEQA purposes.

- **No impact** would occur if the construction, operation, and maintenance of the alternative under consideration would not have any direct or indirect effects on the environment. "No impact" means no change from existing conditions. This impact level does not need mitigation.

- An impact that would not result in a substantial and adverse change in the environment would be **less than significant**. This impact level does not require mitigation under CEQA, even if applicable measures are available.

- A **significant** impact is defined by California PRC Section 21068 as "a substantial, or potentially substantial, adverse change in the environment." Levels of significance can vary by project, based on the change in the existing physical condition. This Draft EIS uses the CEQA definition of "significant impact."

- A **potentially significant** impact is one that, if it were to occur, would be considered a significant impact as described above; however, the occurrence of the impact cannot be immediately determined with certainty. For CEQA purposes, a potentially significant impact is treated as if it were a significant impact. Therefore, under CEQA, feasible mitigation measures or alternatives to the proposed action must be identified,

where applicable, to reduce the magnitude of potentially significant impacts.

- A **significant and unavoidable impact** is a substantial or potentially substantial adverse effect on the environment that cannot be reduced to a less-than-significant level even with any feasible mitigation. Under CEQA, a project with significant and unavoidable impacts could proceed, but the lead agency would be required to do the following:

  - Conclude in findings that there are no feasible means of substantially lessening or avoiding the significant impact in accordance with Section 15091(a)(3) of the State CEQA Guidelines (i.e., CCR Title 14, Section 15091(a)(3)).

  - Prepare a statement of overriding considerations, in accordance with Section 15093 of the State CEQA Guidelines, explaining why the lead agency would proceed with a project in spite of the potential for significant impacts.

- A **significant cumulative** impact would occur when the project would make a "cumulatively considerable incremental contribution" to an overall significant cumulative impact. If an overall cumulative impact would not be significant, even when the project would make a cumulatively considerable incremental contribution to the cumulative impact, then it is determined that the project would not cause a significant cumulative impact.

- A **beneficial** impact is a positive change or improvement in the environment and for which no mitigation measures are required.

- An impact may have a level of significance that is too uncertain to be reasonably determined. Such an impact would be designated **too speculative for meaningful evaluation**, in accordance with Section 15145 of the State CEQA Guidelines. Where some degree of evidence points to the reasonable potential for a significant effect, the Draft EIS may explain that a determination of significance is uncertain, but is still assumed to be "potentially significant," as described above. In other circumstances, after thorough

investigation, the determination of significance may still be too speculative to be meaningful. This is an effect for which the degree of significance cannot be determined for specific reasons. For example, aspects of the impact itself may be unpredictable or the severity of consequences cannot be known at this time.

Mitigation Development Process and Objectives

Mitigation measures are presented where feasible to avoid, minimize, rectify, reduce, or compensate for significant and potentially significant impacts of the proposed action and alternatives, in accordance with NEPA regulations (40 CFR 1508.20) and the State CEQA Guidelines (Section 15126.4). Each mitigation measure is identified numerically to correspond with the number of the impact being mitigated by the measure. No mitigation measures are needed when an impact is determined to be "less than significant" or "beneficial," or where no impact would occur. Where sufficient feasible mitigation is not available to reduce an impact to a less-than-significant level, the impact is identified as "significant and unavoidable."

Significance After Mitigation

For every impact that would be significant or potentially significant, mitigation is applied, if feasible, to avoid or reduce the impact to a less-than-significant level and one of two conclusions is reached:

- The mitigation would reduce the impact to a less-than-significant level.

OR

- No feasible mitigation exists to reduce the impact to a less-than-significant level, and thus the impact would be significant and unavoidable.

Impact significance is reevaluated after application of mitigation in this Draft EIS.

Cumulative Effects

Chapter 27, "Cumulative Effects," provides an analysis of overall cumulative effects of the No Action Alternative and action alternatives. Cumulative effects are determined by analyzing the potential for impacts of an alternative to combine with the impacts of other past, present, and reasonably foreseeable future projects to produce project-related impacts (as defined above). This analysis follows applicable guidance provided by CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005).

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Chapter 4
Air Quality and Greenhouse Gas Emissions

This chapter describes the affected environment for air quality and GHG emissions, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

This section describes existing air quality conditions and GHG emissions in the primary study area for the dam and reservoir modifications proposed under the Investigation. The climate and the emissions of criteria air pollutants and toxic air contaminants (TAC) from Friant Dam to Kerckhoff Dam, including Millerton Lake, in the San Joaquin River watershed are described. In addition, the attainment statuses within the Study Area relative to national and State air quality standards are summarized.

The primary study area for this analysis has two components – local and regional. The local area is the immediate vicinity of Millerton Lake, where project construction would occur. Regionally, Madera and Fresno counties are located in the San Joaquin Valley Air Basin (SJVAB). The SJVAB also includes all of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare counties; and the San Joaquin Valley portion of Kern County.

The action alternatives would not include any construction or operational activities in the extended study area that would affect air quality or contribute to any GHG emissions. Therefore, this section only minimally discusses air quality conditions and does not discuss any GHG emissions in the extended study area.

Topography, Climate, and Meteorology

The SJVAB is bounded by the Sacramento-San Joaquin River Delta to the north, the Sierra Nevada Range to the east, the Transverse Range to the south, and Coastal Ranges to the west. The SJVAB is particularly vulnerable to air pollution formation because of its topography, climate, and growing population. Surrounding mountains trap airborne pollutants near the San Joaquin Valley floor, and summer temperatures promote the formation of harmful ground-level ozone (i.e., smog). The valley is often subject to inversion layers that, coupled with geographic barriers and high summer temperatures, create high potential for air pollution problems.

Criteria Air Pollutants

Concentrations of the following air pollutants are used as indicators of ambient air quality conditions: ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable and fine particulate matter (PM_{10} and $PM_{2.5}$), and lead. Because these are the most prevalent air pollutants known to be deleterious to human health, they are commonly referred to as “criteria air pollutants.”

Ozone

Ozone is a photochemical oxidant and the primary component of smog. Ozone is not directly emitted into the air, but is formed through complex chemical reactions between precursor emissions of reactive organic gases (ROG) and oxides of nitrogen (NO_X) in the presence of sunlight. ROGs are volatile organic compounds (VOC). ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that results from the combustion of fuels.

Ozone located in the lower atmosphere is a major health and environmental concern. Meteorology and terrain play a major role in ozone formation. Low wind speeds or stagnant air coupled with warm temperatures and clear skies provide the optimum conditions for ozone formation. Therefore, summer is the peak ozone season. Ozone is a regional pollutant that often affects large areas. Ozone concentrations over or near urban and rural areas reflect an interplay of emissions of ozone precursors, transport, meteorology, and atmospheric chemistry (Godish 2004).

Carbon Monoxide

CO is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels, primarily from mobile

(transportation) sources. Approximately 77 percent of the nation's CO emissions are from mobile sources. The other 23 percent consist of CO emissions from wood-burning stoves, incinerators, and industrial sources. The highest concentrations are generally associated with cold, stagnant weather conditions that occur during winter. In contrast to ozone, which is a regional pollutant, CO causes problems on a local scale.

Nitrogen Dioxide

NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary combustion engines. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to formation of ground-level ozone and fine particle pollution, NO_2 is linked with a number of adverse respiratory system effects (EPA 2010). The combined emissions of NO and NO_2 are referred to as NO_X, which are reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with ozone, the NO_2 concentration in a particular geographical area may not be representative of the local NO_X emission sources.

Sulfur Dioxide

SO_2 is produced by such stationary sources such as coal and oil combustion, steel mills, refineries, and pulp and paper mills. SO_2 is a respiratory irritant. On contact with the moist mucous membranes, SO_2 produces sulfurous acid.

Particulate Matter

Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction operations, fires, and natural windblown dust, and particulate matter formed in the atmosphere by condensation and/or transformation of SO_2 and ROGs. $PM_{2.5}$ includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less.

Lead

Lead is a metal found naturally in the environment and in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters.

Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

Criteria Air Pollutant Monitoring and Attainment

Concentrations of criteria air pollutants are measured at several monitoring stations in Fresno and Madera counties. The Clovis-N Villa Avenue station is the closest station to the area of project features with recent data for ozone and particulate matter. In general, the ambient air quality measurements from these stations are representative of the primary study area's air quality. Table 4-1 summarizes the air quality data from the most recent 3 years. The data are compared with the ambient air quality standards as noted below. Refer to Table 4-2 for a full listing of all ambient air quality standards.

The monitoring data are used to designate areas according to attainment status for criteria air pollutants. The purpose of these designations is to identify areas with air quality problems and thereby initiate planning efforts for improvement. The three basic designation categories are "nonattainment," "attainment," and "unclassified (see notes in Table 4-2 for full definitions)." "Unclassified" is used in an area that cannot be classified on the basis of available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, "nonattainment-transitional," that is given to nonattainment areas that are progressing and nearing attainment.

The most current attainment designations for Fresno County are shown in Table 4-2 for each criteria air pollutant. Much of the extended study area, including the San Joaquin River watershed, is located in the SJVAB, which is a Federal and State nonattainment area for ozone and PM_{10}; and is in State nonattainment with and $PM_{2.5}$.

Table 4-1. Summary of Annual Ambient Air Quality Data (2009 – 2011)

Criteria Air Pollutant	2009	2010	2011
OZONE			
Clovis-N Villa Avenue Monitoring Station			
California maximum concentration (1-hour/8-hour average, ppm)	0.119/ 0.105	0.133/ 0.105	0.133/ 0.103
Number of days State 1-hour/8-hour standard exceeded	33/64	22/58	32/72
Number of days national 1-hour/8-hour standard exceeded	0/48	3/39	2/49
FINE PARTICULATE MATTER ($PM_{2.5}$)			
Clovis-N Villa Avenue Monitoring Station			
California maximum concentration ($\mu g/m^3$)	71.0	75.2	76.4
Number of days national standard exceeded (measured[1])	26	19	38
RESPIRABLE PARTICULATE MATTER (PM_{10})			
Clovis-N Villa Avenue Monitoring Station			
Maximum concentration ($\mu g/m^3$)	65.2	62.2	77.0
Number of days State standard exceeded (measured/calculated[1])	5/32.8	8/47.9	9/53.0
Number of days national standard exceeded (measured/calculated[1])	0/0	0/0	0/0

Source: ARB 2011a, ARB 2011b

Note:

[1] Measured days are those days that an actual measurement was greater than the level of the State daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

Key:
$\mu g/m^3$ = micrograms per cubic meter
$PM_{2.5}$ = fine particulate matter with an aerodynamic diameter of 2.5 micrometers or less
PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
ppm = parts per million

Table 4-1. Summary of Annual Ambient Air Quality Data (2009 – 2011) (contd.)

	2009	2010	2011
RESPIRABLE PARTICULATE MATTER (PM_{10})			
Clovis-N Villa Avenue Monitoring Station			
Maximum concentration (µg/m^3)	65.2	62.2	77.0
Number of days State standard exceeded (measured/calculated[a])	5/32.8	8/47.9	9/53.0
Number of days national standard exceeded (measured/calculated[a])	0/0	0/0	0/0

Source: ARB 2011a, ARB 2011b

Note:
[a] Measured days are those days that an actual measurement was greater than the level of the State daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

Key:
µg/m^3 = micrograms per cubic meter
$PM_{2.5}$ = fine particulate matter with an aerodynamic diameter of 2.5 micrometers or less
PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
ppm = parts per million

Table 4-2. Ambient Air Quality Standards and Designations

Pollutant	Averaging Time	California		National Standards[1]		
		Standards [2,3]	Attainment Status (Fresno County) [4]	Primary [3,5]	Secondary [3,6]	Attainment Status (Fresno County) [7]
Ozone	1-hour	0.09 ppm (180 µg/m^3)	N (Severe)	[8]	Same as primary standard	–
	8-hour	0.070 ppm	–	0.075 ppm (147 µg/m^3)	Same as primary standard	N
Carbon monoxide	1-hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	–	U/A
	8-hour	9 ppm (10 mg/m^3)	A	9 ppm (10 mg/m^3)	–	U/A
	8-hour (Lake Tahoe)	6 ppm (7 mg/m^3)	–	–	–	–
Nitrogen dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	–	0.053 ppm (100 µg/m^3) [9]	Same as primary standard	U/A
	1-hour	0.18 ppm (339 µg/m^3)	A	0.100 ppm (188 µg/m^3) [9]	Same as primary standard	–
Sulfur dioxide (SO_2)	24-hour	0.04 ppm (105 µg/m^3)	A	–	–	U
	3-hour	–	–	–	0.5 ppm (1300 µg/m^3) [10]	U
	1-hour	0.25 ppm (655 µg/m^3)	A	0.075 ppm (196 µg/m^3) [10]	–	–
Respirable particulate matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	N	–	Same as primary standard	A
	24-hour	50 µg/m^3	N	150 µg/m^3 [(6)]	Same as primary standard	A
Fine particulate matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	N	15 µg/m^3	Same as primary standard	N
	24-hour	–	–	35 µg/m^3	Same as primary standard	N

Table 4-2. Ambient Air Quality Standards and Designations (contd.)

Pollutant	Averaging Time	California		National Standards [1]		
		Standards [2,3]	Attainment Status (Fresno County) [4]	Primary [3,5]	Secondary [3,6]	Attainment Status (Fresno County) [7]
Lead [11]	30-day Average	1.5 µg/m^3	A	–	–	–
	Calendar Quarter	–	–	1.5 µg/m^3	Same as primary standard	A
	Rolling 3 Month Average	–	–	0.15 µg/m^3	Same as primary standard	A
Sulfates	24-hour	25 µg/m^3	A	No national standards		
Hydrogen sulfide	1-hour	0.03 ppm (42 µg/m^3)	U	No national standards		
Vinyl chloride [11]	24-hour	0.01 ppm (26 µg/m^3)	U/A	No national standards		
Visibility-reducing particle matter	8-hour	Extinction coefficient of 0.23 per kilometer—visibility of 10 mi or more	U	No national standards		

Sources: ARB 2011a, 2011b

Notes:

[1] National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM10 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The PM2.5 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the U.S. Environmental Protection Agency (EPA) for further clarification and current Federal policies.

[2] California standards for ozone, CO (except Lake Tahoe), SO2 (1- and 24-hour), NO2, particulate matter, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

[3] Concentration is expressed first in units in which it was promulgated (i.e., parts per million (ppm) or micrograms per cubic meter (µg/m3)). Equivalent units given in parentheses are based upon a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[4] Unclassified (U): A pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment. Attainment (A): A pollutant is designated attainment if the State standard for that pollutant was not violated at any site in the area during a 3-year period. Nonattainment (N): A pollutant is designated nonattainment if there was a least one violation of a State standard for that pollutant in the area. Nonattainment/Transitional (NT): A subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

Table 4-2. Ambient Air Quality Standards and Designations (contd.)

Notes: (contd.)

[5] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[6] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[7] Nonattainment (N): Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. Attainment (A): Any area that meets the national primary or secondary ambient air quality standard for the pollutant. Unclassifiable (U): Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

[8] The 1-hour ozone national ambient air quality standard was revoked on June 15, 2005, for all areas in California.

[9] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 part per million (ppm) (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of ppm. To directly compare the national standards to the California standards, the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

[10] On June 2, 2010, EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010. The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in ppb. California standards are in ppm. To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

[11] The California Air Resources Board has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Key:
$\mu g/m^3$ = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter
ppm = parts per million

Toxic Air Contaminants

TACs, or in Federal terms, hazardous air pollutants (HAP), are air pollutants that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations. Of the TACs for which data are available in California, diesel particulate matter (diesel PM), naturally occurring asbestos, benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene pose the greatest known health risks. Dioxins are also considered to pose substantial health risk, and diesel PM poses the greatest health risk. Current facilities permitted by SJVAPCD near the primary study area are Calmat Company, Celestial Family Holdings, LLC, the Federal Aviation Administration, Fort Washington Country Club, Professional Exchange Service Corporation, the Ponderosa Telephone Company, and Verizon Wireless–Friant (ARB 2008).

Odors

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

With respect to odors, the human nose is the sole sensing device. The ability to detect odors varies considerably among the population and overall is quite subjective. Some individuals have the ability to smell very minute quantities of specific substances; others may not have the same sensitivity but may be sensitive to odors of other substances. In addition, people may have different reactions to the same odor; an odor that is offensive to one person may be perfectly acceptable to another (e.g., fast-food restaurant). It is important to also note that an unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs when the intensity of the odor changes.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as

flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word “strong” to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the concentration decreases. As this occurs, the intensity of the odor weakens and eventually becomes so low that the odor is quite difficult to detect or recognize. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the threshold means that the concentration in the air is not detectable by the average human.

There are no existing potential sources of odors in the primary study area. The nearest landfill to the site is the River Road Transfer Station, located at 10463 North Rice Road in Fresno, CA, approximately 12 miles southwest of the primary study area.

Existing Sensitive Receptors

Sensitive receptors are more susceptible to the effects of air pollution than the general population. SJVAPCD defines sensitive receptors as “facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants,” such as hospitals, schools, convalescent facilities, and residential areas.

Sensitive receptors in the vicinity of the area of project features include residences scattered around Millerton Lake and the community of Friant, to the southwest. Residences closest to the project site are located along Sky Harbour Road, approximately 1 mile north and west of the area of project features, and scattered rural residences approximately 0.75 north of the area of project features in Madera County.

Greenhouse Gases and Climate Change Science

Certain gases in the earth’s atmosphere, classified as GHGs, play a critical role in determining the earth’s surface temperature. Solar radiation enters the earth’s atmosphere from space. A portion of the radiation is absorbed by the earth’s surface, and a smaller portion of this radiation is reflected back toward space. This absorbed radiation is then emitted from the earth as low-frequency infrared radiation. The frequencies at which bodies emit radiation are proportional to temperature. The earth has a much lower temperature than the sun; therefore, the earth emits lower frequency radiation. Most solar radiation passes through GHGs; however, infrared radiation is

absorbed by these gases. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the greenhouse effect, is responsible for maintaining a habitable climate on Earth. Without the greenhouse effect, Earth would not be able to support life as we know it.

Prominent GHGs contributing to the greenhouse effect are water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), among others. Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth's climate, known as global climate change or global warming. It is extremely unlikely that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007).

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and TACs, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about 1 day), GHGs have long atmospheric lifetimes (1 year to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be pinpointed, it is understood that more CO_2 is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. Of the total annual human-caused CO_2 emissions, approximately 54 percent is sequestered through ocean uptake, uptake by northern hemisphere forest regrowth, and other terrestrial sinks within a year, whereas the remaining 46 percent of human-caused CO_2 emissions remains stored in the atmosphere (Seinfeld and Pandis 1998).

Greenhouse Gas Emissions Sources

Emissions of GHGs contributing to global climate change are attributable in large part to human activities associated with the transportation, industrial/manufacturing, utility, residential, commercial and agricultural sectors (ARB 2014). California produced 448 million gross metric tons (MT) of carbon dioxide equivalent (CO_2e) in 2011 (ARB 2014).

Combustion of fossil fuel in the transportation sector was the single largest source of California's GHG emissions in 2011,

accounting for 38 percent of total GHG emissions in the state (ARB 2014). This sector was followed by the industrial sector (21 percent) and the electric power sector (including both in- and out-of-state generation) (19 percent) (ARB 2014). California GHG emissions inventory and projections are summarized in Table 4-3.

Table 4-3. California Greenhouse Gas Emissions Inventory and Projections

Emissions Sector	MMT CO_2e/yr				
	1990	**2000**	**2005**	**2011**	**2020**
Electric Power[1]	110.6	104.9	107.9	86.6	110.4
Residential/Commercial	44.1	43.6	42.5	45.5	45.3
Transportation	150.7	176.3	188.9	168.4	183.9
Industrial	103.0	95.8	94.2	93.2	91.5
High GWP	-[2]	7.1	9.3	15.2	37.9
Agriculture	23.4	29.0	32.8	32.2	29.1
Recycling and Waste	-[2]	6.1	6.5	6.9	8.5
Forestry	0.2	-	-	-	0.2
Gross Total Emissions[3]	433	462.9	482.1	448.1	506.8
Carbon Sequestration	-6.7	*see notes	*see notes	*see notes	*see notes
Net Emissions[3]	427	*see notes	*see notes	*see notes	*see notes

Source: ARB 2007:6, 2013, 2014.

Notes:
*Inventory reporting methodology change initiated by ARB no longer accounts for carbon sequestration.
[1] Includes in-state-generated and imported electricity production.
[2] Contained within Industrial Sector emissions.
[3] Totals may not sum exactly due to rounding.

Key:
GWP = global warming potential
MMT CO_2e/yr = million metric tons carbon dioxide equivalent per year.

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on air quality and GHG emissions that could result from implementing any of the alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on air quality and GHG emissions. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on air quality and GHG emissions and associated mitigation measures are summarized in Table 4-4.

Table 4-4. Summary of Impacts and Mitigation Measures for Air Quality and Greenhouse Gas Emissions

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-1: Reduce Mobile-Source Exhaust Emissions	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
AQ-2: Project-Generated Construction-Related Toxic Air Contaminant Emissions that would Expose Sensitive Receptors to Substantial Pollutant Concentrations and Increased Health Risks	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-2: Implement Mitigation Measure AQ-1, Reduce Mobile-Source Exhaust Emissions	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 4-4. Summary of Impacts and Mitigation Measures for Air Quality and Greenhouse Gas Emissions (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
AQ-3: Project-Generated Operational Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	AQ-4: Reduce Greenhouse Gas Emissions	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
- = Not Applicable
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

Methods and Assumptions

Air Quality

Analysis of potential impacts on air quality is based on guidance developed by SJVAPCD. The action alternatives consist of implementing construction activities for the dam structure; construction of the dam, diversion tunnel, intake structure, and permanent and temporary access/haul routes for construction and maintenance; clearing the reservoir area that would be affected by inundation; and construction of related facilities such as a powerhouse/valve house, and transmission facilities.

The analysis was based on project-specific details, where available, along with SJVAPCD-recommended inputs and model default settings. A project-specific detailed list of heavy-duty construction equipment (i.e., proposed work hours and fuel consumption for each activity type) under each action alternative was available. The number of truck trips and trip distances for export of spoils and import of materials, volumes of material to be hauled, and construction schedules and phasing estimates was also available. For operational activities, primary data inputs were the number of vehicle trips and average trip distances associated with visitation to the recreation facilities.

Quantification of criteria air pollutant (and precursor) emissions were based on a combination of methods, including the use of fugitive dust emission factors from EPA's published Air Pollution (AP)-42 guidance, exhaust emission factors derived from ARB's off- and on-road emissions factor models (OFFROAD 2007 and EMFAC 2011, respectively), and the SJVAPCD-approved California Emissions Estimator Model (CalEEMod) version 2013.2. Each method is explained in more detail below.

Emission factors obtained from EPA's AP-42 guidance were used to model fugitive dust emissions (PM_{10}) from construction activities (e.g., grading, earthmoving, blasting, stockpiling of material, and road travel for truck haul and for worker commute trips). Three primary construction activities were identified that would represent the worst-case fugitive dust emissions from all action alternatives: aggregate handling and truck loading/unloading of material at the different quarry, batch plant, and haul road locations (i.e., option A, B, or C), grading/earth moving, and concrete batching (see discussion

below). EPA's AP-42 guidance provides emission factors that estimate fugitive dust emissions from the loading of aggregate onto storage piles, equipment traffic in storage areas, wind erosion from pile surfaces, loadout of aggregate for shipment or return to the process stream (e.g., batch or continuous drop operations), and from bulldozing/grading.

Primary inputs to model fugitive dust from aggregate handling and storage piles included total quantities of excavated material and heavy-duty construction equipment hours (e.g., graders, bulldozers, scrapers, and excavators).

For fugitive dust emissions associated with the concrete batch plant, emission factors from the Concrete Batching Policy Manual, published by the Sacramento Metropolitan Air Quality Management District, were relied upon for various batch plant-related processes. More specifically, these include aggregate transfer, sand transfer, cement unloading, cement supplement unloading, hopper loading, and mixer loading. Primary inputs to estimate fugitive dust from the concrete batching operations included total quantities of aggregate material that would be required by each construction phase of each action alternative.

Exhaust emissions of ROG, NO_X, PM_{10}, and CO_2 from heavy-duty construction equipment were estimated using emission factors derived from OFFROAD 2007. OFFROAD is a database that contains an off-road emissions inventory of the population, activity, and emissions estimate of the varied types of off-road equipment within each county in California. The major categories of engines and vehicles include agricultural, construction, lawn and garden, and off-road recreation. OFFROAD was run for San Joaquin Valley in 2015 (exhaust emissions would decrease in the future, thus 2015 was used as a conservative assumption) and used to generate a fleet-wide emission rate for each exhaust pollutant based on fuel consumption.

EMFAC 2011 is a model developed by ARB to estimate emissions from on-road vehicles. EMFAC 2011 was run for San Joaquin Valley in 2015 and used to generate exhaust emission rates for worker commute trips and truck hauling trips. Emission rates were applied to daily truck trips and worker commute trips required by each action alternative.

CalEEMod was developed in collaboration with the air districts of California. Default data (e.g., emission factors, trip lengths, meteorology, and source inventory) were provided by the

various California air districts to account for local requirements and conditions. CalEEMod can be used to estimate air pollutant emissions from construction activities, mobile-source emissions, and operational emissions from mobile and area sources. CalEEMod was used to estimate mobile-source emissions of criteria air pollutants (and precursors) (i.e., ROG, NOx, PM_{10}, and CO) from operational trips associated with visitation to the recreational sites. CalEEMod was also used to obtain certain regional attributes (e.g., vehicle fleet composition, annual precipitation) needed for input to methods described above.

TACs and odors were also analyzed in accordance with SJVAPCD, ARB, and EPA guidance, policies, and rules.

In addition to modeling mass emissions of criteria air pollutants (and precursors), as discussed above, cancer risk as a result of exposure from diesel PM from construction activities was also modeled for all quarry, batch plant, and haul road options for Alternative Plan 4. Alternative Plan 4 would generate the most mass emissions compared to the other alternatives and thus options A, B, and C under Alternative Plan 4 represent the worst-case scenario.

Diesel PM concentrations were modeled with AERMOD, an air dispersion model, and the associated cancer risk was determined using SJVAPCD-approved methods. All modeling was conducted in coordination with SJVAPCD. The AERMOD modeling included 130 nearby receptors, primarily single-family residences and commercial structures. Source inputs included construction staging areas, construction activity areas, and the onsite quarry as area sources; as well as access/haul roads as line volume sources. Resultant concentrations averaged over the entire period of meteorological data were then multiplied by SJVAPCD-provided adjustment factor to estimate cancer risk.

Refer to the Physical Resources Appendix for detailed model input assumptions and output results.

Greenhouse Gas Emissions

GHG emission levels associated with the action alternatives would be generated by short-term construction activities from the use of heavy-duty construction equipment and mobile sources such as worker commuter and vendor hauling of materials. All action alternatives would also partially clear vegetation/trees from the reservoir area that would be affected

by inundation. This would result in loss of CO_2 sequestration. Operational GHG emissions would result from energy consumption and recreational activities.

GHG emissions were estimated using a combination of methods. GHG exhaust emissions from heavy-duty construction equipment were estimated using the most recent version of ARB's off-road emission factor model OFFROAD. The model was run for the San Joaquin Valley in 2015 (exhaust emissions would decrease in the future, thus 2015 was used as a conservative assumption) and was used to generate a county fleet-wide emission rate for GHG based on diesel fuel consumption.

The most recent version of ARB's on-road emission factors model (EMFAC 2011) was used for estimating emissions from on-road vehicles. EMFAC 2011 was run for San Joaquin Valley in 2015 (exhaust emissions would decrease in the future, thus 2015 was used as a conservative assumption) and was used to generate exhaust emission rates for worker commute trips and truck hauling trips. Emission rates were applied to daily truck trips and worker commute trips required by each action alternative.

CalEEMod was used to estimate mobile-source GHG emissions from operational trips associated with visitation to the recreational sites of the project as well as to estimate loss of CO_2 sequestration from vegetation clearing.

Operational GHG emissions were estimated with utility specific intensity factors for PG&E based on total annual electricity consumption for each action alternative.

Construction-generated emissions were amortized over the lifetime of the project (i.e., 50 years) and added to operational emissions to determine the overall level of GHG generation.

SVJAPCD has not determined a quantitative level of GHG emissions increase, above which a project would have a significant impact on the environment, and below which would have a less-than-significant impact. SJVAPCD has developed a tiered approach to determining project-level significance on a project-by-project basis, as discussed below. This analysis follows the SJVAPCD-recommended approach.

However, because the SVJAPCD does not currently have an adopted quantitative threshold, this analysis also considers

other GHG thresholds currently being used in other parts of California to provide context for the GHG emission estimates.

The criteria suggested by various agencies primarily address operational emissions, and not the relatively short-term emissions of construction activities. One of the more commonly suggested mass emissions thresholds is 25,000 MT CO_2e per year. This value has been selected because it is the threshold established for mandatory emissions reporting for most sources in California under AB 32. Project emissions were compared to this threshold to determine significance.

Refer to the Physical Resources Appendix for detailed model input assumptions and output results.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and the range of action alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project and a reasonable range of alternatives, if required. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on air quality or GHG emissions would be significant under CEQA if project implementation would do any of the following:

- Conflict with or obstruct implementation of the applicable air quality plan
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation

- Expose sensitive receptors to substantial pollutant concentrations

- Create objectionable odors affecting a substantial number or people

- Generate GHG emissions, either directly or indirectly that exceed 25,000 MT/year that may have a significant impact on the environment

- Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing GHG emissions

As stated in the CEQA guidelines, where available, the significance established by the applicable air quality management of air pollution control district may be relied upon to make the above determinations. Thus, criteria considered in the analysis below include SJVAPCD-recommend thresholds of significance for criteria air pollutants and TACs. SJVAPCD policy also provides for a tiered approach in assessing significance of project specific GHG emission increases, as follows:

- Projects complying with an approved GHG emission reduction plan or GHG mitigation program which avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions. Such plans or programs must be specified in law or approved by the lead agency with jurisdiction over the affected resource and supported by a CEQA compliant environmental review document adopted by the lead agency. Projects complying with an approved GHG emission reduction plan or GHG mitigation program would not be required to implement Best Performance Standards (BPS).

- Projects implementing BPS would not require quantification of project specific GHG emissions. Consistent with CEQA Guidelines, such projects would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects not implementing BPS would require quantification of project specific GHG emissions and demonstration that project specific GHG emissions

would be reduced or mitigated by at least 29 percent, compared to Business as Usual (BAU), including GHG emission reductions achieved since the 2002-2004 baseline period, consistent with GHG emission reduction targets established in ARB's AB 32 Scoping Plan.

Topics Eliminated from Further Consideration

Construction activities for each of the action alternatives would involve blasting for aggregate production which could result in fugitive dust emissions. However, dust emissions would be minimal and would not represent a substantial portion of the total dust emissions in comparison to all other construction activities. Thus, this issue is not addressed further.

Implementation of the action alternatives would not result in the long-term operation of a major odor source and construction-generated odors would dissipate quickly (e.g., diesel emissions from heavy-duty construction equipment) and not be located within typical odor screening distances (e.g., operation of the concrete batch plant would be located at least 2,000 feet from any sensitive receptor). In addition, implementing any of the action alternatives would not result in locating any new sensitive receptors near existing odor sources. Thus, the creation of objectionable odors affecting a substantial number of people is not discussed further in this analysis.

Once construction is complete, operations would be limited to minor maintenance activities. Long-term operational activities would not involve the use of heavy-duty diesel construction equipment or haul trucks and thus would not result in increased emissions of toxic air contaminants or increased health risk at any nearby sensitive receptors. Therefore, project-generated operational-related toxic air contaminants are not discussed further in this analysis.

The action alternatives would not generate GHG emissions in the extended study area; therefore the potential to create any GHG emissions in the extended study area is not discussed further in this analysis.

No topics related to climate change (including GHGs) that are included in the significance criteria listed above were eliminated from further consideration.

All other relevant topics are analyzed below.

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impacts related to the generation of GHGs, described under Impact AQ-4, focus on the contribution of the alternatives to the buildup of GHGs in the atmosphere, which has been shown to contribute to climate change (IPCC 2007). It is unlikely that any single project by itself could have a significant impact on the environment with respect to GHGs. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which has in turn been shown to be the main cause of global climate change (IPCC 2007). Therefore, analysis of the environmental effects of GHG emissions from implementing the alternatives is addressed below as a cumulative impact analysis.

Impact AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative. There would be **no impact** under the No Action Alternative.

Action Alternatives Construction-related activities under the action alternatives would result in a direct effect on air quality from project-generated criteria air pollutant (PM_{10}) and precursor emissions (ROG and NO_X). Based on the modeling conducted, as summarized in Table 4-5, annual project-generated construction-related emissions would exceed SJVAPCD's significance thresholds for ROG, NO_X, and PM_{10} (shown in bold font in Table 4-5). All control measures in compliance with the requirements of Regulation VIII are currently incorporated into the project description, as described in Chapter 2, "Alternatives." However, the remaining dust emissions could violate or contribute substantially to an existing or projected air quality violation, especially

considering the current nonattainment status of the area. Consequently, project-generated construction-related emissions could expose nearby existing sensitive receptors to substantial pollutant concentrations. Refer to the Physical Resources Appendix for the general conformity determination.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Table 4-5. Summary of Modeled Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions Under All Action Alternatives

Phase and Duration	ROG	NO_X	PM_{10} (Exhaust/ Fugitive Dust/Total)
	Tons Per Year (TPY)		
Quarry, Batch Plant, and Haul Road Option A			
Alternative Plans 1, 2, 3, 5			
Overall Annual Average	17[1]	148[1]	5/42[1]/47[1]
Phase 1	21[1]	189[1]	6/33[1]/39[1]
Phase 2	4	35[1]	1/2/3
Phase 3	21[1]	200[1]	7/59[1]/66[1]
Alternative Plan 4			
Overall Annual Average	18[1]	150[1]	5/42[1]/47[1]
Phase 1	21[1]	189[1]	6/33[1]/39[1]
Phase 2	5	41[1]	1/2/3
Phase 3	21[1]	200[1]	7/59[1]/66[1]
SJVAPCD Significance Threshold	10	10	15
Quarry, Batch Plant, and Haul Road Option B			
Alternative Plans 1, 2, 3, 5			
Overall Annual Average	17[1]	142[1]	5/41[1]/46[1]
Phase 1	20[1]	185[1]	6/33/39
Phase 2	4	35[1]	1/2/3
Phase 3	20[1]	192[1]	6/58[1]/64[1]

Table 4-5. Summary of Modeled Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions under All Action Alternatives (contd.)

Phase and Duration	ROG	NO_X	PM_{10} (Exhaust/ Fugitive Dust/Total)
	Tons Per Year (TPY)		
Quarry, Batch Plant, and Haul Road Option B			
Alternative Plan 4			
Overall Annual Average	17[1]	145[1]	5/41[1]/46[1]
Phase 1	20[1]	185[1]	6/33[1]/39[1]
Phase 2	5	41[1]	1/2/3
Phase 3	20[1]	192[1]	6/58[1]/64[1]
SJVAPCD Significance Threshold	10	10	15
Quarry, Batch Plant, and Haul Road Option C			
Alternative Plans 1, 2, 3, 5			
Overall Annual Average	23[1]	187[1]	7/43[1]/50[1]
Phase 1	23[1]	211[1]	7/36[1]/43[1]
Phase 2	4	37	1/2/3
Phase 3	29[1]	262[1]	9/58[1]/67[1]
Alternative Plan 4			
Overall Annual Average	23[1]	190[1]	7/43[1]/50[1]
Phase 1	23[1]	190[1]	7/36[1]/43[1]
Phase 2	23[1]	211[1]	2/2/4
Phase 3	5	43[1]	9/58[1]/67[1]
SJVAPCD Significance Threshold	10	10	15

Notes:
[1] Modeled level exceeds SJVAPCD's thresholds.

Key:
NO_X = oxides of nitrogen
PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
ROG = reactive organic gases
SJVAPCD = San Joaquin Valley Air Pollution Control District

Impact AQ-2: Project-Generated Construction-Related Toxic Air Contaminant Emissions that would Expose Sensitive Receptors to Substantial Pollutant Concentrations and Increased Health Risks

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction-related activities under all the action alternatives would result in a direct effect on air quality from project-generated TAC emissions (i.e., diesel PM) from heavy-duty truck travel on proposed haul routes and heavy-duty construction equipment.

As discussed in Chapter 2, "Alternatives," because of uncertainties in adequacy of rock for aggregate, three quarry, batch plant, and haul road options are being considered within each action alterative. The main dam batch plant location and haul road connecting the potential quarry site to main dam batch plant would also vary depending on quarry option. The location of construction activity relative to nearby receptors could influence health risk.

Risk modeling was conducted using the worst-case emissions scenario for each action alternative. Due to the type of intake structure proposed under Alternative Plan 4, additional heavy-duty equipment would be required in comparison to the other action alternatives. Therefore, Alternative Plan 4 represents the worst-case emissions scenario among all action alternatives. Emissions of diesel PM would vary based on the three quarry, batch plant, and haul road options (i.e., between Option A, B, and C). Thus, worst-case modeling is represented by modeling Alternative Plan 4 Option A, Alternative Plan 4 Option B, and Alternative Plan 4 Option C. Impacts are discussed for each option separately, where appropriate.

Quarry, Batch Plant, and Haul Road Options A and C
Emission sources and receptors included in the model for Option A and C are shown below in Figure 4-1 and Figure 4-2, respectively. Quarry and haul road locations are described in further detail in Chapter 2, "Alternatives."

Based on the modeling conducted, the worst-case project-generated construction-related excess cancer risk for Option A

and C would be 2.4 and 7.4 chances per million, respectively, which would not exceed SJVAPCD's significance threshold of 10 chances per million, as shown in Table 4-6. Consequently, project-generated construction-related emissions for all action alternatives with either Option A or C would not result in the exposure of nearby existing sensitive receptors to substantial TAC concentrations.

Quarry, Batch Plant, and Haul Road Option B

Emission sources and receptors included in the model for Option B are shown below in Figure 4-3. Quarry, batch plant, and haul road Option B would result in locating the quarry in close proximity to other construction activities as well as nearby sensitive receptors. Quarry and haul road locations are described in further detail in Chapter 2, "Alternatives."

Based on the modeling conducted, the worst-case project-generated construction-related excess cancer risk for Option B would be 16.5 chances per million, which would exceed SJVAPCD's significance threshold of 10 chances per million, as shown in Table 4-6. Consequently, project-generated construction-related emissions for quarry, batch plant, and haul road Option B under any action alternative would result in the exposure of nearby existing sensitive receptors to substantial TAC concentrations.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

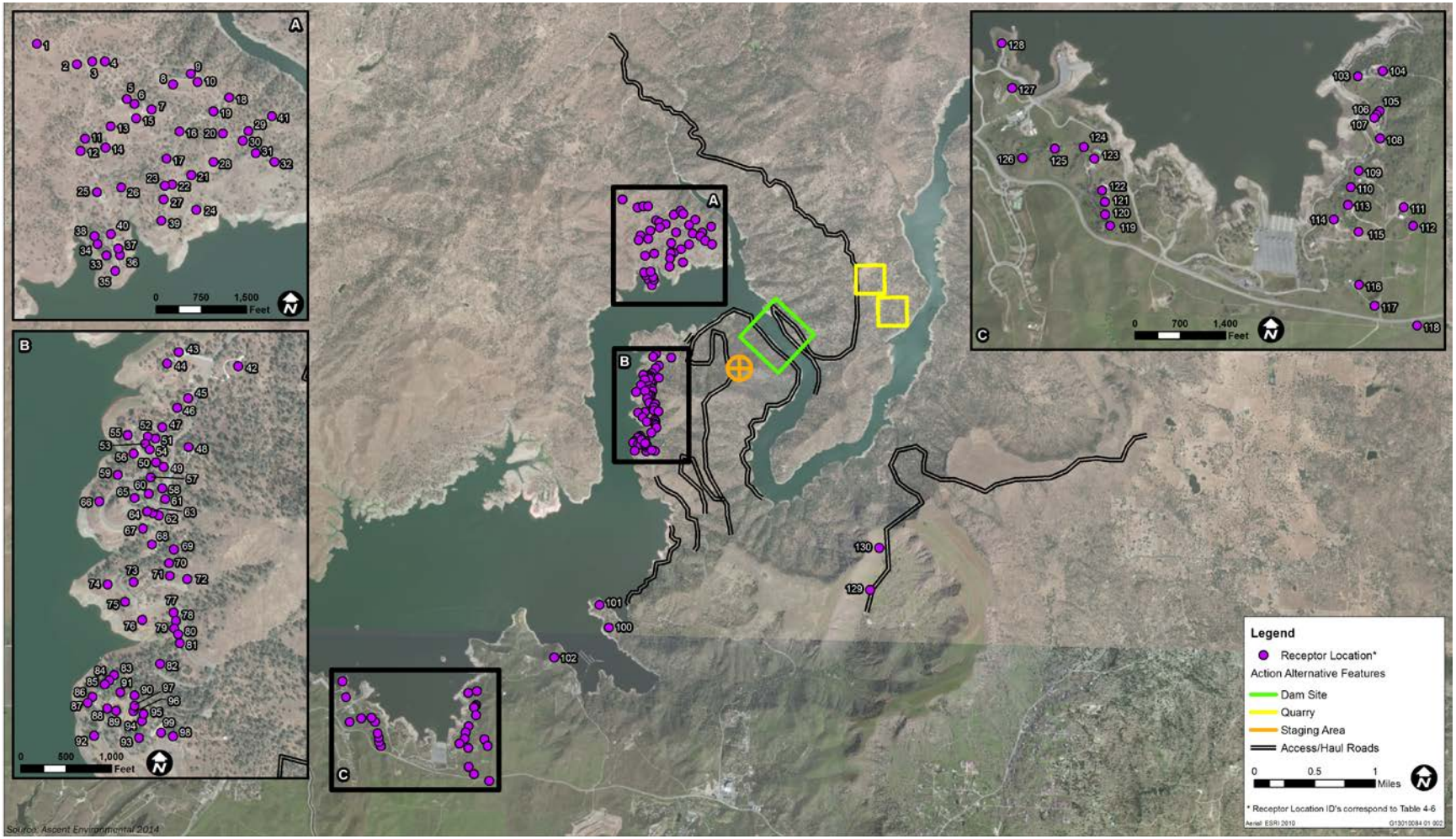

Figure 4-1. Receptor Locations for Cancer Risk (Quarry, Batch Plant, and Haul Road Option A)

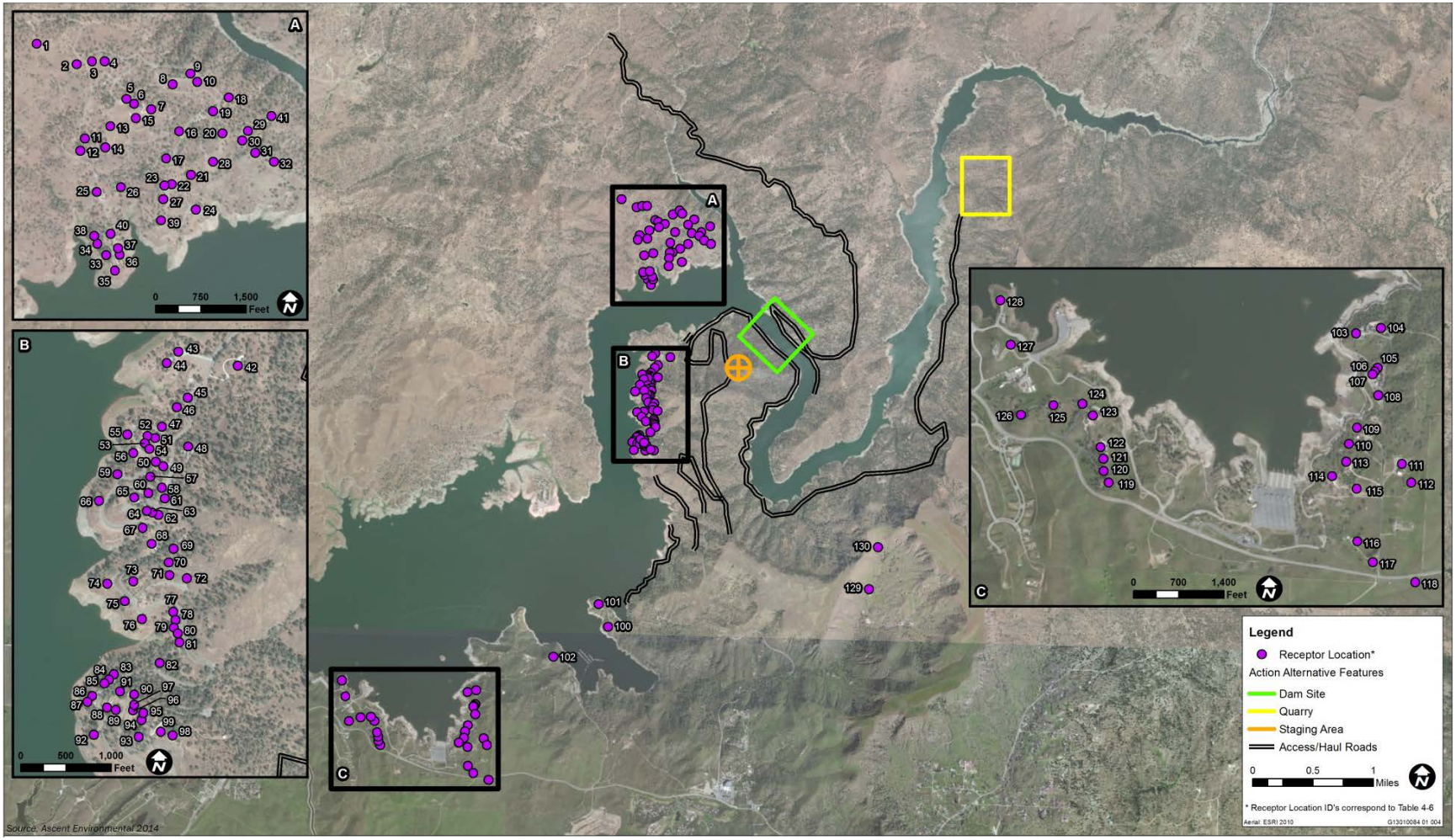

Figure 4-2. Receptor Locations for Cancer Risk (Quarry, Batch Plant, and Haul Road Option C)

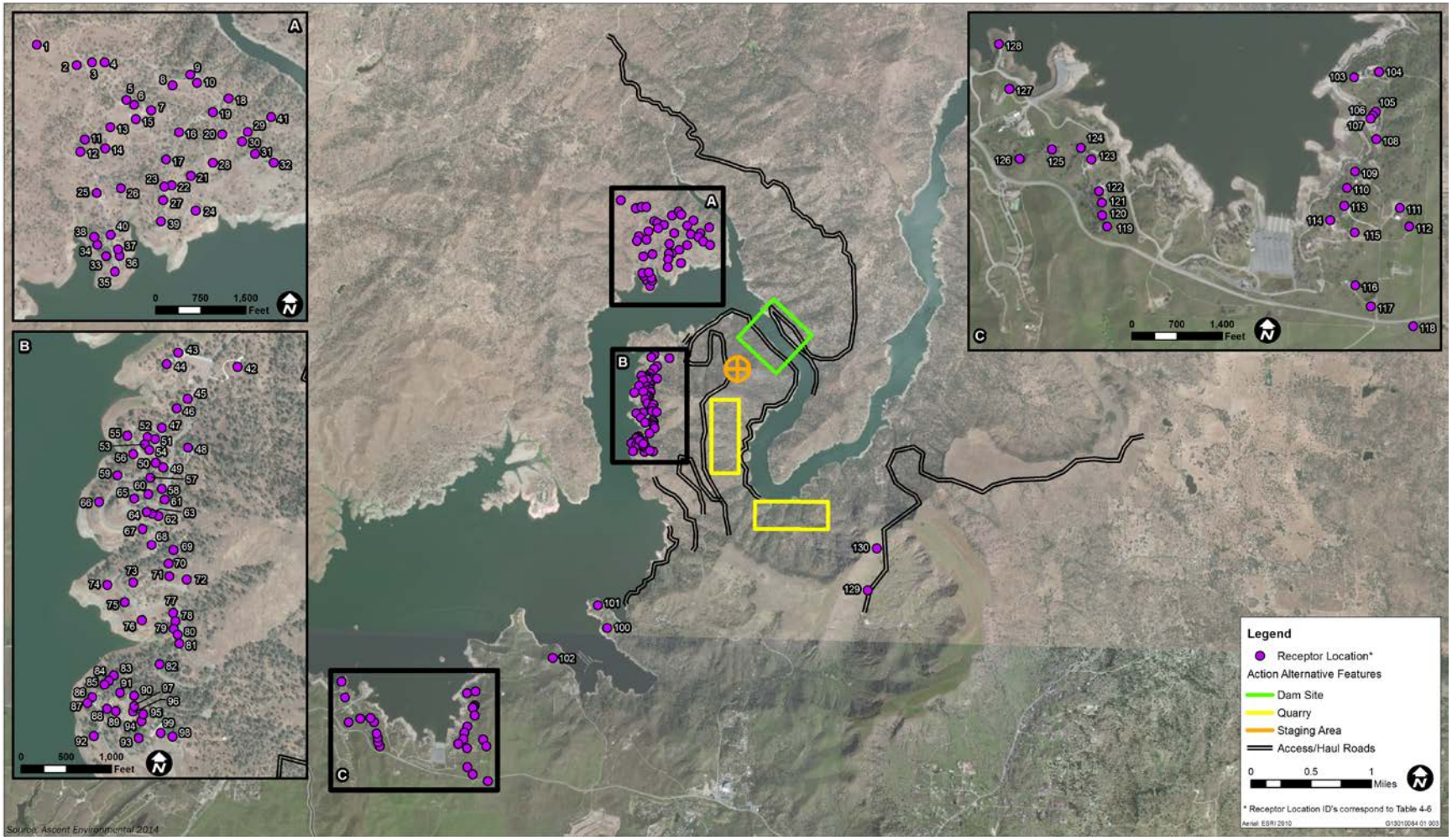

Figure 4-3. Receptor Locations for Cancer Risk (Quarry, Batch Plant, and Haul Road Option B)

Table 4-6. Worst-Case Modeled Excess Cancer Risk (chances per million) by Receptor Location ID for each Quarry, Batch Plant, and Haul Road Option (Options A, B, and C) of the Action Alternatives

Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)	Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)	Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)
1	1	2	1	45	1	9	3	88	<1	12	1
2	1	2	1	46	1	10	3	89	<1	12	1
3	1	2	1	47	1	10	2	90	<1	13	1
4	1	2	1	48	1	12	3	91	<1	13	1
5	1	2	2	49	1	12	2	92	<1	11	1
6	1	2	2	50	1	12	2	93	<1	13	1
7	2	2	3	51	1	11	3	94	<1	13	1
8	1	2	2	52	1	10	3	95	<1	14	1
9	1	1	2	53	1	11	3	96	<1	13	1
10	1	1	2	54	1	11	2	97	<1	13	1
11	2	2	3	55	1	10	2	98	<1	15	1
12	2	3	3	56	1	11	2	99	<1	14	1
13	2	3	3	57	<1	12	2	100	<1	1	1
14	2	3	3	58	<1	13	2	101	<1	1	1
15	2	2	3	59	<1	11	2	102	<1	1	<1
16	2	2	5	60	<1	12	2	103	<1	1	1
17	2	2	7	61	<1	13	2	104	<1	1	1
18	2	2	2	62	<1	13	2	105	<1	1	1
19	2	2	3	63	<1	13	2	106	<1	1	1
20	2	2	3	64	<1	13	2	107	<1	1	1

Table 4-6. Worst-Case Modeled Excess Cancer Risk (chances per million) by Receptor Location ID for each Quarry, Batch Plant, and Haul Road Option (Options A, B, and C) of the Action Alternatives (contd.)

Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)	Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)	Receptor ID[1]	Cancer Risk (Option A)	Cancer Risk (Option B)	Cancer Risk (Option C)
21	2	3	7	65	<1	12	2	108	<1	1	1
22	2	3	6	66	<1	10	2	109	<1	1	<1
23	2	3	6	67	<1	13	2	110	<1	1	<1
24	2	3	7	68	<1	14	2	111	<1	1	<1
25	2	2	6	69	<1	15	2	112	<1	<1	<1
26	2	3	7	70	<1	15	2	113	<1	1	<1
27	2	3	7	71	<1	15	2	114	<1	1	<1
28	2	2	4	72	<1	16	1	115	<1	1	<1
29	2	2	2	73	<1	13	2	116	<1	<1	<1
30	2	2	2	74	<1	12	2	117	<1	<1	<1
31	2	2	2	75	<1	13	2	118	<1	<1	<1
32	2	3	3	76	<1	14	2	119	<1	1	1
33	2	3	5	77	<1	16	2	120	<1	1	1
34	1	3	5	78	<1	16	2	121	<1	1	1
35	2	3	5	79	<1	16	2	122	<1	1	1
36	2	3	5	80	<1	16	2	123	<1	<1	1
37	2	3	6	81	<1	16	2	124	<1	<1	<1
38	1	2	5	82	<1	15	1	125	<1	<1	<1
39	2	3	7	83	<1	12	1	126	<1	<1	<1
40	2	3	6	84	<1	12	1	127	<1	<1	<1
41	2	2	2	85	<1	12	1	128	<1	1	<1
42	1	7	4	86	<1	12	1	129	<1	7	<1
43	1	7	3	87	<1	11	1	130	<1	4	<1
44	1	8	3								

Notes:
[1] Receptor identification number corresponding to receptor location in Figures 4-1, 4-2, and 4-3.
Key:
ID = receptor identification number

Impact AQ-3: Project-Generated Operational Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Action Alternatives Operations under the action alternatives would result in a direct effect on air quality from project-generated criteria air pollutant (PM_{10}) and precursor emissions (ROG and NOx) associated with recreational activities. Based on the modeling conducted, as summarized in Table 4-7, annual project-generated operational emissions would not exceed SJVAPCD's significance thresholds for ROG, NOx, and PM_{10}.

Therefore, this impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Table 4-7. Summary of Modeled Project-Generated Operational Criteria Air Pollutant and Precursor Emissions Under All Action Alternatives (Unmitigated)

Alternative Plan	ROG	NO_X	PM_{10}
	Tons Per Year		
1	<1	<1	<1
2	<1	<1	<1
3	<1	<1	<1
4	<1	<1	<1
5	<1	<1	<1
SJVAPCD Significance Threshold	10	10	15

Key:
NO_X = oxides of nitrogen
PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
ROG = reactive organic gases
SJVAPCD = San Joaquin Valley Air Pollution Control District

Impact AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementation of the action alternatives would result in direct and indirect generation of GHG emissions (i.e., from energy consumption). Construction activities for the action alternatives would result in increased generation of GHG emissions. Heavy-duty off-road equipment, materials transport in haul trucks, and worker commute would result in exhaust emissions of GHGs. GHG emissions associated with operation of the project would consist of GHG emissions from increases in visitors to new recreation areas, energy consumption from increases in pumping, and a loss of CO_2 sequestration from vegetation clearing that would be conducted throughout the inundation areas.

The total net increase in GHG emissions was estimated using the methods described above and is summarized below in Table 4-8.

Table 4-8. Summary of GHG Emissions Associated with the Action Alternatives

Source	CO_2e MT/Year		
Alternative Plan 1	**Option A**	**Option B**	**Option C**
Construction (Amortized over 50 years)[1]	5,215	4,922	6,321
Recreational Visitation Trips	136	136	136
Energy Consumption	54,493	54,493	54,493
Loss from Vegetation Accumulation	18,033	18,033	18,033
Total	**77,877**	**77,584**	**78,983**

Table 4-8. Summary of GHG Emissions Associated with the Action Alternatives (contd.)

Source	CO_2e MT/Year		
Alternative Plan 2	**Option A**	**Option B**	**Option C**
Construction (Amortized over 50 years)[1]	5,215	4,922	6,321
Recreational Visitation Trips	138	138	138
Energy Consumption	39,607	39,607	39,607
Loss from Vegetation Accumulation	18,033	18,033	18,033
Total	**62,993**	**62,700**	**64,099**
Alternative Plan 3	**Option A**	**Option B**	**Option C**
Construction (Amortized over 50 years)[1]	5,215	4,922	6,321
Recreational Visitation Trips	132	132	132
Energy Consumption	41,417	41,417	41,417
Loss from Vegetation Accumulation	18,033	18,033	18,033
Total	**64,797**	**64,504**	**65,903**
Alternative Plan 4	**Option A**	**Option B**	**Option C**
Construction (Amortized over 50 years)[1]	5,290	4,997	6,396
Recreational Visitation Trips	158	158	158
Energy Consumption	32,194	32,194	32,194
Loss from Vegetation Accumulation	18,033	18,033	18,033
Total	**55,675**	**55,382**	**56,781**
Alternative Plan 5	**Option A**	**Option B**	**Option C**
Construction (Amortized over 50 years)[1]	5,215	4,922	6,321
Recreational Visitation Trips	68	68	68
Energy Consumption	19,877	19,877	19,877
Loss from Vegetation Accumulation	18,033	18,033	18,033
Total	**43,193**	**42,900**	**44,299**

Note:

[1] Construction emissions were calculated for each year of each phase and summed for the entire Alternative. Alternative totals were then amortized over 50 years to be easily added to annual operational emissions. Refer to Physical Resourced Appendix for detailed modeling input data and output results.

Key:

CO_2e MT/Year = metric tons of carbon dioxide equivalent per year

GHG = greenhouse gas

Based on SJVAPCD-recommended procedures for evaluating GHG emissions, the action alternatives (including all quarry, batch plant, and haul road options) would not be subject to incorporation of any BPS, as no stationary GHG sources would result. However, although the SJVAPCD does not have quantitative thresholds in place that relate directly to this type of project, GHG emissions were compared to other adopted GHG thresholds, as described in the Methods and Assumptions section above. Estimated annual GHG emissions would exceed the applicable threshold of 25,000 MT/year for all action alternatives, and would cause a cumulatively considerable incremental contribution to the overall significant cumulative impact.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 4-4.

No mitigation is required for Impact AQ-3 within the primary study area, because this impact would be less than significant for all action alternatives. Impacts AQ-1 through AQ-4 would not occur in the extended study area.

Mitigation Measures AQ-1, AQ-2, and AQ-4, described below, are required for Impacts AQ-1, AQ-2, and AQ-4, respectively, in the primary study area for all action alternatives.

Mitigation Measure AQ-1: Reduce Mobile-Source Exhaust Emissions

For the reduction of construction-related mobile-source exhaust emissions of ROG, NO_X, and PM_{10}, Reclamation will implement the following actions:

- Exhaust emissions for construction equipment greater than 50 horsepower used or associated with the project shall be reduced by 20 percent of the total NO_X and by 45 percent of the total PM_{10} emissions from the statewide average as estimated by the ARB by using less polluting construction equipment, which can be achieved by utilizing add-on controls, cleaner fuels, or newer lower emitting equipment.

- Provide commercial electric power to the project site in adequate capacity to avoid or minimize the use of portable electric generators and the equipment.

- Where feasible, substitute electric-powered equipment for diesel engine driven equipment.

- When not in use, on-site equipment shall not be left idling.

- Limit the hours of operation of heavy duty equipment and/or the amount of equipment in use at any one time.

- Curtail construction during periods of high ambient pollutant concentrations (e.g., Spare the Air Days).

- Before construction contracts are issued, the project applicants shall perform a review of new technology, as it relates to heavy-duty equipment, to determine what (if any) advances in emissions reductions are available for use and are economically feasible. Construction contract and bid specifications shall require contractors to use the available and economically feasible technology on an established percentage of the equipment fleet. It is anticipated that in the near future both NO_X and PM_{10} control equipment will be available. The SJVAPCD shall be consulted with on this process.

Implementing Mitigation Measure AQ-1 would result in a 5, 20, and 45 percent reduction in ROG, NO_X, and PM_{10} mobile-source exhaust emissions, respectively. However, this mitigation would not be sufficient to reduce this air quality effect to a less-than-significant level. As a result, Impact AQ-1 would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure AQ-2: Implement Mitigation Measure AQ-1, Reduce Mobile-Source Exhaust Emissions

Implementing Mitigation Measure AQ-2 would reduce health risk from 16 chances in one million to 9 chances in one million due to the reduction of diesel PM and thus would reduce Impact AQ-2 to a **less than-significant** level.

Mitigation Measure AQ-4: Reduce Greenhouse Gas Emissions

For the reduction of GHG emissions, Reclamation will implement the following actions during the construction phase:

- Improve fuel efficiency from construction equipment by:
  - Maintaining all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated; and
  - Ensuring that all equipment operators are trained in proper use of equipment.
- Reduce electricity use in the construction offices by using compact fluorescent bulbs, powering off computers every day, and using energy-efficient (i.e., EPA EnergyStar Rated) appliances (e.g., heating and cooling units);
- Recycle or salvage non-hazardous construction and demolition debris; and
- Use locally sourced or recycled materials for construction materials.

Reclamation will implement the following actions during the operations phase:

- Reduce consumption of non-renewable energy. This could be accomplished by providing onsite renewable energy such as solar panels, or similar means to offset fossil fuel-powered electricity generation (e.g., solar panels for pumps).

Implementation of Mitigation Measure AQ-4 would reduce GHG emissions associated with construction and operations. Actions to reduce construction-related GHG emissions are BMPs and do not relate to a clear, quantifiable reduction in GHG emissions. Due to the magnitude of construction activities and heavy-duty construction equipment required, minimal GHG reduction from construction activities would be achieved. The most effective way to reduce GHG emissions would be to use renewable energy sources that do not use fossil

fuels for electricity generation. However, the level at which proposed project components could rely on solar power at this time is unknown. Implementation of Mitigation Measure AQ-4 would result in some level of GHG emissions reduction. However, due to the magnitude of annual GHG emissions and the availability of space (e.g., land, roofs of structures/building), solar panels would not be anticipated to reduce annual GHG emissions to below the 25,000 MT/year threshold. As a result, Impact AQ-4 would remain **significant and unavoidable** under the action alternatives.

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Chapter 5
Biological Resources – Fisheries and Aquatic Ecosystems

This chapter describes the affected environment for aquatic resources, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The affected environment for aquatic resources includes a discussion of the key fish species and their respective habitats in the primary and extended study areas.

Primary Study Area

Temperance Flat Reservoir Area

The Temperance Flat Reservoir Area currently consists of the San Joaquin River from upper Millerton Lake to Kerckhoff Dam and the upper section of Millerton Lake. The following describes both the San Joaquin River and the upper lake habitat.

Aquatic Habitat The reach of the San Joaquin River between Kerckhoff Dam and Millerton Lake has a bedrock channel, many long narrow pools, and an occasional steep cascade. In the past, sluicing to remove sediments from Kerckhoff Reservoir resulted in extremely high levels of sediments in this reach of the river, but flood flows in intervening years may have flushed these sediments from the river into Millerton Lake.

Overall, the section of the San Joaquin River between Kerckhoff Dam and Millerton Lake consists of extensive

stretches of bedrock walls above and below the water line. Large boulders and cobble are abundant. The quality and quantity of smaller gravels have not been evaluated.

The predominant habitat types are mostly pool and run habitats (with few glide habitat units). Run habitat was classified as being fairly swiftly flowing segments with some surface agitation, no major flow obstructions, and substrates dominated by gravel and cobble. Glide habitat was classified as areas with wide, uniform channel bottoms; low-to-moderate water velocity and without obvious turbulence; and substrates dominated by cobble, gravel, and sand.

Riffle habitat appeared to be predominantly high gradient (i.e., greater than 4 percent) or even cascade (high gradient consisting of alternating small waterfalls and shallow pools) habitat types, many of which are likely passage impediments for some fish. Low-gradient riffles (i.e., less than 4 percent) are less common.

Because of the abundance of bedrock, gravel recruitment into the river is low and, as a result, gravel that could be used by riverine fishes for spawning is probably fairly highly embedded, thus reducing the quality of spawning habitat.

Riparian vegetation along most of the river is poorly developed because the river margins are steep and rocky and flood flows frequently scour the channel. However, riparian vegetation occurs at the confluence of small streams in the upper portion of this reach. Where bedrock does not dominate the banks, riparian habitat consists of primarily coniferous trees; where the channel is less confined, alders and willows are more abundant.

The San Joaquin River Basin consists of granitic soils with low mineral nutrient content. Millerton Lake, therefore, has relatively low productivity. No information is available regarding the plankton communities of the reservoir.

Several reservoirs in the upper portion of the San Joaquin River watershed, including Mammoth Pool and Shaver Lake, are used primarily for hydroelectric power generation (see Chapter 20, “Power and Energy”). Operation of these reservoirs affects timing of inflow to Millerton Lake. Big Sandy Creek, Fine Gold Creek, and several smaller, ephemeral streams also provide flows directly into Millerton Lake. Flow released from the powerhouses into the lower reach of the San Joaquin River

is colder than that in the river since the waters travel at high velocities through tunnels from Kerckhoff Dam directly to the powerhouses.

During summer, cold-water outflows from the Kerckhoff powerhouses bypass the San Joaquin River through tunnels from Kerckhoff Lake to the upper extent of Millerton Lake. The cold, dense river inflow submerges at a location referred to as the plunge point and continues to flow downstream below the warmer, surface layer in the reservoir (Ford 1990, PG&E 2001). The distance in the reservoir to the plunge point is a function of the volume and temperature of San Joaquin River inflow, storage elevation of Millerton Lake, and water temperature of the reservoir surface layer. When inflow is high, the plunge point is often located near the upper end of the Millerton Lake area (PG&E 1990). This affects fish spawning habitat.

Fish Species Native fish species in this reach of river include hardhead (*Mylopharodon conocephalus*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker (*Catostomus occidentalis*), and rainbow trout (*Oncorhynchus mykiss*). Kern brook lamprey (*Lampetra hubbsi*) were originally thought to be endemic to the east side of the San Joaquin Valley; however, in recent years, they have been found in the San Joaquin River downstream from Friant Dam and in several tributaries of the Sacramento River (Goodman 2014). The San Joaquin River between Kerckhoff Dam to the upper portion of Millerton Lake contains spawning habitat for nonnative American shad (*Alosa sapidissima*) and striped bass (*Morone saxatilis*).

The commonly occurring species in the Temperance Flat Reservoir Area include reservoir fish that spawn in riverine habitat as well as fully riverine fish species. Several native nongame species have been collected from the reservoir, including Sacramento sucker, Sacramento pikeminnow, Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Levinia exilicauda*), and hardhead. Aquatic species reported in the primary study area are listed in Table 5-1.

Table 5-1. Fish Species in the Primary Study Area

Common Name	Scientific Name	Study Area Distribution	Native or Introduced
American shad	*Alosa sapidissima*	Millerton Lake	Introduced
Black crappie	*Pomoxis nigromaculatus*	Millerton Lake	Introduced
Bluegill	*Lepomis macrochirus*	Millerton Lake	Introduced
Hardhead	*Mylopharodon conocephalus*	San Joaquin River below Kerckhoff Dam	Native
Hitch	*Levinia exilicauda*	Millerton Lake	Native
Kern brook lamprey[1]	*Lampetra hubbsi*	San Joaquin River below Kerckhoff Dam	Native
Largemouth bass	*Micropterus salmoides*	Millerton Lake	Introduced
Rainbow trout	*Oncorhynchus mykiss*	Millerton Lake	Native
Sacramento blackfish	*Orthodon microlepidotus*	Millerton Lake	Native
Sacramento pikeminnow	*Ptychocheilus grandis*	Millerton Lake	Native
Sacramento sucker	*Catostomus occidentalis*	Millerton Lake	Native
Smallmouth bass	*Micropterus dolomieui*	Millerton Lake	Introduced
Spotted bass	*Micropterus punctulatus*	Millerton Lake	Introduced
Striped bass	*Morone saxatilis*	Millerton Lake	Introduced
Threadfin shad	*Dorosoma pretense*	Millerton Lake	Introduced
White sturgeon	*Acipenser transmontanus*	Millerton Lake	Native

Source: Mitchell 2006
Note:
[1] Presence of Kern brook lamprey is uncertain.

In addition to fish, beds of the large, freshwater pearlshell clam (*Margaritifera* spp.) have been found on the substrate in the river between Kerckhoff Dam and Millerton Lake. The clam is listed as a Special Animal by CDFW, with its status in California classified as uncertain; however, it is fairly common in the San Joaquin River, downstream from Friant Dam (Mitchell 2006). The pearlshell clam was considered for inclusion as a species for evaluation but was not selected because of its downstream abundance. The Special Animal listing provides no regulatory protection to the species, and pearlshell clam overall distribution and abundance are poorly known.

None of the fish species in the Temperance Flat Reservoir Area are federally or State-listed as threatened or endangered. However, three species, hardhead, hitch, and Kern brook lamprey, have special Federal and/or State status because they are considered potentially rare or are declining in abundance

and/or distribution. A number of introduced warm-water species that commonly occur in Millerton Lake are important sport fish species. Rainbow trout, also an important sport fish species, is frequently abundant in the San Joaquin River reach between Kerckhoff Dam and Millerton Lake. The following sections describe the fish species found in the Temperance Flat Reservoir Area in more detail.

Hardhead Hardhead are a native minnow (*Cyprinidae*) species and are a USFS Sensitive Species and a California Species of Special Concern. The species is widely distributed throughout low to mid-elevation streams in the Sacramento–San Joaquin and Russian River drainages (Moyle 2002); however, hardhead populations have substantially declined in recent decades, especially in the southern half of their range, and some populations have disappeared (Moyle et al. 1995).

Hardhead are most commonly found in undisturbed portions of larger streams. Pools with sand-gravel substrates and slow water velocities are the species' preferred habitat; adult fish inhabit the lower half of the water column, while juvenile fish remain in shallow water closer to stream edges. They are abundant in a few, small mid-elevation reservoirs located on major rivers, including Kerckhoff and Redinger reservoirs on the San Joaquin River upstream from Millerton Lake, but are basically absent from Millerton Lake and other large warm-water reservoirs with highly fluctuating water levels. In the primary study area, hardhead primarily occur in the San Joaquin River reach between Kerckhoff Dam and Millerton Lake. They were once found regularly in upper Millerton Lake but have since largely disappeared from the reservoir (Mitchell 2006).

The life history of hardhead is poorly known. Spawning has not been observed, but is believed to occur on beds of gravel in swift water (Moyle 2002). They spawn as 3-year-olds during April and May. Fry are believed to reside along stream edges in dense cover of flooded vegetation or woody debris (Devine Tarbell and Associates, Inc., and Stillwater Sciences 2005). Juvenile hardhead tend to prefer warmer water with substrate consisting of large cobble and boulders. As the fish grow, they move to deeper, quieter water.

Factors that potentially affect hardhead growth and survival include habitat conditions, forage, predation, and water quality. Hardhead typically feed on small invertebrates and aquatic plants at the bottom of quiet water. They are able to withstand

summer water temperatures above 68°F but will select lower temperatures when available (Moyle 2002). Hardhead are relatively intolerant of poorly oxygenated waters, particularly at higher water temperatures (Moyle 2002).

Kern Brook Lamprey Kern brook lamprey are a California Species of Special Concern and were originally thought to be endemic to the east side of the San Joaquin Valley. However, in recent years, they have been found in the San Joaquin River downstream from Friant Dam and in several tributaries of the Sacramento River (Goodman 2014). The status of the Kern brook lamprey is poorly known because identification of the species is difficult, particularly in the larval stage, but remaining populations are likely scattered and isolated (Moyle 2002). Kern brook lamprey were first collected in the Friant-Kern Canal and have since been found in the lower Merced, Kaweah, Kings, and San Joaquin rivers. Ammocoetes (larvae) possibly belonging to this species were collected in the upper San Joaquin River between Kerckhoff Dam and Millerton Lake from 1979 through 1982 (Wang 1986). The species is unlikely to occur anywhere else in the primary study area because they inhabit riverine habitat.

The life history of the Kern brook lamprey is poorly known. Adults spawn in the spring or summer (Moyle 2002, Wang 1986). The ammocoetes probably live for several years before metamorphosing to the adult stage in the fall. No feeding occurs after metamorphosis, and adults die after spawning (Moyle 2002).

Kern brook lamprey typically inhabit silty backwaters of the lower portions of rivers emerging from the Sierras. The ammocoetes occur in shallow pools and other areas of low-flow velocities, favoring substrates consisting of sand and mud. Adults seek riffle habitat with gravel for spawning and rubble for cover (Moyle 2002).

Limiting factors for Kern brook lamprey are poorly understood. The ammocoetes probably feed on algae and organic matter. They avoid habitats with water temperatures exceeding about 77°F (Moyle 2002).

Striped Bass Striped bass are native to the Atlantic and Gulf coasts and were first introduced to the Bay-Delta in 1879. They are currently among the most highly valued sport fish in California. Striped bass have been planted in a number of California reservoirs and have successfully spawned in a few

of these, including Millerton Lake. Young striped bass are regularly entrained in water pumped from the California Aqueduct into San Luis Reservoir and a number of reservoirs in Southern California (Moyle 2002). The reservoir fisheries are relatively small, but are valuable because striped bass are highly sought by some anglers.

Striped bass were first planted in Millerton Lake from 1955 through 1957. This population spawned successfully in Millerton Lake before the addition of the Kerckhoff No. 2 Powerhouse, but the new powerhouse caused changes in river flows that seem to have negatively affected their spawning (Mitchell 2006). In addition, heavy fishing pressure precluded the spawning from sustaining the population. Therefore, CDFW and the California Striped Bass Association (CSBA) periodically replenish the population with plantings of young fish obtained from San Luis Reservoir. In the study area, striped bass occur primarily in open waters of Millerton Lake; but during spring, spawning adults attempt to migrate upstream to the San Joaquin River near Kerckhoff No. 2 Powerhouse.

Striped bass spawn from April through June in the open water of rivers (Wang 1986). The eggs are slightly heavier than water, so they sink slowly as they are transported downstream. They hatch in approximately 2 days at about 66°F. Adult and pre-adult striped bass are open-water predators and opportunistic feeders at the top of the food web, preying on threadfin shad (*Dorosoma pretense*), American shad, smaller striped bass, and any other fish they can catch. Threadfin shad are the most important prey for striped bass in Millerton Lake (Goodson 1966). Striped bass growth is rapid in Millerton Lake, probably because threadfin shad are abundant in the reservoir. By the end of their fourth year, Millerton Lake striped bass are typically 22 inches long (Moyle 2002). The age of maturity for striped bass is generally 4 to 6 years for females and 2 to 3 years for males (Moyle 2002).

The optimum water temperatures for spawning striped bass are about 59°F to 68°F, and spawning ceases at temperatures above 70°F (Moyle 2002). Juveniles and adults become stressed at water temperatures above about 77°F, and temperatures over 85°F are generally lethal.

Rainbow Trout Rainbow trout are native to California, but because of extensive transplanting, only a few populations in California retain their original genetic integrity. In the primary study area, rainbow trout occur primarily in the San Joaquin

River reach between Kerckhoff Dam and Millerton Lake and the uppermost portion of Millerton Lake. Many large trout are captured by anglers near the Kerckhoff No. 2 Powerhouse (Mitchell 2006). Rainbow trout were planted in Millerton Lake in 1964, even though trout were present in the San Joaquin River before Friant Dam was constructed. Many of the trout currently found in the primary study area are likely recruited from upstream stream reaches and reservoirs.

Rainbow trout typically inhabit cool, clear, fast-flowing streams and rivers, where riffles are more prevalent than pools. They are also found in reservoirs, but require spawning habitat in streams for successful reproduction. They seek habitat with abundant cover, including vegetation and large woody material, undercut banks, cobbles, rock, and boulders, and deep water or turbulent flow. Younger, smaller fish are more likely to be found in the smaller riffles, intermediate-sized fish occupy runs, and larger fish use pools.

Rainbow trout tolerate a fairly wide range of water temperatures. The optimum temperature range for rainbow trout growth is about 59°F to 64°F, but the optimum for fry is somewhat lower (Moyle 2002). In warm water, the trout seek out deeper pools where the water is cooler, briefly moving to riffles to feed. Rainbow trout spawn in the spring in nests (redds) dug in coarse gravel in a stream riffle or tail of a pool. The eggs hatch in 3 to 4 weeks at 50°F to 59°F, and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002).

Sacramento Sucker Sacramento sucker are largely distributed throughout California, including streams and reservoirs of the Sacramento River and San Joaquin River watersheds. They occupy waters from cold, high velocity streams to warm, nearly stagnant sloughs. They are common at moderate elevations (650 feet to 2,000 feet). Sacramento suckers can tolerate a wide range of temperature fluctuations, from streams that rarely exceed 59°F to those that reach up to 86°F. Sacramento suckers have the ability to colonize new habitats readily (Moyle 2002).

Sacramento sucker usually spawn for the first time in their fourth or fifth years over riffles from February through June when water temperatures are approximately 54°F to 64°F. When they cannot move upstream, and end up spawning in lake habitat, they typically orient themselves near areas where spring freshets flow into the lake. The young fish typically live

in the natal stream for a couple years before moving downstream to a reservoir or large river (Moyle 2002).

American Shad American shad are native to the Atlantic coast and were first introduced into the Bay-Delta in 1871 (Wang 1986). American shad populations are normally anadromous; however, American shad were accidentally introduced into Millerton Lake between 1955 and 1957. These introductions produced a spawning, self-sustaining population in the reservoir. This is now the only known naturally reproducing, landlocked population of American shad. Populations of American shad also occur in San Luis Reservoir and O'Neill Forebay, but these populations are believed to be maintained by eggs, fry, and small fish pumped in with water from the California Aqueduct rather than by successful spawning in the reservoirs (Stephens 2006). The Millerton Lake population rears throughout the reservoir and spawns near the San Joaquin River inflow to Millerton Lake, upstream from the plunge point (PG&E 1986).

American shad has marginal value as a sport fish in Millerton Lake, but is highly sought after as a sport fish by anglers in some regions of California and other states. It is also an important prey item for adult striped bass (CSBA 2006). Because of its unique status as the only known successfully spawning, landlocked population, Millerton Lake American shad has attracted scientific interest and has been intensively studied in connection with PG&E FERC relicensing studies for the Kerckhoff No. 2 Hydroelectric Project (PG&E 1986, 2001).

American shad in Millerton Lake are sexually mature at 3 to 4 years of age (PG&E 1986). Spawning begins in May, but peaks from mid-June through mid-July, when water temperatures are between 52°F and 63°F (Moyle 2002). Spawning occurs at night, between the hours of 9:00 p.m. and 7:00 a.m., with peak activity between 11:00 p.m. and 4:00 a.m. (PG&E 1986). The fish spawn near the water surface over deep shoreline eddies (PG&E 1990). The eggs are slightly heavier than freshwater, so flow velocities of about 1 to 2 feet per second are required to keep the eggs suspended as they are transported downstream. Flows in the uppermost, riverine portion of Millerton Lake are turbulent, which may cause favorable conditions for American shad eggs, allowing them to remain in the river for a much longer time than they would in straight flow-through conditions (PG&E 1990). Dissolved oxygen (DO) levels of at least 5 milligrams per liter (mg/L) are required for egg survival. The

eggs hatch in approximately 8 to12 days at 52°F to 59°F, 6 to 8 days at 63°F, and 3 days at 75°F (Moyle 2002).

Within 2 days of hatching, larvae begin feeding on small zooplankton. Older American shad typically feed on large zooplankton and other invertebrates, but Millerton Lake shad also feed on threadfin shad (Moyle 2002). Growth of American shad in Millerton Lake is slower than that of anadromous populations.

As previously indicated, the Millerton Lake American shad population has been intensively studied in connection with FERC licensing studies for the PG&E Kerckhoff No. 2 Hydroelectric Project (PG&E 1986, 1990, 2001). These studies focused primarily on effects of flow releases from the Kerckhoff or Kerckhoff No. 2 powerhouses on shad spawning. Kerckhoff Powerhouse discharges into the San Joaquin River approximately 2 miles upstream from Kerckhoff No. 2 Powerhouse, and Kerckhoff No. 2 Powerhouse discharges either into the San Joaquin River or directly into Millerton Lake, depending on the surface elevation of the reservoir. The studies demonstrated that shad need uninterrupted, steady discharges from the powerhouses for successful spawning. Uninterrupted discharges provide the water surface velocities that stimulate spawning behaviors and continuous flows in the lotic portion of the reservoir that keep eggs suspended until hatching occurs.

Before the Kerckhoff No. 2 Powerhouse started operations in 1983, large numbers of adult American shad were recruited in years when stream flows in the San Joaquin River were consistently high, but no American shad were recruited during drought years 1976 and 1977 when flow in the bypass reach dropped to as low as 21 cfs. After Kerckhoff No. 2 Powerhouse was brought into operation, backwater from Kerckhoff No. 2 Powerhouse affected hydraulic conditions in the spawning areas. The results of PG&E studies have led to FERC-mandated minimum flow release requirements from Kerckhoff No. 2 Powerhouse and/or Kerckhoff Powerhouse during the American shad spawning season (PG&E 2001).

Spotted Bass Alabama spotted bass (*Micropterus punctulatus*) were introduced to Millerton Lake in 1974 and 1975 from the Elk Grove Fish Hatchery and from Lake Perris, Riverside County (Moyle 2002, Wang 1986). Alabama spotted bass are native to the southeastern United States, but have been widely introduced into reservoirs because of their ability to spawn

successfully in highly fluctuating water levels. In the primary study area, spotted bass are found in Millerton Lake and the upper San Joaquin River, where they may prey on native fishes (Wang 1986, Mitchell 2006).

Spotted bass begin spawning in Millerton Lake as early as late March, and peak spawning occurs in late May and early June (Wang 1986). Nesting areas include portions of the shoreline of Millerton Lake. Males construct nests in colonies at depths of 3 to 20 feet (Wang 1986). The males guard the nests and newly hatched larvae from predators such as bluegills (*Lepomis macrochirus*) (Aasen and Henry 1980). The larvae typically disperse from the nest 8 days after hatching (Vogele 1975). Spotted bass reach maturity at the age of 2 or 3 years (Moyle 2002), and the maximum total length is about 20 inches (McKechnie 1966). Few live longer than 4 to 5 years (Moyle 2002).

Spotted bass in reservoirs are most often found along steep, rocky shores (Vogele 1975). The adults tend to live at moderate depths (3 to 13 feet), often just above the thermocline, but may seek out deeper water (100 to 130 feet) following fall mixing. In some reservoirs, adults may move up into tributary rivers in summer, where they occupy deep, slow pool and run habitat (Moyle 2002). Juvenile spotted bass generally inhabit more shallow water than the adults. In Millerton Lake during summer, juveniles are often observed near the boat ramps (Wang 1986). Young-of-year bass usually swim in small schools, while larger fish tend to be solitary. Adult spotted bass frequently remain in the same area for most of the year (Moyle 2002).

Spotted bass are warm-water fish, preferring water with summer temperatures of 75°F to 88°F (Moyle 2002). Growth is maximized at about 75°F (McMahon et al. 1984). Spawning begins in spring when the water temperature rises to 59°F to 65°F and continues until temperatures reach 71°F to 73°F (Moyle 2002). They generally spawn in coves and on steeply sloped shorelines with large rock, rubble, or gravel, preferring sites near cover. The eggs hatch in 5 days at a water temperature of 58°F to 60°F and in 2 days at 70°F (Vogele 1975). DO levels greater than 6 mg/L are optimum for spotted bass survival and growth (McMahon et al. 1984). Spotted bass generally survive best in deep reservoirs with clear water and steep, rocky shorelines (Vogele 1975).

Spotted bass are better adapted to fluctuating reservoirs than other black bass species because their preferred spawning depths range from about 8 to 14 feet, which is deeper than the preferred spawning depths for largemouth and smallmouth bass (Moyle 2002, Aasen and Henry 1980). Nevertheless, large and rapid declines in water level may dewater spotted bass nests or increase their vulnerability to near-surface disturbances such as wave action and nest predation. Large increases in water level also may expose the nests to water temperatures so low as to cause males to abandon their nests and cease egg development.

Largemouth Bass Largemouth bass (*Micropterus salmoides*), native to the Mississippi River drainage and the southeastern United States, were first introduced into California in 1891 and have since spread to most suitable habitats in the State (Moyle 2002). They are normally found in warm, quiet waters with low turbidity and beds of aquatic plants. Largemouth bass provide an important sport fishery to many of the Central Valley reservoirs and are one of the most sought after warm-water sport fish in California. Largemouth bass, together with green sunfish (*Lepomis cyanellus*) and bluegill, were the first fish species planted in Millerton Lake when the reservoir was constructed in 1942 (Dill 1946). In the primary study area, largemouth bass essentially occur only in Millerton Lake, but their abundance is currently low (Mitchell 2006). The upper portion of Millerton Lake is a good spawning area for largemouth bass and other black bass fishes when the reservoir water level is high enough to inundate low-gradient shoreline habitat that borders the old river channel (Mitchell 2006).

Largemouth bass begin spawning in Millerton Lake in March and may spawn through June (Mitchell 1982). They typically build their nests on sand, gravel, or debris-littered substrates, often selecting sites next to logs or boulders that provide cover (Moyle 2002). Largemouth bass generally spawn at shallower depths than spotted bass, with most nests constructed between about 3 and 6 feet in depth. The larvae rise from the nest and begin exogenous feeding about 5 to 8 days after hatching (Emig 1966). The males guard the nests and newly hatched larvae from predators, including bluegill and threadfin shad (Mitchell 1982).

Largemouth bass typically inhabit clear, relatively shallow water, particularly in areas with abundant aquatic plants or other cover. In reservoirs, they tend to remain near shore in water 3 to 10 feet deep. Young-of-year bass usually swim in

small schools, while larger fish tend to be solitary (Moyle 2002).

Largemouth bass are predators on fish, frogs, invertebrates, and other prey. Threadfin shad, sunfish, and crayfish are typical food items. The fry feed on zooplankton and switch to small insects and fish fry, including smaller bass fry, as they grow. Juveniles feed on crustaceans, aquatic insects, and fish (Moyle 2002).

Largemouth bass are warm-water fish, with optimal water temperatures for growth ranging from 77°F to 86°F (Moyle 2002). Juveniles prefer somewhat higher water temperatures than adults. During 1973, spawning by largemouth bass in Millerton Lake began when the water temperature reached 60°F and continued until it rose to about 76°F (Mitchell 1982). Incubation time for largemouth bass eggs is inversely related to water temperature, such that eggs hatch in about 6 days at 60°F and in about 2 days at 76°F (Jackson and Noble 2000). The time from hatching to dispersal of larvae from the nest may be similarly related to water temperature (Mitchell 1982). Growth of largemouth bass is reduced at DO levels below about 8 mg/L, and levels below 5 mg/L may produce stress (Stuber et al. 1982).

Threadfin shad and largemouth bass often have complex interactions in reservoirs. Threadfin shad are important prey of juvenile and adult largemouth bass, but are predators of largemouth bass eggs and fry. Threadfin shad also compete with largemouth bass fry for zooplankton. The relative timing of hatching for the two species potentially affects their relative success in reservoirs (Jackson and Noble 2000). The relationship between threadfin shad and largemouth bass in Millerton Lake is uncertain, but it is possible that the introduction of threadfin shad to the reservoir in 1959 has caused more harm than good to the largemouth bass population (Miller 1970).

The overall quality of largemouth bass fishing in most California reservoirs has declined since the reservoirs were constructed because of three main factors: overfishing, reservoir aging, and competition from threadfin shad and other plankton-feeding fishes (Von Geldern and Mitchell 1975). Largemouth bass are extremely vulnerable to angling, and at least half the population of legal-size fish are caught annually in many reservoirs. Over time, the catch rates and average size of the fish have declined. Reservoir aging reduces cover and

forage fish, which reduces largemouth bass populations. Competition between young bass and other plankton-feeding fish, primarily threadfin shad, also reduces largemouth bass populations.

Large water-level fluctuations in many reservoirs inhibit production of largemouth bass populations. As previously noted for spotted bass, rapid declines in water level may dewater largemouth bass nests or increase their vulnerability to near-surface disturbances such as wave action and nest predation. Large increases in water level may also expose the nests to water temperatures so low as to cause males to abandon their nests and stop egg development.

Smallmouth Bass Smallmouth bass (*Micropterus dolomieui*) are native to the upper and middle Mississippi River drainage. They were first introduced into California in 1874 and have since been widely distributed throughout the State (Moyle 2002). They have become established in many reservoirs and are normally found in cool waters, often near the upstream end of the impoundments. They also concentrate in narrow bays or areas along shores where rocky shelves project under water (Moyle 2002). Smallmouth bass are a popular sport fish, but their value as a fishery is generally less important than those of largemouth or spotted bass. In the primary study area, smallmouth bass are primarily found in upper Millerton Lake and the San Joaquin River upstream from the reservoir (Wang 1986).

Spawning activity usually begins in spring when water temperatures reach 59°F to 61°F and ceases when temperatures reach about 78°F (Wang 1986, Cooke et al. 2003). Spawning behavior of smallmouth bass is generally similar to that of largemouth bass, except that they sometimes migrate from lakes and reservoirs a short distance up a stream to spawn. The male guards the nest until the eggs hatch, which occurs between 3 and 10 days, depending on water temperature. The male herds and guards the fry for an additional 1 to 3 weeks until the fry disperse into shallower water. Fluctuations in reservoir water levels often interfere with success of smallmouth bass nests, as previously discussed for largemouth bass and spotted bass nests.

Although smallmouth bass are typically found in cooler water than largemouth and spotted bass, optimum temperatures for growth and survival are similar, approximately 77°F to 81°F (Moyle 2002).

Millerton Lake Below RM 274

Aquatic Habitat Millerton Lake, formed by Friant Dam, is the largest reservoir on the San Joaquin River. The lake is set in the lower foothills of the Sierra Nevada, is fairly open, and is mostly surrounded by low hills. Millerton Lake includes a relatively broad open portion of the reservoir near Friant Dam, and a long, narrow reach that grades upstream into the upper San Joaquin River. The reservoir facilities are part of the Friant Division of the CVP, and reservoir facilities operation substantially affects flow in the San Joaquin River. Friant Dam is operated to supply water to agricultural and urban areas in the eastern San Joaquin Valley and to provide flood protection to downstream areas.

Inflow to Millerton Lake comes primarily from the upper San Joaquin River, and is largely influenced by the operation of several upstream hydropower generation projects. The reservoir typically fills during late spring and early summer when snowmelt in the watershed results in high San Joaquin River flows. Annual water allocations and release schedules are developed with the intent of drawing reservoir storage to minimum levels by the end of September. The reservoir has a maximum volume of 524 TAF and a maximum surface area of 4,905 acres at top of active storage. Median water level, simulated using current reservoir operating conditions based on 1922 through 2003 hydrology data, ranges from elevation 564 feet msl in late spring to elevation 497 feet msl in late summer. At the top of active storage, the reservoir has a maximum depth of 287 feet.

Extreme water-level fluctuation in reservoirs resulting from reservoir management priorities is perhaps the most important environmental factor affecting reservoir fish population productivity. The direct and indirect effects of fluctuating water levels are responsible for many fishery management issues such as limited cover habitat, limited littoral habitat, and shoreline erosion. Reservoirs in the Sierra Nevada operate to store water during winter and spring and release water in summer and fall into the Central Valley. Basin hydrology, and the pattern of storage and releases, results in highly variable seasonal availability of water from reservoirs in the upper San Joaquin River Basin. Under current reservoir operations, Millerton Lake water levels change by a foot or more per day almost 50 percent of days and change by 2 feet or more about 10 percent of days.

Because of the large changes in water levels and eroded soils, shoreline habitat in Millerton Lake is vegetated only in spring and early summer of wetter years, when the reservoir inundates terrestrial plants that have colonized nearshore environments. Arms of the reservoir that inundate mouths of tributary streams generally have the best protected shallow-water habitat in the reservoir. These tributaries include Fine Gold and Winchell creeks in the open, downstream portion of the reservoir, and Big Sandy Creek in the narrow, upstream portion.

Some modest attempts have been made to improve shallow-water habitat in Millerton Lake. These efforts include construction of shoreline subimpoundments in 1949 to allow continued inundation of bluegill nests that would otherwise be exposed when water levels in the reservoir dropped (Fisher 1950). In 1958, 50 brush shelters were suspended 5 to 10 feet below the surface in Winchell Cove, and in 1976 and 1977, bundles of willow cuttings were planted in several coves to stabilize shorelines and provide cover for fish (USFWS 1983). The brush shelters attracted fish, which made their capture easier, but no evidence exists that these or other efforts had any considerable effect on fish populations.

Most of Millerton Lake becomes thermally stratified during spring and summer and, therefore, potentially supports a two-stage fishery, with cold-water species residing in deeper water and warm-water species inhabiting surface waters and shallow areas near shore.

Selected water temperature and DO profiles from 2005, classified as a Wet year, indicate that the reservoir began stratifying in spring and varied little in water temperatures by late fall and winter (see the Physical Resources Appendix). A strong thermocline developed at approximately 25 feet deep in late March. The thermocline moved up about 10 feet during early summer and began moving down again in late summer and fall. Complete mixing of the water column likely occurs during winter. Most of the year, DO levels were high throughout the water column, but DO concentrations were less than 2.5 mg/L below 175 feet deep in November. November of the previous year had similarly low DO levels in the lower part of the water column. DO levels below 2.5 mg/L are stressful to most species of fish, but Millerton Lake fish could easily avoid this hypoxic water layer (i.e., low DO level), particularly because water temperatures throughout the water column are mild in November. Shallow shoreline areas, particularly in protected coves, likely warm and cool more quickly in

response to changes in air temperatures and solar heating than the rest of the reservoir, although water temperatures of tributary streams may also affect these areas when inflows are high.

Fish Species Most of the commonly occurring species in Millerton Lake are the same as the reservoir fishes described in the Temperance Flat Reservoir Area (including reservoir fish that spawn in riverine habitat as well as fully riverine fish species). Most of the native species have been extirpated from Millerton Lake in recent years (Mitchell 2006).

Hitch Hitch is a native minnow whose abundance has declined, and some San Joaquin River Basin populations have been extirpated (Moyle 2002). The species has no formal listing status. Hitch are widespread in warm, low-elevation lakes, sloughs, and slow-moving stretches of river, and in clear, low-gradient streams. Hitch have been found in Millerton Lake, but their current status in the reservoir is uncertain (Mitchell 2006).

Young hitch are often found in aquatic vegetation associated with run habitat, while older fish are found in pools. Hitch feed omnivorously, and include algae, zooplankton, and aquatic and terrestrial insects in their diet (Moyle 2002). In reservoirs, the adults are usually pelagic and migrate into the lower reaches of low-gradient tributary streams to spawn. Like most native cyprinids, hitch are weaker swimmers than salmonids and are more easily obstructed by migration barriers. Spawning occurs in fine- to medium-sized gravel bottoms that are swept clean by water movement, either from wave action or stream currents. They may also spawn in reservoirs.

Hitch mature in their second or third year, and spawn between March and July when water temperatures reach about 57°F to 64°F. Hitch eggs are demersal, absorbing water to help lodge them into the interstices of the gravel. Eggs hatch within 10 days, and larvae become free-swimming 10 days after hatching.

Habitat preferences for hitch include warm-water temperatures (about 80°F to 85°F) and slow water velocities, although they require somewhat higher flow velocities for spawning. They are omnivorous feeders, consuming algae, zooplankton, and insects (Moyle 2002).

White Sturgeon White sturgeon (*Acipenser transmontanus*), the largest freshwater or anadromous fish species in North America, can reach record sizes over 1,300 pounds. Historically, white sturgeon populations ranged from Alaska to Central California; however, the major spawning populations are now limited to the Fraser River (British Columbia, Canada), the Columbia River (Washington), and the Sacramento-San Joaquin River system. Habitat use varies among populations. Portions of populations are considered anadromous, using fresh, brackish, and marine waters during different phases of their life history. After construction of Friant Dam, some white sturgeon became landlocked in Millerton Lake. The status of these fish is unknown, but it is unlikely that the remnant population is spawning in the San Joaquin River, which means it is not a self-sustaining population.

Extended Study Area

San Joaquin River from Friant Dam to Merced River

Aquatic Habitat Aquatic habitat conditions vary spatially and temporally throughout the San Joaquin River between Friant Dam and the Merced River and in the flood bypasses in this area (collectively referred to as the Restoration Area in the SJRRP). This is because of differences in habitat availability and connectivity, water quantity and quality, channel morphology, and predation risks. Significant structures in the Restoration Area that are current impediments to both upstream and downstream fish movement are shown on Figure 5-1 and include the following:

- Seasonally deployed weir located at Hills Ferry (Hills Ferry Barrier) just upstream from the confluence with the Merced River that directs migrating adult salmonids into the Merced River and limits them from entering the San Joaquin River (the Hills Ferry Barrier has been operated by CDFW since 1992; however, through the SJRRP, adult Chinook salmon captured at the Hills Ferry Barrier are being transported upstream to just below Friant Dam)

- Drop structure on the Eastside Bypass near its confluence with the San Joaquin River (a drop structure is a manmade structure that passes water to a lower elevation while controlling the energy and velocity, often to prevent erosion impacts)

- Drop structure on the Mariposa Bypass near its confluence with the San Joaquin River
- San Joaquin River Headgate Structure at the Sand Slough Control Structure
- Sack Dam, a diversion dam for Arroyo Canal
- Mendota Dam, delivery point of the DMC and diversion point for several irrigation canals and pumps
- Radial gates and control structure on the Chowchilla Bypass Bifurcation Structure
- Friant Dam, primary storage dam on the San Joaquin River and upper limit of potential anadromous salmonid migration

Some of the above impediments are included as site-specific projects in the SJRRP for fish passage improvements. In addition to barriers, false migration pathways may impede fish movement in the Restoration Area. False migration pathways lead fish away from habitats that would support survival and growth. False pathways affect both upstream and downstream fish movement. During upstream movement, flow may attract fish into drains and bypasses that do not provide habitat because spawning substrate or cover, food availability, water temperatures, DO concentrations, salinity, and other environmental conditions are unsuitable.

Bypasses may not have environmental conditions that support movement of fish to downstream habitat, especially if flow entering the bypass becomes discontinuous and fish are stranded. Canals generally do not provide habitat that can sustain populations of most fish species, and frequently end in irrigated agricultural fields. Potential false pathways created by the bypass and canal systems are Salt Slough, Mud Slough, Bear Creek, Ash Slough, Berenda Slough, Dry Creek, Fresno River, Lone Willow Slough, Mariposa Bypass, Eastside Bypass, Arroyo Canal, Main Canal, other canals, and Little Dry Creek. Gravel mining ponds downstream from Friant Dam may also be minor false pathways that can confuse downstream and upstream migrating fish and delay migration.

Most aquatic habitat in the bypasses is temporary, and its duration depends on the frequency and magnitude of flood flows. The bypasses are largely devoid of aquatic and riparian

habitat because of hydraulic conveyance maintenance efforts that involve vegetative clearing (McBain & Trush 2002). Portions of the Eastside Bypass near Merced National Wildlife Refuge (NWR) are reportedly wet year-round, but it is unknown whether these areas support fish. Although the bypasses provide very little perennial aquatic habitat, fish and other aquatic species may be present in the bypasses during wet conditions, including high-flow periods when a portion of the San Joaquin River flow is routed into the bypass system.

The San Joaquin River within the Restoration Area has been broken down into five distinct reaches:

- **Reach 1** – Friant Dam to Gravelly Ford
- **Reach 2** – Gravelly Ford Mendota Dam
- **Reach 3** – Mendota Dam to Sack Dam
- **Reach 4** – Sack Dam to the Sand Slough Control Structure
- **Reach 5** – Sand Slough Control Structure to the Merced River confluence

These reaches are shown in Figure 5-1.

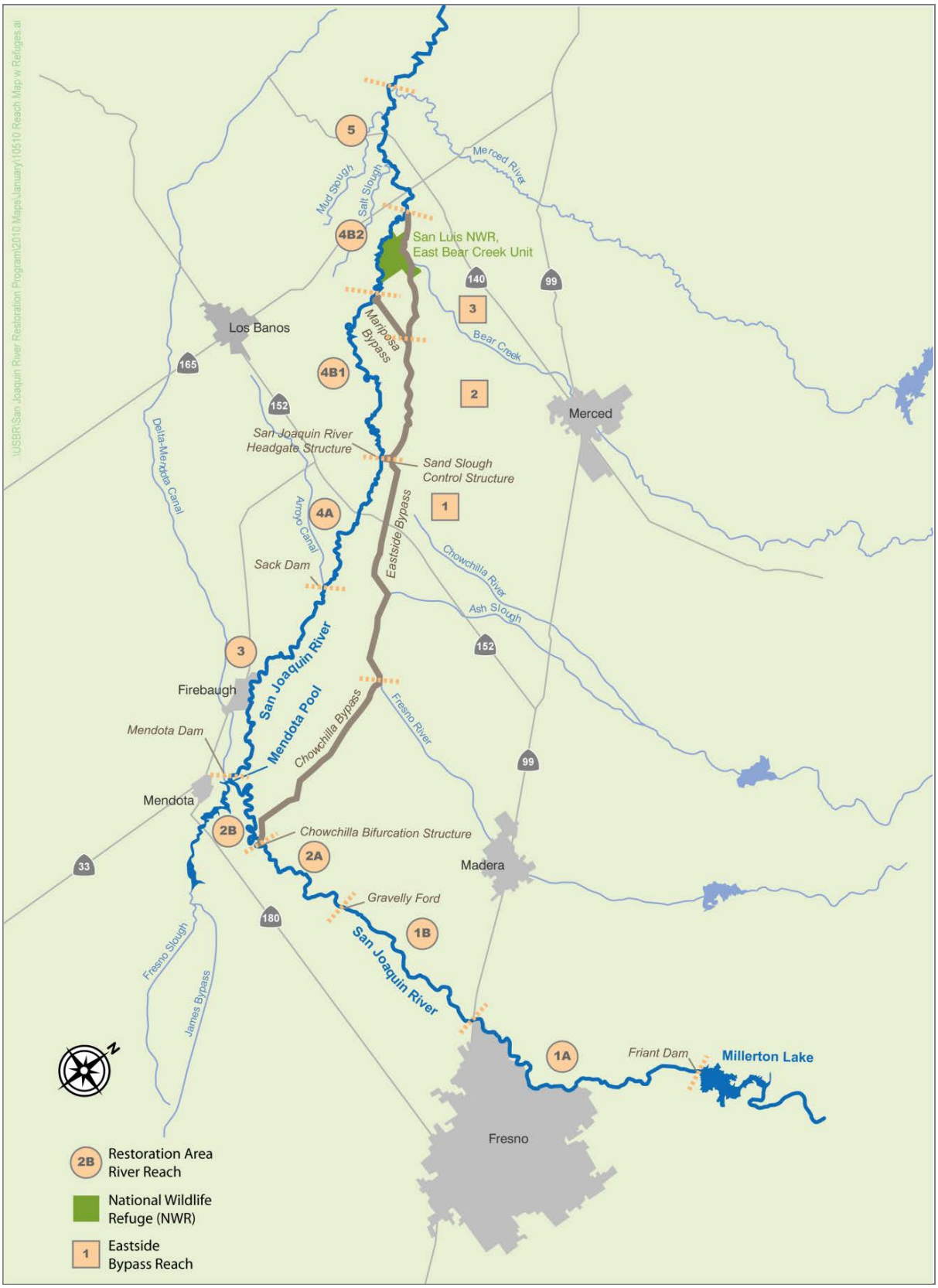


Figure 5-1. San Joaquin River Reaches and Flood Bypass System in Restoration Area

Many changes have occurred to channel morphology in the Restoration Area over the last century, producing the conditions found there today. The most pronounced changes are as follows.

- **Reach 1** – In-channel and floodplain pits and exposed gravel bars and floodplains created by instream gravel mining in Reach 1 have impeded coarse sediment routing, reduced native fish habitat, increased river water temperatures, and increased habitat for nonnative species. As has been demonstrated on the Tuolumne River, these pits, which converted stream habitat to more pond-type habitat, provide habitat conducive to nonnative predatory fish species such as largemouth and smallmouth bass (EA Engineering 1991). In addition, in Reach 1, riparian encroachment has occurred, channels have been incised, mobilization of bed material is less frequent, and filling of gravel interstices with fine sediment has likely occurred.

- **Reaches 2 through 5** – Habitat conditions for fish in Reaches 2 through 5 have been substantially modified by levee/dike construction, agricultural encroachment, and water diversions. These changes have reduced the quantity of floodplain habitat, as well as reducing main channel habitat complexity and the quantity and quality of off-channel habitat in these reaches. Much of this floodplain habitat has been isolated from the river by dikes and levees, and the remaining floodplain habitat is rarely inundated under current hydrologic conditions.

Fish Fish assemblages currently found in the San Joaquin River are the result of substantial changes to the physical environment, combined with more than a century of nonnative species introductions, both accidental and intentional. Areas where unique and highly endemic fish assemblages once occurred are now inhabited by assemblages composed primarily of introduced species. The San Joaquin River provides a migratory corridor for salmonids to its major tributary rivers, the Stanislaus, the Tuolumne, and the Merced rivers.

The San Joaquin River from the end of Reach 1 to the Merced River confluence currently does not support spawning anadromous salmonids; however, with the ongoing implementation of the Settlement, self-sustaining populations of spring-run Chinook salmon and steelhead are expected to be

reestablished. The estimated time frame for reintroduction is as follows: (1) a Reintroduction Period between the present and December 31, 2019; (2) an Interim Period between January 1, 2020, and December 31, 2024; (3) a Growth Population Period between January 1, 2025, and December 31, 2040; and (4) a Long-term Period beyond January 1, 2041.

Of the approximately 21 native fish species historically present in the San Joaquin River, at least eight are now uncommon, rare, or extinct, and an entire native fish assemblage (e.g., Sacramento splittail (*Pogonichthys macrolepidotus*), Sacramento blackfish) has been largely replaced by nonnative warm-water fish species (e.g., catfish) (Moyle 2002). Warm-water fish assemblages, comprising many nonnative species such as black bass species and sunfish species, appear better adapted to current, disturbed habitat conditions than native assemblages. However, habitat conditions in Reach 1 (slightly higher gradient, cooler water temperatures, and higher water velocities) seem to have restricted many introduced species from colonizing. The occurrence of fish species within the Restoration Area is described below by reach.

Reach 1 Studies conducted from 2003 through 2005 by CDFW and Reclamation inventoried recent fish distributions in the Restoration Area (DFG 2007). Native fish species captured in Reach 1A included rainbow trout, Sacramento sucker, threespine stickleback (*Gasterosteus aculeatus*), lamprey species, sculpin species, and Sacramento pikeminnow (DFG 2007). No native fish species were captured in Reach 1B during the CDFW/Reclamation inventory. Although these species were not detected in Reach 1 from 2003 through 2005, earlier investigations report occurrence in Reach 1 of riffle sculpin (Brown and Moyle 1993), prickly sculpin (*Cottus asper*) (Saiki 1984, Brown and Moyle 1993, Moyle 2002), hardhead (Saiki 1984, Brown and Moyle 1993), tule perch (*Hysterocarpus traski*) (Saiki 1984, Brown and Moyle 1993, Moyle 2002), and fall-run Chinook salmon (Yoshiyama et al. 1998, Moyle 2002).

The following introduced fish species were captured in Reach 1A: green sunfish, western mosquitofish (*Gambusia affinis*), largemouth bass, redear sunfish (*Lepomis microlophus*), brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), bluegill, channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), golden shiner (*Notemigonus crysoleucas*), kokanee (*Oncorhynchus nerka*), and spotted bass. The

introduced fish species captured in Reach 1B were bluegill, green sunfish, redear sunfish, and spotted bass (DFG 2007).

Chinook salmon are currently being introduced in this reach through implementation of the SJRRP. Adult fall-run Chinook salmon are captured at the Hills Ferry Barrier and transported upstream to just below Friant Dam. Additionally, juveniles are brought in from the Feather River hatchery and tagged to monitor their movements. In 2011, 596 Chinook were released below Friant Dam (RM 266) and 631 were released at San Mateo Crossing (RM 211). A subsample of these fish (192) was tagged, and 71 of the tagged fish were later detected at the lower end of the Restoration Area (Reclamation 2011). These fish may come back as adults in later years; however, there is currently no self-sustaining population of Chinook salmon in the San Joaquin River upstream from the Merced River confluence. A Chinook salmon hatchery below Friant Dam to support a self-sustaining population is scheduled to be constructed during 2015 to enable the facility to be on-line by fall 2015. It is anticipated that the first hatchery year of Chinook salmon will be delivered to the San Joaquin River by 2016 (Reclamation 2013a).

Reach 2 In general, species diversity increases downstream, while species composition shifts from native species to nonnative species (DFG 2007). Historically, much of Reach 2 was typically dry; thus, fish populations were confined to the upper part of Reach 2 upstream from Gravelly Ford, and to Mendota Pool in the lower part of Reach 2, with restricted fish migration between these habitats. All native species known to occur historically in Reach 1 were also known to persist in Reaches 2 through 5, with the exception of rainbow trout and perhaps riffle sculpin. The current nonnative species composition in Reach 2 is the same as that in Reach 1, with the addition of white crappie (*Pomoxis annularis*), threadfin shad, fathead minnow (*Pimephales promelas*), white catfish (*Ameiurus catus*), and striped bass (Saiki 1984, Moyle 2002, DFG 2007).

Reach 3 Recent accounts document the presence in Reach 3 of the following native fish species: prickly sculpin, hitch, Sacramento blackfish, and tule perch (Saiki 1984, Brown and Moyle 1993, Moyle 2002, DFG 2007). Nonnative fish species present in Reach 3 include all of those documented in Reaches 1 and 2, as well as inland silverside (*Menidia beryllina*) and red shiner (*Cyprinella lutrensis*) (Saiki 1984, Brown and Moyle 1993, Moyle 2002, DFG 2007).

Reach 4 Historically Reach 4 was dry much of the time, and only a single fish species (inland silverside) has been documented in this reach in the past 25 years (Saiki 1984, DFG 2007).

Reach 5 Native species recently documented in Reach 5 include Sacramento sucker, prickly sculpin, hitch, Sacramento blackfish, Sacramento pikeminnow, Sacramento splittail, and tule perch. All nonnative species present upstream from Reach 5 are also present in this reach. Pumpkinseed (*Lepomis gibbosus*) and spotted bass have also been detected recently in Reach 5 (Saiki 1984, Brown and Moyle 1993, Moyle 2002, DFG 2007).

The current distributions of white sturgeon, green sturgeon, river lamprey (*Lampetra ayresii*), Kern brook lamprey, and western brook lamprey (*L. richardsoni*) within the Restoration Area are unknown.

Bypass System The occurrence of fish in the bypasses depends on the routing of flood flows through the bypass system. When water is present, fish of all life stages may enter the bypasses from upstream diversion points such as the Chowchilla Bypass Bifurcation Structure and Sand Slough Control Structure. Information on fish species that may use temporary aquatic habitat in the bypasses is not available. However, it is assumed that any species present near the diversion points could be routed into the bypasses along with flood flows.

San Joaquin River from Merced River to the Delta

Aquatic habitat and fish presently found in the San Joaquin River from the confluence with the Merced River to the Delta are discussed below.

Aquatic Habitat The San Joaquin River downstream from Reach 5 has a physical habitat and water quality conditions similar to those found in Reach 5, with increased flows provided by major tributaries, including the Merced, Tuolumne, Stanislaus, and Calaveras rivers. Water management in the San Joaquin River focuses on diversion of water out of streams and rivers into canals for agricultural use, with some of the applied water returned as agricultural drainage (Brown and May 2006). Flood control levees closely border much of the river but are set back in places, creating some off-channel aquatic habitat areas when inundated.

Fish Fish species presently inhabiting the San Joaquin River from the confluence with the Merced River to the Delta, including anadromous salmonids, other native species, and nonnative species, are discussed in the following sections.

Anadromous Salmonids Currently, the San Joaquin River downstream from the Merced River confluence provides transitory habitat for migrating fall-run Chinook salmon and steelhead, both as adults and juveniles, as they move upstream to tributaries, or downstream toward the Delta. Both fall-run Chinook salmon and steelhead spawn and rear in the Merced, Tuolumne and Stanislaus rivers. Their life stage timing is shown in Table 5-2.

Table 5-2. Temporal Occurrence of Each Life Stage of Fall-Run Chinook Salmon and Steelhead in the San Joaquin River and Major Tributaries (Merced, Tuolumne, and Stanislaus Rivers)

Life Stage	Month																							
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Chinook Salmon (Fall-Run)																								
Adult migration																								
Spawning																								
Incubation and emergence																								
Juvenile rearing																								
Juvenile migration																								
Chinook Salmon (Spring-Run)																								
Adult migration																								
Spawning																								
Incubation and emergence																								
Juvenile rearing																								
Juvenile migration																								
Steelhead																								
Adult migration																								
Spawning																								
Incubation and emergence																								
Juvenile rearing																								
Juvenile migration																								

Source: SJRRP 2012

KEY:

	No presence
	Some presence
	Peak presence

Native Fish Species Brown and May (2006) summarized presence/absence of fish species in the San Joaquin River downstream from the Merced River confluence using spring seining data collected from 1994 through 2002 by the Interagency Ecological Program (IEP) and by the Turlock and Modesto irrigation districts (ID). Native species present in the San Joaquin River included Sacramento sucker, Sacramento pikeminnow, Sacramento splittail, tule perch, prickly sculpin, Sacramento blackfish, and hardhead (Brown and May 2006). Splittail are listed as a California State species of special concern largely because of the reduction in valley floor habitat once occupied by this species. Splittail move into the mainstem San Joaquin River during Wet years, but today are mostly resident in the Delta and San Francisco Estuary (Moyle 2002). Hardhead are also listed as a California State species of special concern primarily because of their reduced numbers and increasingly isolated populations throughout California streams. Historical records indicate that they were once present in most streams in the San Joaquin drainage but today a number of the populations have disappeared (Brown and Moyle 1993). Additionally, fall-run Chinook salmon, steelhead, California roach (*Hesperoleucus symmetricus*), threespine stickleback, lamprey, and hitch are also known to occur. The fall-run Chinook salmon population is supported in part by hatchery stock in the Merced River. In addition, California roach, threespine stickleback, lamprey, and hitch are likely inhabitants of this portion of the river, although they were not detected during the springtime monitoring efforts summarized by Brown and May (2006). Each of these native species is also present in the Restoration Area.

Moyle and Light (1996) suggested that nonnative piscivorous (fish-eating) fish are most likely to alter fish assemblages. Largemouth bass are documented predators of outmigrating juvenile anadromous salmonids (Turlock ID/Modesto ID 1992). They may also play the role of keystone predator (i.e., species that may increase biodiversity by preventing any one species from becoming dominant) in many aquatic environments because of broad environmental tolerances and their ability to forage on a wide variety of prey under many conditions. Smallmouth bass may primarily affect hardhead through competition for food resources, and may prey on juvenile cyprinids. Striped bass may be an important predator on immature life stages of river lamprey and Sacramento splittail. Inland silversides may feed on eggs and larvae of Sacramento splittail and other fish species in floodplain spawning areas. Native species expected to be the most

sensitive to predation by nonnative predators include juvenile hardhead and Sacramento splittail.

Changes in predator success due to increased abundance and vulnerability of prey may occur at newly constructed or altered diversion intakes or passage structures. Many predatory fish may be more successful at locations where prey fish are artificially concentrated or stressed, such as at dams or salvage and hatchery release sites (Buchanan et al. 1981, Pickard et al. 1982). High predation rates are known to occur below small dams, such as the Sack Dam in the Restoration Area. As they pass over small dams, fish are subject to conditions that may disorient them, making them highly susceptible to predation by fish or birds. In addition, deep-pool habitats tend to form immediately downstream from such dams, creating conditions that promote congregation of Sacramento pikeminnow, striped bass, and other predators. For example, Tucker et al. (1998) showed high rates of predation by Sacramento pikeminnow and striped bass on juvenile salmon immediately below the Red Bluff Diversion Dam.

Vegetation or other cover may provide optimal habitat for vulnerable fish life stages while reducing capture rates of predators. Aquatic vegetative cover as low as 15 percent has been reported to limit largemouth bass foraging success in experimental trials (Savino and Stein 1982).

Nonnative Fish Species Nonnative fish reported in the San Joaquin River between the Merced River confluence and the Delta include red shiner, inland silverside, threadfin shad, western mosquitofish, fathead minnow, black bass species, bigscale logperch (*Percina macrolepida*), bluegill, white crappie, striped bass, redear sunfish, common carp, goldfish, black bullhead (*Ameiurus melas*), channel catfish, and green sunfish (Brown and May 2006). Golden shiner, black crappie, white catfish, and warmouth (*Lepomis gulosus*) are also likely in the main stem San Joaquin River downstream from the Merced River confluence.

San Joaquin River Tributaries

Aquatic habitat and fish presently found in the three main San Joaquin River tributaries, the Merced, Tuolumne, and Stanislaus rivers, are discussed below.

Aquatic Habitat The Merced River is accessible to anadromous fish for the first 51 river miles upstream from the San Joaquin River confluence, with access terminating at

Crocker-Huffman Dam (USFWS 2001). Most spawning occurs within a few miles of the dam. Aquatic habitats in the Tuolumne River downstream from LaGrange Dam are influenced by several factors, many of them related to former gold mining activities and gravel mining (McBain & Trush 2000). In the Stanislaus River, fall-run Chinook salmon spawn in a 23-mile stretch of the Stanislaus downstream from Goodwin Dam, but most spawning occurs in the first 10 miles below the dam.

Fish Fall-run Chinook salmon inhabit the Merced, Tuolumne, and Stanislaus rivers, supported in part by hatchery stock in the Merced River. The average annual spawning escapement (1952 through 2013) for the three major San Joaquin River tributaries was an estimated 13,400 adults (river and hatchery combined) (CDFW 2014a). Since 1952, fall-run Chinook salmon populations in the San Joaquin River Basin have fluctuated widely, with a distinct periodicity that generally corresponds to periods of drought and wet conditions. In 2007, Chinook salmon experienced a population decline that occurred throughout the Central Valley, presumably unrelated to drought, with a near-record low escapement in 2007; however, numbers have been increasing since 2010 (CDFW 2014a). There are indications that there may be small populations of spring-run Chinook salmon in the Tuolumne and Stanislaus rivers based on adult and juvenile field data (Franks 2012). Some of the juveniles may rear year-round. Steelhead are still present in low numbers in the Tuolumne, Stanislaus, and possibly the Merced river systems below the major dams (McEwan 2001, Zimmerman et al. 2008), but escapement estimates are not available.

Sacramento–San Joaquin Delta

The aquatic habitat and fish presently found in the Delta are discussed below.

Aquatic Habitat The historical Delta consisted of low-lying islands and marshes that flooded during high spring flows. More than 95 percent of the original tidal marshes have been leveed and filled for agriculture and other uses, resulting in substantial loss of important shallow-water aquatic habitat (USGS 2007). The current Delta consists of islands, generally below sea level, surrounded by levees to keep out water. Inflow of freshwater into the Delta has been substantially reduced by upstream water diversions, mostly to support agriculture. Dredging and other physical changes have altered water flow patterns and salinity (USGS 2007). Numerous nonnative

species are changing the Delta's ecology by altering its food webs (Grimaldo et al. 2009a). All of these changes have had substantial effects on the Delta's biological resources, including marked declines in the abundance of many native fish and invertebrate species (Greiner et al. 2007).

Delta flow refers to the timing, volume, and direction of water flowing through the Delta. The natural Delta flow patterns have been radically altered by dredging, construction of levees, storage reservoirs, and major diversions both upstream from and within the Delta (Kimmerer 2004). Current unnatural flow patterns change fish distributions and exacerbate low survival, especially in the central and south Delta. For example, the Jones and Banks pumping plants diversions in the south Delta export such large volumes of water at times that the tidally averaged flow of water in channels leading away from the pumps is often upstream (i.e., reversed). These reverse flows interfere with the natural downstream migrations from the south Delta of young fish of several important Delta species, including delta smelt, longfin smelt (*Spirinchus thaleichthyes*), Chinook salmon, and striped bass (Monsen et al. 2007, Kimmerer 2004). In addition, these reverse flows may increase fish salvage (Grimaldo et al. 2009b) and entrainment mortality (Kimmerer 2008) at the CVP and SWP export facilities in the south Delta, or prolong fish residence in the south Delta, which may have harmful indirect consequences resulting from increased predation, poor water quality, degraded physical habitat, and other factors (Feyrer and Healey 2003).

Delta outflow establishes the location in the Delta of the low salinity zone (LSZ), an area that historically has had high prey densities and other favorable habitat conditions for rearing juvenile delta smelt, striped bass, and other fish species (Kimmerer 2004). The LSZ is often referenced by X2, which is the distance upstream, in kilometers (km), from the Golden Gate Bridge where tidally averaged salinity is equal to 2 parts per thousand (ppt). X2 is largely determined by Delta outflow (Kimmerer 2004). The best combination of habitat factors is believed to occur when X2 is located downstream from the confluence of the Sacramento and San Joaquin rivers. When Delta outflow is low, X2 is located in the relatively narrow channel of these rivers, and at higher outflows, it moves downstream into more open waters.

The Jones and Banks pumping plants in the south Delta entrain millions of fish each year, most of which are nonnative fishes (Reclamation 2008). Fish screens at the facilities are used to

salvage fish greater than a certain size (around 20 millimeters), but many of the salvaged fish are assumed not to survive their return to the Delta (Kimmerer 2004). The loss of fish at the facilities has been shown to contribute to recent declines of delta smelt (Kimmerer 2008). Other species are also affected by direct losses from entrainment or salvage-related mortality at these CVP and SWP facilities.

The Delta has large regional variations in habitat quality and quantity. For most fish species, habitat quality in the south Delta is believed to be poor (Feyrer 2004, Feyrer and Healey 2003, Feyrer et al. 2007, Monsen et al. 2007). Nobriga et al. (2008) showed that very low summer abundances of delta smelt in the south Delta are related to significantly higher water temperatures and water clarity in the south Delta than other areas of the Delta. Increased water clarity may increase predation risks and reduce feeding success of planktivorous fish such as delta smelt. Entrainment risk is much higher in the south Delta because of the large volumes of water exported by the Jones and Banks pumping plants (Kimmerer 2008). In experimental releases, survival of fall-run Chinook salmon smolts migrating from the San Joaquin River was lower for smolts moving through the Delta via the channels south of the San Joaquin River than for those remaining in the river channel (SJRGA 2001 through 2009, Brandes and McLain 2001). Because of these risks, hydrodynamic flow patterns that transport fish larvae into the south Delta or increase residence time of fish there are likely to adversely affect the populations.

San Joaquin River inflow and diversion rates at the Jones and Banks pumping plants strongly affect net flow patterns in the San Joaquin River side of the Delta, thereby influencing how fish are distributed with respect to the south Delta, and how long the fish remain there (NMFS 2009, Kimmerer and Nobriga 2008, Monsen et al. 2007, Feyrer and Healey 2003, Mesick 2001). The Delta is a tidal system, and water naturally flows upstream with the incoming tide. However, diversions at the Jones and Banks pumping plants can export such large volumes that the pumping changes the balance to a net upstream flow more frequently than under natural conditions, such as at Old and Middle rivers (USFWS 2008, Monsen et al. 2007). San Joaquin River inflow and reverse Old and Middle river flows generally have counteracting effects on the distribution of fish: (1) higher inflows tend to move fish larvae away from the south Delta and reduce passage time of smolts emigrating from the San Joaquin River, and (2) higher reverse flows tend to move fish toward the south Delta (NMFS 2009,

USFWS 2008, Kimmerer and Nobriga 2008). These flows are also likely to indirectly affect upstream migrating adult fish, with high reverse flows leading to increased straying away from the main channel of the San Joaquin River toward the south Delta (USFWS 2008, Kimmerer and Nobriga 2008, Mesick 2001).

Delta flow patterns affect migration of adult salmonids to upstream spawning areas and tributaries as well as juvenile outmigration. River discharge is an important migration cue for adult salmonids attempting to enter their natal streams to spawn, and increases in discharge may improve water quality and habitat conditions in the Delta. Low DO concentrations may cause delays in the onset of upstream migration until later in the fall when DO concentrations improve (Hallock et al. 1970).

Increased water temperature in the Delta could adversely affect cold-water fish species, including Central Valley fall-run Chinook salmon, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, Central Valley steelhead, and other special-status species that use the Delta, including white and green sturgeon, longfin smelt, and delta smelt. The San Joaquin side of the Delta (south Delta) currently often has poor water temperature conditions for the special-status fish species, especially during late summer and early fall (Nobriga et al. 2008, Feyrer 2004, Kimmerer 2004). DO levels in the San Joaquin River near the Stockton Deep Water Ship Channel are often low during late summer and early fall because of high water temperatures, algal biomass, and low river flow (Giovannini 2005, Lee and Jones-Lee 2003). Water temperatures are especially important for Chinook salmon and steelhead adults that migrate upstream in the San Joaquin River beginning in late summer and smolts that migrate downstream through the Delta in spring because these fish have lower temperature tolerances than other Delta fish species. Low DO levels may interfere with upstream migrations of adult fall-run Chinook salmon.

Fish The Delta contains freshwater fishes (e.g., hitch, Sacramento blackfish, pikeminnow), endemic fish that live nowhere else (e.g., delta smelt), anadromous fishes that spend part of their life cycle there (e.g., white sturgeon, Chinook salmon, steelhead, longfin smelt, Pacific lamprey), adult marine fishes and those that spend juvenile stages there (e.g., staghorn sculpin [*Leptocottus armatus*] and starry flounder [*Platichthys stellatus*]), and freshwater species that can tolerate

high salinities (e.g., Sacramento perch, tule perch, Sacramento splittail, prickly sculpin) (Moyle 2002). The Delta also contains a large number of introduced species, including striped bass, largemouth bass, white catfish, and inland silverside.

Over the last decade, abundances of pelagic fishes in the Delta have markedly declined (Sommer et al. 2007). The abundance indices for 2007 through 2013 include record lows for delta smelt, longfin smelt, striped bass, American shad, and threadfin shad (CDFW 2014b). The Delta has become a suboptimal environment for native fishes because of diversions, pollution, physical modifications, and exotic species invasions (Moyle 2002). Introduced species have the potential to greatly alter the Delta ecosystem and threaten native species through competition for resources, direct predation, complex food web effects, hybridization, habitat interference, and the spread of new diseases (Moyle 2002). Losses of salmonids associated with CVP and SWP diversions from the south Delta result from a variety of mortality factors, including entrainment at the CVP and SWP pumps near Tracy, predation in pump forebays, predation within south Delta channels, and fish salvage operations at the pumping facilities.

CVP and SWP Water Service Areas

No fisheries resources in the CVP and SWP water service areas would be affected by the project, so this region is not discussed further in this chapter.

Environmental Consequences and Mitigation Measures

This section discusses environmental consequences on aquatic resources associated with implementation of the alternatives. It also describes potential mitigation measures associated with impacts on aquatic resources that are significant or potentially significant. The potential direct and indirect impacts to aquatic resources and associated mitigation measures are summarized in Table 5-3.

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-1: Loss of Riverine Habitat for Lotic Fish Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-2: Short-term Degradation of Aquatic Habitat from Accidental Spills or Seepage of Hazardous Materials during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-3: Short-term Degradation of Aquatic Habitat from Increased Turbidity or Sedimentation during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-4: Loss of Reservoir Fish Habitat Resulting from Changes in Water Temperature	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-5: Changes to Reservoir Fish Habitat Caused by Turbidity from Increased Surface Area of Exposed Shoreline	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-6: Loss of Reservoir Fish Caused by Entrainment	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-7: Change in Shallow-Water Habitat for Largemouth Bass, Spotted Bass, Smallmouth Bass, and Other Sport Fish Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-8: Change in Open-Water Habitat for Striped Bass and American Shad	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-10: Change in Habitat Potential for Spring-Run Chinook Salmon	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	Beneficial	None Required	Beneficial
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	PS	None Available	PSU
FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-12: Change to Habitat for Moderately Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
FSH-13: Changes to Habitat for Highly Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS	None Required	LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-14: Changes to Spawning and Rearing Habitat from Changes to Flood Pulses and Floodplain Connectivity	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS and Beneficial	None Required	PSU and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-15: Change in Fish Habitat and Migratory Behaviors from Changes in Water Temperatures	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-16: Change in Fish Habitat and Migratory Behaviors from Changes in Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-17: Loss of Fish Habitat from Changes in Tributary Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Available	PSU
		Alternative Plan 1	PS		PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
FSH-19: Loss of Suitable Fish Habitat from Salinity Changes in the Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-20: Loss of Suitable Fish Habitat from Change in Flow Patterns in the South Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FSH-21: Reduction in Fish Abundance from Changes in Exports and Entrainment in the South Delta	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table 5-3. Summary of Impacts and Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FSH-22: Loss of Suitable Fish Habitat Resulting from Changes in X2	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Key:
LTS = less than significant
NI = no impact
PS = potentially significant
PSU = potentially significant and unavoidable
S = significant
SU = significant and unavoidable

Methods and Assumptions

Impacts were evaluated based on the temporal and spatial presence of fish life stages (e.g., spawning adult, egg, juvenile). The methods used varied by geographic area, species, life stage, environmental conditions, and impact mechanism, and depended largely on the amount of available information. An important consideration in evaluating the potential impacts of the alternatives on fish species was that fish life stages vary greatly in their vulnerability to change in environmental conditions. Therefore, impacts were evaluated with respect to the life-cycle timing and spatial distribution of each life stage.

The impact assessment for fisheries is divided into six geographic areas:

- San Joaquin River upstream from Millerton Lake
- Millerton Lake and Temperance Flat RM 274 Reservoir
- San Joaquin River – Friant Dam to Merced River
- San Joaquin River – Merced River to the Delta
- San Joaquin River tributaries (Merced, Tuolumne, and Stanislaus rivers)
- Delta

Each geographic area includes a unique combination of existing representative species and environmental conditions. The following discussion provides an overview of representative species and environmental conditions, followed by a description of the specific methods that were used within each geographic area. As stated previously, there would be no impacts to aquatic resources in the CVP and SWP water service areas so this geographic area is not discussed further.

Three general categories of environmental conditions were used in this impact assessment: (1) water temperature and water quality, (2) physical processes/conditions, and (3) biological interactions. Each category consists of multiple environmental factors that can affect the aquatic ecosystem, and can result in direct and/or indirect impacts on the representative fish species and other fishes.

Impacts are described using three comparisons; the No Action Alternative to existing conditions: action alternatives to No

Action Alternative; and action alternatives to existing conditions.

San Joaquin River Upstream from Millerton Lake

Effects of the alternatives on lotic (i.e., riverine or stream) habitat were evaluated by calculating the amount of stream habitat under current maximum reservoir storage conditions and how much stream habitat would be inundated at maximum reservoir storage conditions under each alternative. These physical effects were expressed as lengths of stream habitat lost from estimated reservoir inundation.

Streambed gradient (i.e., stream slopes) of all lotic reaches was estimated from contour maps and digital elevation models. Length of stream habitat with slopes less than and greater than 3 percent was estimated. The results generated for the length of stream under each gradient category are approximations and are meant to only be used for comparing alternatives.

Species evaluations for the alternatives relative to lotic habitat were considered with regard to their effects on important habitat elements of the evaluated species and their life-stage requirements. The length of useable stream habitat affected for each of the lotic species was calculated.

The lotic habitat evaluation for rainbow trout was based on the assumption that this species occupies stream habitat with a gradient both greater and less than 3 percent, and potentially occurs in Big Sandy Creek and the San Joaquin River. Hardhead and Kern brook lamprey habitat analyses assumed these species mostly use habitat with a gradient of less than 3 percent. Although a 3 percent gradient is not always a barrier to hardhead or to the Kern brook lamprey, the fishes are not likely present on a regular basis in higher gradient habitats, so the higher gradient reaches were not included as useable habitat. Hardhead are known to occur in the San Joaquin River, but for purposes of the evaluation, it was assumed that they are also present where the stream gradient is less than 3 percent in Big Sandy Creek. Kern brook lamprey were assumed to occur only in the San Joaquin River.

For the stream resident species, stream habitat was segregated by gradient into useable and not useable habitat. Useable habitat was defined as the principal habitat of a species. Habitat with a greater than 3 percent gradient was considered not useable by Kern brook lamprey, hardhead, Sacramento sucker, and Sacramento pikeminnow. All stream habitat was

considered useable by rainbow trout. Useable habitat of each of the streams was allocated to the fish species based on known or potential presence of the species in that stream. Rainbow trout, hardhead, and Kern brook lamprey were all considered residents of the San Joaquin River. The effects of the alternative on each of the fish species was assessed by determining the length of useable habitat in streams potentially inhabited by the species that would be inundated by the predicted change in reservoir elevation.

Millerton Lake and Temperance Flat RM 274 Reservoir

The effects of the alternatives on Millerton Lake fish were evaluated by identifying expected environmental changes caused by the alternatives, and evaluating impacts of these changes on five key Millerton Lake sport fish species—largemouth, spotted, smallmouth, and striped bass, and American shad.

Many of the impacts on environmental conditions could not be directly quantified, but were inferred from quantifiable impacts on the following habitat factors: (1) surface area of shallow water, (2) surface area and volume of open-water habitat, (3) fluctuations in water levels, and (4) water temperatures. Risk of entrainment of fish through the reservoir outlets were evaluated by comparing elevations of the outlets at different times of year with the elevations of the reservoir epilimnion (i.e., top layer of a thermally stratified lake), which is where most of the vulnerable fish are expected to reside.

Operations modeling results were used with Millerton Lake bathymetric data to estimate changes in the surface area of open-water and shallow-water habitats, and changes in water-level fluctuations. Evaluation of changes in Millerton Lake was generally limited to the times of year that included the most active spawning, incubation, feeding, and growth period for the selected species. Changes in water temperatures were estimated for both shallow-water habitat and deep, open-water habitat based on water temperature modeling results.

Shallow-water habitat analyses were conducted for three black bass: largemouth bass, spotted bass, and smallmouth bass, which reside primarily in the shallow-water margins of reservoirs. Mean surface area between the reservoir surface and the 15-foot-depth contour, which is the approximate lower margin of the principal spawning and rearing habitat of largemouth bass (Mitchell 1982, Stuber et al. 1982), was computed for each alternative. The surface areas were

computed for April through September, since most spawning for these species occurs from April through June, and the most critical months for successful rearing are April through September (Moyle 2002, Mitchell 1982, Aasen and Henry 1980).

Water-level fluctuations affect the spawning success of largemouth bass, spotted bass, and smallmouth bass because these species spawn in shallow water (O'Brien 1990, McMahon et al. 1984, Mitchell 1982, Stuber et al. 1982). Mean quarter-month increases and decreases in water levels were computed for the alternatives because the time required for hatching black bass eggs exposed to the water temperature conditions that typically occur during spring in Millerton Lake is approximately a quarter-month (Knoteck and Orth 1998, Mitchell 1982).

Results of the reservoir habitat analyses were combined with the known habitat requirements of the selected reservoir species to assess species-specific impacts of the alternatives. For striped bass and American shad, impact analyses were based on water temperature model results and reservoir operation projections for reservoir surface areas and inundation zones, including inundation of spawning habitat.

Impacts to spawning largemouth bass and spotted bass were determined using a spawning production model, which was developed to evaluate effects of reservoir surface-level fluctuations, shallow-water surface areas, and water temperatures for each alternative. The model simulated spawning production of these species under each alternative. The model outputs an index of total reservoir production rather than a true production estimate. Results for largemouth bass were used to determine likely impacts of the alternatives on smallmouth bass spawning because, except for water temperatures, the two species have similar spawning habitat requirements. A detailed description of the spawning production model is provided in the Modeling Appendix.

Water-level fluctuations can have both positive and negative effects on shallow-water habitat factors for fish (O'Brien 1990). Many of these effects are integrated in the Black Bass Spawning Production Model (see the Modeling Appendix) to estimate spawning production for largemouth bass and spotted bass. Effects incorporated in the model include nest dewatering, water temperature effects on development rates and egg and larvae survival, and substrate condition factors.

However, water-level fluctuations also affect important factors that are more difficult to quantify, including predation risk and food resource availability. Potential effects of water-level fluctuations on predation risk and trophic factors are summarized in Table 5-4.

Table 5-4. Potential Effects of Increased Water-Level Fluctuations on Predation Risk and Food Resource Availability for Largemouth Bass, Spotted Bass, and Smallmouth Bass

Increased water-level fluctuations increase predation risk
Young largemouth, spotted, and smallmouth bass sheltering in inundated terrestrial vegetation and other nearshore refuges forced from shelter (falling water level)
Guard males forced from nests by risk of exposure to surface (falling water level) or intrusion of cold water (rising water level)
Nests near water surface exposed to predation by birds and other terrestrial predators (falling water level)
Development of eggs and larvae slowed by intrusion of cold water, increasing time of exposure to high predation risk (rising water level)
Increased water-level fluctuations reduce predation risk
Increased availability of inundated terrestrial vegetation used as shelter by young largemouth, spotted, and smallmouth bass (rising water level)
Increased water-level fluctuations reduce food resources
Unstable water levels interfere with development of diverse community of invertebrates (falling or rising water levels)
Muddy/silty substrates at lower reservoir depths have poor habitat quality for invertebrate prey species (falling water levels)
Increased water-level fluctuations increase food resources
Inundated terrestrial vegetation provides excellent food web support for all life stages of black bass (rising water level)
Small prey fish of older largemouth, spotted, and smallmouth bass that shelter in inundated terrestrial vegetation and other nearshore refuges forced from shelter (falling water level)

Source: Aasen and Henry 1980, O'Brien 1990, Kohler et al. 1993, Knoteck and Orth 1998, Garvey et al. 2000

The effects of the habitat factors discussed above (shallow-water surface area, water-level fluctuations, and water temperatures) were integrated with additional factors using the Spawning Production Model to compute spawning production indices for largemouth bass and spotted bass for Millerton Lake.

San Joaquin River – Friant Dam to Merced River

The effects of the alternatives on aquatic habitats and species between Friant Dam and the Merced River were evaluated by characterizing water quality and physical habitat changes anticipated to occur under the alternatives, and evaluating the

likely range of resulting effects on fish species of interest. All water year types are based on the Restoration Year Type index.

Future conditions include full Restoration Flows and Settlement implementation, which will benefit Chinook salmon as well as other native anadromous fish and resident fish species. All action alternatives described in this Draft EIS would affect restoration of the San Joaquin River, as follows:

- The reduced frequency, magnitude, and duration of Friant Dam releases greater than Restoration Flows would:
    - Reduce the risk of damage to SJRRP instream and floodplain investments
    - Reduce river continuity with some gravel pits
    - Increase flexibility for managing riparian recruitment flows and flexible flow periods
    - Reduce the potential for riparian zone/bank erosion
    - Reduce the rate of unmanaged migration of gravel from spawning areas and potentially reduce the required rate of gravel augmentation
    - Reduce the rate of downstream unmanaged sand migration and potentially reduce the rate/frequency of required sand removal at flow control structures
- Reduce the frequency, magnitude, and duration of floodplain habitat inundation, affecting rearing habitat
- Potential to increase primary productivity in waters released to the San Joaquin River at Friant Dam associated with increased residence time of water in Temperance Flat RM 274 Reservoir
- Improve flexibility in management of Restoration Flows with no effect on water deliveries, including increased operational flexibility for providing buffer flows, and pulse flows for gravel mobilization

The effects of the alternatives on fish and aquatic habitat in the San Joaquin River between Friant Dam and the Merced River were assessed using six different impact indicators. These indicators and the methods used to evaluate their effects are

described in the following sections. Many of these impact indicators are evaluated based on the river reaches as defined in the Settlement and further subdivided for this analysis, as listed in Table 5-5.

Table 5-5. San Joaquin River Flow Capacity by Reach, Friant Dam to Merced River

Reach	Location	Reach Length (miles)	Flow Capacity (cfs)	Average Gradient
1A	Friant Dam to Highway 99	23.7	8,000	0.07
1B	Highway 99 to Gravelly Ford	14.2	8,000	0.04
2A	Gravelly Ford to Chowchilla Bypass Bifurcation	12.9	8,000	0.04
2B1	Chowchilla Bifurcation to Fresno Slough Obstruction	10.2	1,300	0.01
2B2	Fresno Slough Obstruction to Mendota Dam	0.65	1,300	0.02
3	Mendota Dam to Sack Dam	22.3	4,500	0.02
4A	Sack Dam to Sand Slough Control Structure	13.5	4,500	0.02
4B	Sand Slough Control Structure to Bear Creek	32.3	475	0.02
5	Bear Creek to Merced River	16.6	26,000	0.02

Note: Flow capacity is as assumed for this analysis, as described in the Modeling Appendix.

Key:
cfs = cubic feet per second

Habitat Potential for Spring-Run Chinook Salmon The effect of the alternatives on spring-run Chinook salmon habitat potential was evaluated quantitatively using the EDT model (see the Modeling Appendix). The EDT model was previously used to evaluate the anticipated effects of the SJRRP on habitat potential for spring-run Chinook salmon in the year 2030. The descriptions provided in the SJRRP PEIS/R were also used to describe the physical habitat and water quality conditions under existing and future conditions for the No Action Alternative when high-flow events are not taking place (Reclamation 2012a). The simulated SJRRP effects are representative of anticipated future conditions under the No Action Alternative.

Additional EDT scenarios were modeled to evaluate the effects of each action alternative relative to the No Action Alternative. EDT model scenarios for each alternative were developed using San Joaquin River flow and water temperature inputs derived from SRJ5Q and CalSim II model outputs for each alternative (see the Modeling Appendix).

EDT model outputs included:

- Habitat productivity: The density-independent habitat productivity, or habitat quality, expressed in terms of the number of returning adults per original spawning adult

- Habitat capacity: The ultimate capacity, or quantity, of available habitat capable of supporting the modeled species, or, the number of fish that can be supported by the available habitat

- Equilibrium abundance (Neq): The theoretical population size that habitat of a given quantity and quality (capacity and productivity) can support

Habitat potential was modeled using the EDT model as described in the Modeling Appendix. The results are shown with high SAR and low SAR conditions. The SAR variations assume different adult and juvenile survival rates during migration through the lower San Joaquin River (i.e., downstream from the Merced River) and the Delta, and in the ocean. Juvenile and adult Chinook through-Delta survival rates are variable and uncertain, so the high SAR and low SAR scenarios are intended to provide upper and lower bounds for modeling habitat performance.

The EDT modeling is performed for a single representative year for each water year type. The average is an average of the water year type results, weighted by the frequency of each water year type during the simulation period. Details on the EDT model and modeling process are included in the Modeling Appendix.

Water Temperatures Supporting Pre-Spawn Holding Adults and Juvenile Chinook Salmon and Steelhead Migration San Joaquin River temperature conditions were modeled from Friant Dam to the Merced River and a threshold temperature of 55°F was used to describe water temperatures suitable for adult pre-spawn holding and spawning

temperatures in reaches 1A and 1B. This threshold is also useful as an upper bound for suitable water temperatures for transformation to the smolt life history stage during juvenile migration for Chinook salmon and steelhead. These water temperature effects are incorporated into the EDT model for spring-run Chinook, but additional analysis is useful to characterize potential effects on specific Chinook life history strategies and on other anadromous species including steelhead which could recolonize the San Joaquin River.

EPA (1999) and Richter and Kolmes (2005) summarized the scientific literature on water temperature effects on salmonids and found that temperatures approaching and exceeding 55°F can inhibit and even reverse smoltification in steelhead and Chinook salmon. The extent and significance of these effects are dependent on the duration of exposure and the prevalence of smolt transformation before migration. Juvenile steelhead and Chinook salmon that outmigrate as yearlings transform to the smolt phase before or in the early stages of migration. As the extent and duration of water temperatures above 55°F increases, conditions become less favorable for this life history strategy. By extension this would favor the subyearling migrant life history strategy, potentially limiting the life history diversity of the affected population. Sauter et al. (2001a) found that water temperature exposures during rearing influence temperature preferences during smolting; temperature preferences decline as age at smolting increases; and yearling spring-run Chinook preferred water temperatures below 52°F while early-migrant fall-run Chinook could tolerate higher temperatures.

On this basis, even small increases in the duration of water temperatures above the 55°F threshold could potentially restrict the period during which successful smolt transformation can occur in the San Joaquin River migration corridor. Any habitat alterations that reduce the range of potential life history expression are considered to have a negative effect on spring-run Chinook and other salmonids.

San Joaquin River temperature conditions under the No Action Alternative and action alternatives from Friant Dam to the Merced River were modeled using the SJRQ5 model (see the Modeling Appendix). SJRQ5 was developed specifically to support the SJRRP. Model outputs include projected daily minimum, maximum, and average water temperatures calculated from simulated flow conditions for the years 1922 to 2003.

For this analysis, the simulated daily mean water temperatures were processed into a 7-day running average, as a parameter reflective of the biological benefit of both temperature magnitude and duration, and the 10 percent, 50 percent, and 90 percent exceedence values for each day of the year computed. Figure 5-2 displays the results of this process for the No Action Alternative at Reach 1A (see the Modeling Appendix for additional figures).

The number of days during specific periods of interest for the fishery analysis that were below specific thresholds for each exceedance level were counted and divided by 7 to get weeks for use as an indicator of the biological impact of water temperature. A reduction in the number of week between the baseline and action alternative is considered a significant impact and an increase beneficial.

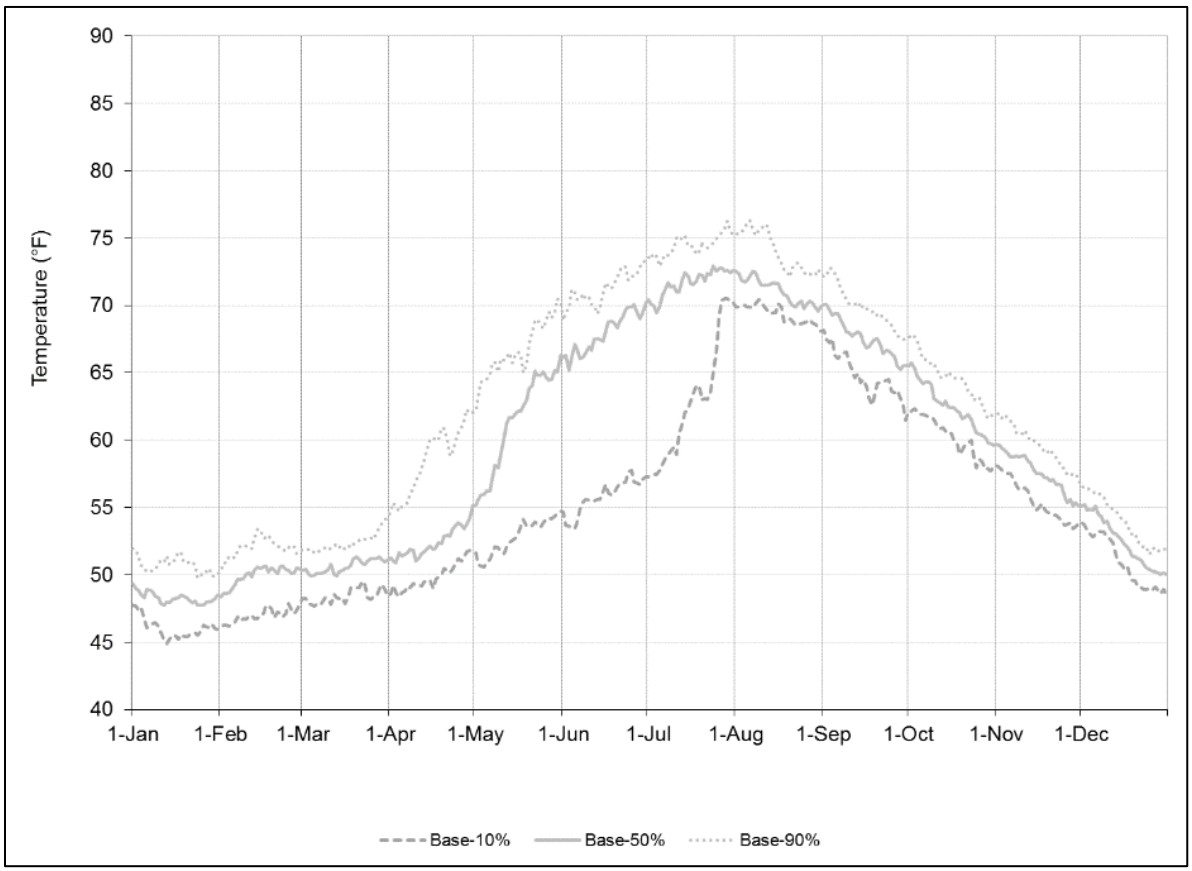


Figure 5-2. The 10th, 50th, and 90th Percentile San Joaquin 7-Day Mean Daily Running Average San Joaquin River Water Temperature for Reach 1A Under the No Action Alternative

Water Temperatures Supporting Moderately Tolerant Native Fish Species The methods for evaluating effects of the alternatives on the temperature regime of the San Joaquin River relative to the thermal requirements of several native fish species that have slightly higher water temperature preferences than salmonids are described below. The species covered under this analysis include hitch, splittail, Sacramento blackfish, and tule perch, species belonging to the deep-bodied assemblage as defined by Moyle (2002), as well as Sacramento pikeminnow, and prickly and riffle sculpin.

The upper limit of optimal growth water temperatures for species in this assemblage ranges from 75°F to 84°F, with splittail, tule perch, and pikeminnow having lower optimal temperature ranges and hitch and blackfish the highest. Splittail are more temperature sensitive overall, having a maximum water temperature tolerance of 84°F (Reclamation 2012a). A water temperature threshold of 77°F provides a useful basis for evaluating a change in habitat conditions for this assemblage, as it marks a transition point between lower and higher optimal water temperature ranges across these four species. The same process described above was used to compute the number of weeks where the 7-day running average was below the 77°F threshold. Any reduction of the number of weeks is considered a significant impact and an increase beneficial.

Water Temperatures Supporting Highly Tolerant Native Fish Species The effects of the alternatives on the temperature regime of the San Joaquin River relative to the thermal requirements of native fish species with the highest water temperature tolerance ranges were evaluated using the methods described below. The species included were Sacramento sucker and hardhead, members of the pikeminnow-hardhead-sucker assemblage as defined by Moyle (2002). The upper limit of optimal growth water temperatures for these two species ranges from 83°F to 86°F (Reclamation 2012a). Both species can tolerate much higher water temperatures, but a threshold of 84°F provides a reasonable upper bound for optimal conditions and a useful basis for evaluating the effects of the alternatives on these species. SJRQ5-simulated temperature conditions for the San Joaquin River from Friant Dam to the Merced River were used to characterize water temperature conditions relative to this threshold.

The same process described above under Water Temperatures Supporting Juvenile Salmon and Steelhead Migration was used to compute the number of weeks where the 7-day running

average was below the 84°F threshold. Any reduction of the number of weeks is considered a significant impact and an increase beneficial.

Flood Pulses and Floodplain Connectivity The relationship between floodplain inundation and aquatic ecosystem health has been documented in numerous studies. Flood pulses provide a connection between aquatic and terrestrial ecosystems that promotes beneficial changes in physical habitat conditions, provides spawning and rearing habitat for floodplain-adapted fish species, and supports high food web productivity (Benke 2001; Junk et al. 1989; Matella and Merenlender 2014; Middleton 2002; Sommer et al. 2002, 2004a, 2004b). These concepts have been integrated into ecosystem management and habitat restoration efforts in the Sacramento and San Joaquin River systems, including the SJRRP (Matella and Merenlender 2014; USACE and Reclamation Board 2002, Reclamation 2012a).

A central component of these concepts is the maintenance and/or reestablishment of normative flow patterns, which include regular (i.e., interannual), low-magnitude flood pulses punctuated by larger floods (e.g., 5- to 10-year recurrence interval) to support healthy ecological processes (Poff et al. 1997). In the case of the San Joaquin River ecosystem, changes in flood peaks could affect phytoplankton and zooplankton production, limits establishment of native riparian vegetation, and fragments key habitats used by native fish species (Opperman 2012). Matella and Merenlender (2014) conclude that the successful restoration of native fish habitat in the San Joaquin River system will depend on simulation of natural flood pulse regimes that make effective use of the available floodplain. The background studies supporting the SJRRP identified 8,000 cfs releases at Friant Dam as the functional equivalent of a 10-year recurrence interval event for the purpose of floodplain activation (Reclamation 2002).

The SJRRP Restoration Flow Schedule was designed to provide flood peaks of sufficient size and frequency to support ecological functions beneficial to Chinook salmon in reaches with sufficient flow capacity to support them. All action alternatives meet the SJRRP Restoration Flow Schedule, with full Exhibit B Schedule flow releases in all simulations of future conditions. The addition of Temperance Flat RM 274 Reservoir would allow for the capture and use of flood flows above the SJRRP Restoration Flow Schedule. This analysis evaluates the potential impacts of changes to the flood flows on

ecological functions. Daily operation modeling was performed for the period from 1922 to 2003 for all scenarios (see the Modeling Appendix). The peak daily release from Millerton Reservoir for each year is used as an indicator of flood peak impacts of the alternatives. Figure 5-3 shows the annual peak flows for the future condition scenarios.

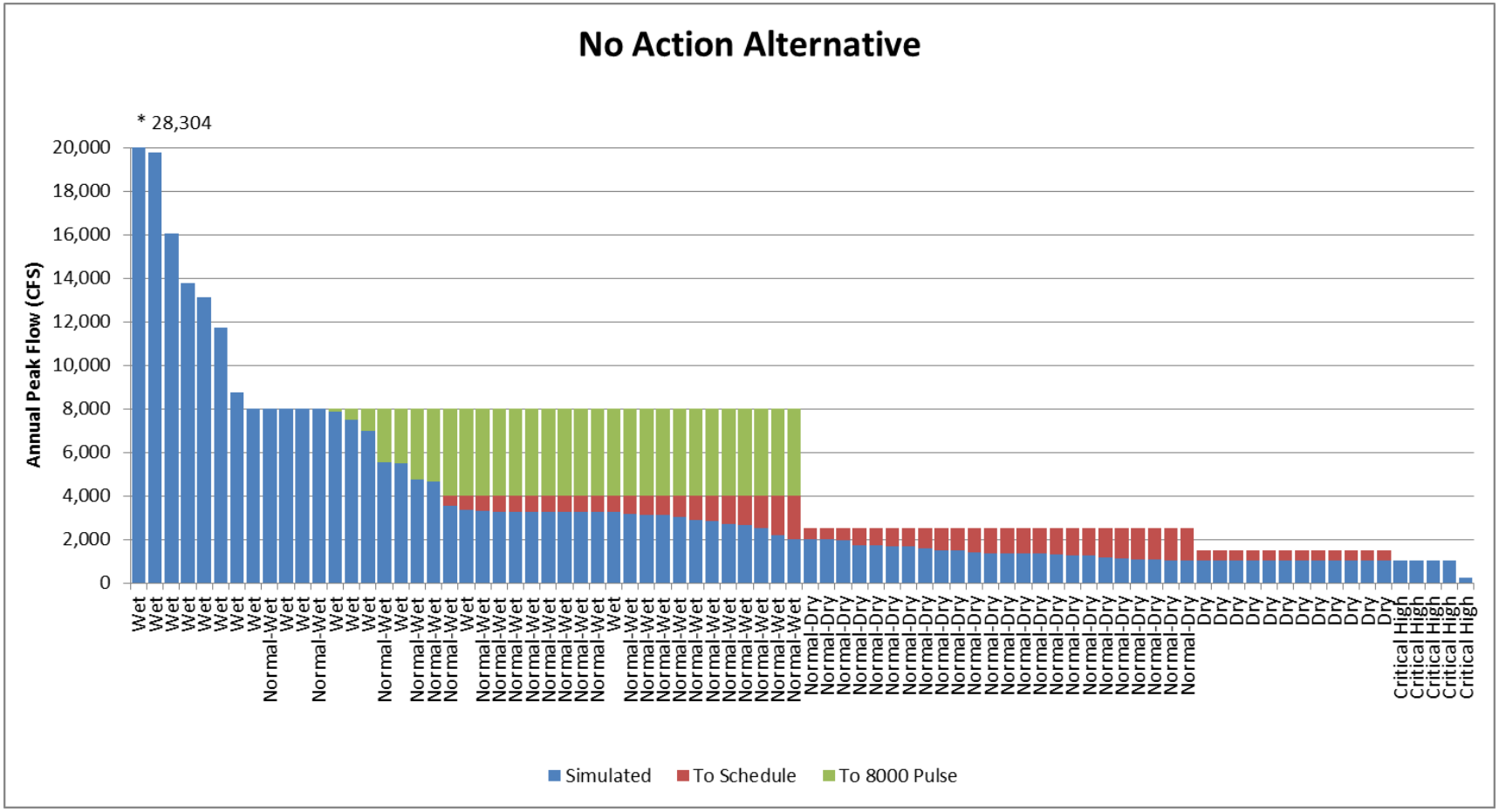


Figure 5-3. Annual Peak Release from Friant Dam to San Joaquin River for the No Action Alternative

San Joaquin River – Merced River to Delta

The San Joaquin River between the Merced River confluence and the Delta is used primarily as a migratory corridor for both juvenile and adult fish, including Chinook salmon and steelhead. Migration could be affected in the lower San Joaquin River through changes in water temperature or flow. These changes could affect the timing or duration of migration, or even the direct survival of individual fish as they move upstream or downstream.

Simulated San Joaquin River monthly flows from the CalSim II simulation results downstream from the Merced River confluence and near Vernalis were compared to the baselines for each alternative. Downstream from the Merced River a flow reduction of 10 percent or greater, when the baseline flow is below 6,000 cfs, is considered significant. Downstream from Vernalis a flow reduction of 10 percent or greater, when the baseline flow is below 10,000 cfs, is considered significant.

San Joaquin River Tributaries

The Merced, Tuolumne, and Stanislaus rivers are the three main tributaries to the lower San Joaquin River. Each tributary supports self-sustaining populations of fall-run Chinook salmon and Central Valley steelhead.

Criteria for determining impacts to tributary fish were based on the flows in each tributary expected to provide the maximum habitat for each life stage of Chinook salmon and Central Valley steelhead. Optimal flows were identified based on several sources, including two instream flow incremental methodology (IFIM) studies conducted to calculate maximum weighted usable area of habitat for each life stage, studies conducted for FERC relicensing projects, and from CDFW modeling (USFWS 1993, 1995, and 1997; DFG 2005; NMFS 2009). In the evaluation, all years were first combined, and then separated by water year type based on the San Joaquin Valley Index. Resulting average flows are presented for each time frame for the life stages provided in Table 5-6.

Table 5-6. Tributary Flows Assumed to Provide Maximum Salmon and Steelhead Habitat

Time Frame	Life Stage	Flow (cfs)
Merced River Chinook Salmon/Steehead[1]		
October 1–December 31	Spawning	400
January 1–March 15	Incubation/Fry Rearing	400
March 16–June 15	Juvenile Rearing/Migration	1,500
June 15–October 31	Juvenile Rearing/Adult (steelhead)	250
Tuolumne River Chinook Salmon[2]		
October 1–April 30	Spawning/Incubation/Fry Rearing	275
January 1–December 31	Juvenile Rearing	150
January 1–June 30	Juvenile Migration	1,100
Tuolumne River Steelhead[2]		
January 1–December 31	All Life Stages	275
March 15–June 30	Juvenile Migration	1,100
Stanislaus River Chinook Salmon[3]		
October 15– December 31	Spawning	300
January 1–February 28	Incubation/Fry Rearing	300
January 1–December 31	Juvenile Rearing	200
March 15–June 30	Juvenile Migration	2,000
Stanislaus River Steelhead[3]		
November 1–February 28	Spawning	200
January 1–March 31	Incubation/Fry Rearing	200
January 1–December 31	Juvenile Rearing	150
March 15–June 30	Juvenile Migration	2,000

Sources: USFWS 1993, 1995, and 1997; DFG 2005; NMFS 2009
Notes:
[1] Because information is limited on steelhead, flows needed for Chinook salmon and steelhead are combined.
[2] Flows are based on USFWS 1995 and from results of the DFG Chinook model.
[3] Flows are based on USFWS 1993, and from the 2009 Operations Criteria and Plan Biological Opinion for Below-Normal years
Key:
cfs = cubic feet per second

Delta

The effects of the alternatives on aquatic habitats and species in the Delta were evaluated by characterizing water quality and physical habitat changes anticipated to occur under the alternatives and evaluating the likely range of resulting effects on Delta fish species of interest. The alternatives are expected to have virtually no effect on environmental conditions in most of the Delta, but they are expected to affect conditions in the south Delta because of changed flows in the San Joaquin River

entering the south Delta during wet hydrologic periods. Therefore, the impact analysis focuses on anticipated changes and effects on fish in the south Delta.

The effects of the alternatives on fish and aquatic habitat in the Delta were assessed using five different impact indicators. Many of the effects analyses were based on mean results for different water year types, using the water year types of the Sacramento Valley Index. These five impact indicators and the methods used to evaluate their effects are described in the following sections.

Water Temperature and Dissolved Oxygen Concentration
Exposure to water temperatures exceeding the upper limits of suitable temperature ranges for the fish species of interest, during the time of year when the species is expected to occur in the south Delta, is considered significant. The upper water temperature limits for Chinook salmon and steelhead are 55°F and 70°F for the juvenile and adult life stages, respectively. Justification for these temperature limits is provided above in methods descriptions for the San Joaquin River—Friant Dam to Merced River. The upper limit for other species of interest is 77°F for delta smelt (Sommer and Mejia 2013), 64°F for longfin smelt (Moyle 2002), and 66°F for both white sturgeon (Israel et al. 2010) and green sturgeon (Israel and Kimley 2008). However, changes in Delta water temperatures resulting from the project are highly unlikely because by the time Friant Dam releases reach the Delta, water temperatures would be directly affected by air temperature and tributary water temperatures.

Effects of the alternatives on DO concentrations in the Delta were not estimated directly, but were assessed from their effects on San Joaquin River inflow. The most important issue concerning DO in the Delta is periodic depletions of DO in the San Joaquin River near the Stockton Deep Water Ship Channel. The low DO levels often occur in late summer and fall and are believed to delay the upstream migration of adult fall-run Chinook salmon (Lee and Jones-Lee 2003). DO levels are at times directly affected by San Joaquin River inflow, with low inflow resulting in reduced DO concentration (Lee and Jones-Lee 2003). The relationships between San Joaquin River inflow and DO concentrations, and between the DO concentrations and fall-run salmon migration delay have not been well quantified, but Lee and Jones-Lee (2003) found that DO depletion occurred only at flows below about 2,000 cfs. Therefore, for this analysis, San Joaquin River inflow below

2,000 cfs during late summer and fall (defined here as September through November) is considered to have potentially adverse effects on DO levels encountered by upstream migrating adult fall-run salmon. To evaluate the potential effect of changes in San Joaquin River inflow on fish habitat in the south Delta, and considering the inherent uncertainty within the hydrologic model, it was assumed that changes that were less than 5 percent (plus or minus) relative to the basis of comparison in the frequency of months with mean flows less than 2,000 cfs would not result in a significant (detectable) effect on DO concentration to which adult fall-run salmon were exposed. Therefore, an alternative is considered to have a significant impact if its implementation would result in an increase of 5 percent or more in the percentage of months per water year type with mean San Joaquin River inflow less than 2,000 cfs during September through November.

Salinity Elevated salinity levels adversely affect special-status Delta fish species, including delta smelt and longfin smelt, both of which spawn in the freshwater portions of the Delta. The egg and larval stages are particularly vulnerable.

The State Water Board Water Right Decision 1641 (D-1641) for Delta salinity objectives and X2 standards are designed to protect sensitive Delta species such as delta smelt. Any changes to salinity or X2 resulting in violation of any of the objectives and standards is considered a significant impact.

Delta Flow Patterns Hydrodynamics in the south Delta influence distributions of Delta fish species and thereby affect their risk of exposure with respect to preexisting adverse environmental conditions. As previously noted, habitat conditions in the south Delta are considered to be particularly poor. The expected effects of the alternatives on south Delta hydrodynamics were quantified using CalSim II simulations of San Joaquin River flow at Vernalis (inflow), Old and Middle river flows, and combined diversions (exports) of the Banks and Jones export facilities. San Joaquin River inflow affects the movement of fish into and out of the south Delta. Reversed flows in Old and Middle rivers are believed to affect fish by altering their natural migration behaviors and increasing time of exposure to entrainment risk and other adverse conditions. Reverse flows in Old and Middle rivers, resulting from low San Joaquin River inflows and increased exports to the CVP and SWP, have been identified as a potential cause of increased delta smelt mortality at the CVP and SWP fish facilities within recent years (Simi and Ruhl 2005, Wanger 2007). Results of

analyses of the relationship between the magnitude of reverse flows in Old and Middle rivers and salvage of adult delta smelt in the late winter shows a substantial increase in salvage as reverse flows exceed approximately -5,000 cfs. Concerns regarding reverse flows in Old and Middle rivers have also focused on planktonic egg and larval stages of splittail and on Chinook salmon smolts, in addition to delta smelt and, while these species do not spawn to a significant extent in the south Delta, eggs and larvae may be transported into the area by reverse flows in Old and Middle rivers. The ratio of San Joaquin River inflow to total exports (inflow:export [I:E] ratio) has been used to evaluate the net effect of these factors on emigrating fall-run Chinook salmon (NMFS 2009). Increases in the ratio are considered to reduce the probability of fish entering or remaining in the south Delta.

The significance criteria used in this analysis for determining a significant impact of the alternatives on Delta flow patterns, based on the RPAs of the NMFS 2009 and USFWS 2008 BOs, employ Old and Middle rivers reverse flows and the I:E ratios as follows:

- A comparison of reverse flows within Old and Middle rivers under the basis of comparison and proposed alternative project operations was prepared for the seasonal period extending from January through June. Per the RPAs in the USFWS 2008 and NMFS 2009 BOs, any reduction in Old and Middle River reverse flows (i.e., flows that are more negative) that result in flows greater than (i.e., flows that are more negative) -5,000 cfs are considered to be a significant impact. Additionally, a 5 percent reduction in Old and Middle river flows making them more negative is also considered a significant impact.

- An alternative is considered to have a significant impact if its implementation would result in an increase of 5 percent or more in the percentage of months with a mean I:E ratio less than 4:1 in Wet and Above-Normal years, less than 3:1 in Below-Normal years, less than 2:1 in Dry years and less than 1:1 in Critical years, during the April and May period of Chinook salmon and steelhead emigration (NMFS RPA Action IV.2.1)(NMFS 2009).

For purposes of evaluating the potential effect of changes in Old and Middle river flows and I:E ratios on fish habitat in the

south Delta, and considering the inherent uncertainty within the hydrologic model, it was assumed that changes that were less than 5 percent (plus or minus) relative to the basis of comparison in the frequency of the above-described conditions would not result in a significant (detectable) effect on habitat quality or availability. Therefore, an alternative is considered to have a significant impact if its implementation would result in an increase of 5 percent or more in the frequency of Old and Middle river flows less than -2,000 cfs or -5,000 cfs, respectively, or in the frequency of low I:E ratios, as defined above.

Entrainment Sensitive Delta fish species, including fall-run, spring-run, and winter-run Chinook salmon, steelhead, longfin smelt, and delta smelt, are regularly entrained with white and green sturgeon entrained less frequently at the Banks and Jones export facilities (Williams 2006, NMFS 2009, Harvey and Stroble 2013, DWR 2013a). Assuming the fish are present in the south Delta, increases in diversions at the Banks and Jones facilities increase their risk of entrainment and exposure to other adverse conditions, including increased predation, reduced water quality, and migration delays. Young life stages are especially at risk. The period of the year that presents an increased risk of entrainment and related effects encompassing all the special-status Delta species is December through June (USFWS 2008, NMFS 2009). For evaluating the potential effect of changes in entrainment and related effects on fish abundance, these factors are assumed, on an average basis, to be directly proportional to the diversion level. Considering the inherent uncertainty of this relationship and of the hydrologic model used to estimate diversion levels, it was assumed that changes in mean monthly diversions that were less than 5 percent (plus or minus) relative to the basis of comparison would not result in a significant (detectable) effect on entrainment and related effects. Therefore, increases in the mean monthly Banks and Jones combined diversion rates, by water year type, of more than 5 percent that occur during the December-through-June period of increased risk are considered to have a significant impact on Delta fishes.

X2 Shifts in X2 provide a measure of changing habitat conditions resulting from changes in flow downstream from the south Delta. The CalSim II model was used to simulate the location of X2. Except under extreme high-flow conditions, reductions in X2 generally provide improved habitat conditions for special-status species such as delta smelt and longfin smelt. Also, reductions in X2 reflect increased Delta outflow, which

is considered important in dispersing fish larvae, especially longfin smelt, into habitats downstream from the Delta. Historically, X2 has varied between San Pablo Bay (River Kilometer 50) during high Delta outflow and Rio Vista (River Kilometer 100) during low Delta outflow. X2 has typically been located between approximately Honker Bay and Sherman Island (River Kilometer 70 to 85). Upstream shifts that move X2 from downstream to upstream from the confluence of the Sacramento and San Joaquin rivers (81 km) may be especially deleterious for fish habitat because the surface area and quality of habitat are substantially reduced upstream from the confluence (Unger 1994, USFWS 2008).

X2 is controlled directly by the volume of Delta outflow, although changes in X2 lag behind changes in outflow. Minor modifications in outflow do not greatly alter X2. Operations of upstream storage reservoirs have the potential to affect the location of X2 as a result of changes in freshwater flows from the upstream tributaries through the Delta. For purposes of evaluating changes in habitat quantity and quality for estuarine species, a significance criterion of an upstream change in X2 location within 1 km of the basis-of-comparison condition was considered to be less than significant. The criterion was applied to a comparison of hydrologic model results for basis-of-comparison conditions and action alternatives, by month and water year, for the months from February through May and September through November, based on the X2 requirements identified in the USFWS 2008 BO.

Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an EIS must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A “[s]ignificant effect of the environment” means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

Significance criteria (sometimes called thresholds of significance) used in this analysis are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, and local agencies. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of the context and the intensity of its effects.

For the assessment of impacts on fisheries and aquatic ecosystems, habitat indicators for project operations, such as water temperature, flows, and important ecological processes, have been used to evaluate whether the alternatives would have an adverse effect on the species and/or species' habitat. For example, changes in river flows and water temperatures during certain periods of the year have the potential to affect spawning, fry emergence, and juvenile emigration. Therefore, changes in monthly mean river flows and water temperatures during certain times of the year (during spawning, incubation, and initial rearing) have also been used as habitat impact indicators for species of primary management concern.

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on fisheries and aquatic ecosystems would be significant if project implementation would do any of the following:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by CDFW, USFWS, or NMFS.

- Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved State, regional, or local habitat conservation plan or policies or ordinances protecting biological resources.

- Interfere substantially with the movement of any native resident or migratory fish species or with established habitat, or impede the use of native fish nursery/rearing sites.

- Conflict with a local policy or ordinance that protects aquatic and fishery resources.

- Substantially reduce the habitat of a fish species, cause a fish species to drop below self-sustaining levels, threaten to eliminate a fish or macroinvertebrate community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened fish species.

Significance statements are relative to both the existing conditions and future conditions, unless stated otherwise.

Topics Eliminated from Further Consideration

Because implementing any of the action alternatives would not result in land use changes or other physical consequences in the CVP and SWP water service areas that would affect existing habitat for biological resources, their implementation would not create an impact on biological resources within these service areas. This portion of the extended study area is not discussed further in this analysis.

Direct and Indirect Effects

Impact FSH-1: Loss of Riverine Habitat for Lotic Fish Species

Primary Study Area – San Joaquin River Upstream from Millerton Lake

No Action Alternative Under the No Action Alternative, no change to the reservoir elevation would occur, and no riverine habitat upstream from Millerton Lake would be inundated. Therefore, there would be no loss of riverine habitat for lotic fish species in the upper San Joaquin River.

There would be **no impact** under the No Action Alternative.

Action Alternatives The San Joaquin River between Millerton Lake and Kerckhoff Dam currently provides roughly 9 miles of riverine habitat, about 6 miles of which has gradients of 3 percent or less. These lower gradient habitats are necessary for Kern brook lamprey, hardhead, Sacramento sucker, and Sacramento pikeminnow, as habitat gradients higher than 3 percent are typically difficult for these fishes to pass. Rainbow trout are able to pass these higher gradient habitats.

When full, Temperance Flat RM 274 Reservoir would affect all useable habitat for the riverine fish species. Within the riverine

habitat, assuming rainbow trout, Kern brook lamprey, hardhead, Sacramento sucker, and Sacramento pikeminnow all inhabit the San Joaquin River; all lotic habitat for these fishes would be affected by all the action alternatives. The action alternatives would frequently eliminate all riverine habitat for these fish, potentially including during the reproductive season. A portion of Big Sandy Creek would also be inundated, however, it is not likely to contain suitable habitat for Kern brook lamprey, hardhead, or Sacramento pikeminnow. More evaluations would be required to determine the quality of habitat for these species. Rainbow trout and Sacramento sucker may move upstream and inhabit Big Sandy Creek.

Striped bass may be less affected because their spawning success in the riverine habitat analysis area is already questionable, and stocking is necessary to propagate the Millerton Lake population. American shad would also lose the required habitat conditions necessary for spawning. Neither of these species is likely to use Big Sandy Creek.

Of the fishes that currently occupy the riverine segment during all or portions of their life stage, rainbow trout, hardhead, pikeminnow, striped bass and American shad can all also live in reservoirs. Kern brook lamprey, however, require stream conditions, and cannot transition into a reservoir habitat condition.

This impact would be **significant** under all the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact FSH-2: Short-term Degradation of Aquatic Habitat from Accidental Spills or Seepage of Hazardous Materials during Construction of Temperance Flat RM 274 Dam and Other Facilities

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, no construction activities would occur in the primary study area. Therefore, there would be no potential spills of hazardous materials related to construction in Millerton Lake that would adversely affect fish populations in the reservoir.

There would be **no impact** under the No Action Alternative.

Action Alternatives As described in Chapter 15, "Hydrology – Surface Water Quality," construction-related activities in the reservoir basin could discharge waste petroleum products or other construction-related substances containing metals that could enter waterways in runoff. In addition, chemicals associated with operating heavy machinery would be used, transported, and stored on site during construction activities. Concentrations of hazardous materials could become especially elevated in shallow-water embayments, where dilution mixing from other parts of the reservoir would be limited. These materials would be potentially harmful to fish in Millerton Lake and in the Temperance Flat Reservoir Area.

As described in Chapter 2, "Alternatives," Reclamation would prepare and implement a SWPPP before construction, identifying BMPs to prevent or minimize the discharge of sediments and other contaminants with the potential to affect beneficial uses or lead to violations of water quality objectives of surface waters. These measures are expected to protect all life stages of fish in Millerton Lake and the Temperance Flat Reservoir Area and their tributaries. The accidental release of chemicals, fuels, lubricants, and non-storm-drainage water into water bodies would be prevented to the extent feasible.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-3: Short-term Degradation of Aquatic Habitat from Increased Turbidity or Sedimentation during Construction of Temperance Flat RM 274 Dam and Other Facilities

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, no construction activities would occur in the primary study area. Therefore, there would be no short-term increases in turbidity or suspended sediment in Millerton Lake that would adversely affect fish population in the reservoir.

There would be **no impact** under the No Action Alternative.

Action Alternatives As described in Chapter 15, "Hydrology – Surface Water Quality," construction-related activities in the reservoir basin would result in short-term increases in the amount of exposed shoreline area subject to erosion. The erosion would raise levels of turbidity and suspended

sediments in the reservoir, which could result in thickening of the gills, potentially causing the loss of respiratory function; in clogging and abrasion of gills; and in increased stress levels, which in turn could reduce tolerance to disease and toxicants. Prolonged exposure to high levels of suspended sediment would create a loss of visual capability in fish in aquatic habitats within the primary study area, leading to reduced feeding and growth rates.

Levels could become especially elevated in shallow-water bays, where dilution mixing from other parts of the reservoir would be limited. Activities that could lead to erosion include construction of the Temperance Flat RM 274 Dam and associated structures, which would require the excavation, transport, stockpiling, grading, drilling, blasting, and use of bedrock, alluvium, and soil obtained from the aggregate quarry. Other activities producing erosion would include the demolition and removal of existing facilities within the inundation zone, installation of support structures, construction of permanent access roads and temporary haul roads, and use of staging areas. Additionally, about 3,580 acres of vegetation in parts of the new inundation area would be partially or completely removed. Removal of vegetation would reduce the amount of effective ground cover (both live and dead material), thereby increasing the potential for short-term erosion and sedimentation along the shoreline. Soils disturbed by these activities as well as materials stockpiled for use during construction would be susceptible to erosion.

Temporary construction-related erosion will be avoided and minimized via implementation of the erosion and sediment control plans and SWPPPs (i.e., erosion and sediment control plans, including site revegetation) that are a part of the environmental commitments common to all action alternatives. The plans would include site-specific structural and operational BMPs to prevent and control short- and long-term erosion and sedimentation effects, stabilize soils and vegetation in areas affected by construction activities, and prevent and control impacts on runoff quality. Types of BMPs may include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, silt fencing, sediment basins, fiber rolls, sandbag barriers, straw bale barriers, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-4: Loss of Reservoir Fish Habitat Resulting from Changes in Water Temperature

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, water temperatures would be expected to be slightly different that existing conditions. The increased releases for full Restoration Flows could deplete the existing cold-water pool slightly, resulting in slightly higher temperatures at deeper depths in Millerton Lake during the fall months.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives is expected to have an effect on water temperatures in Millerton Lake under existing and future conditions because of the increased surface area and increased area of shallow shoreline habitat. Increased water temperatures are expected in Millerton Lake and the Temperance Flat Reservoir Area for both shallow depths (less than 25 feet) where black bass spawn and at greater depths where striped bass and American shad may reside.

The open water in Millerton Lake and the Temperance Flat Reservoir Area would be warmer under the action alternatives especially in deep water (greater than 150 feet) during October and January (see Figure 5-4 and additional water temperature figures in the Modeling Appendix). The highest water temperatures under any of the alternatives could be as high as 79°F, which slightly exceeds the lowest warm-water temperature found stressful for striped bass (Moyle 2002).

The open water of both Millerton Lake and Temperance Flat RM 274 Reservoir would provide a wide range of water temperatures during July because of temperature stratification (see results in the Modeling Appendix), so striped bass and American shad would be able to find suitable temperatures in the reservoirs. For the March through June period, future action alternatives would create reservoir water temperatures greater than the No Action Alternative and existing conditions for Millerton Lake at the same depth. The expected water

temperatures are somewhat greater for Millerton Lake than for the Temperance Flat RM 274 Reservoir, especially for the 11- to 15-foot and 16- to 22-foot depth intervals (see Figure 5-5 and Figure 5-6 and additional water temperature figures in the Modeling Appendix). Depth ranges of 3 to 6 feet and 8 to 13 feet are considered optimal for largemouth bass and spotted bass spawning, respectively (Moyle 2002). Differences among the five action alternatives in these shallow depths during spring are small.

Black bass spawning production could benefit from increasing rates of egg and larval development at warmer water temperatures. However, spotted bass and largemouth bass cease spawning when water temperatures exceed about 72°F (Moyle 2002) and 76°F (Mitchell 1982), respectively. These water temperatures are exceeded more frequently under the action alternatives in Millerton Lake, but Temperance Flat RM 274 would add additional areas of suitable temperatures to somewhat offset this effect (see the Modeling Appendix).

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

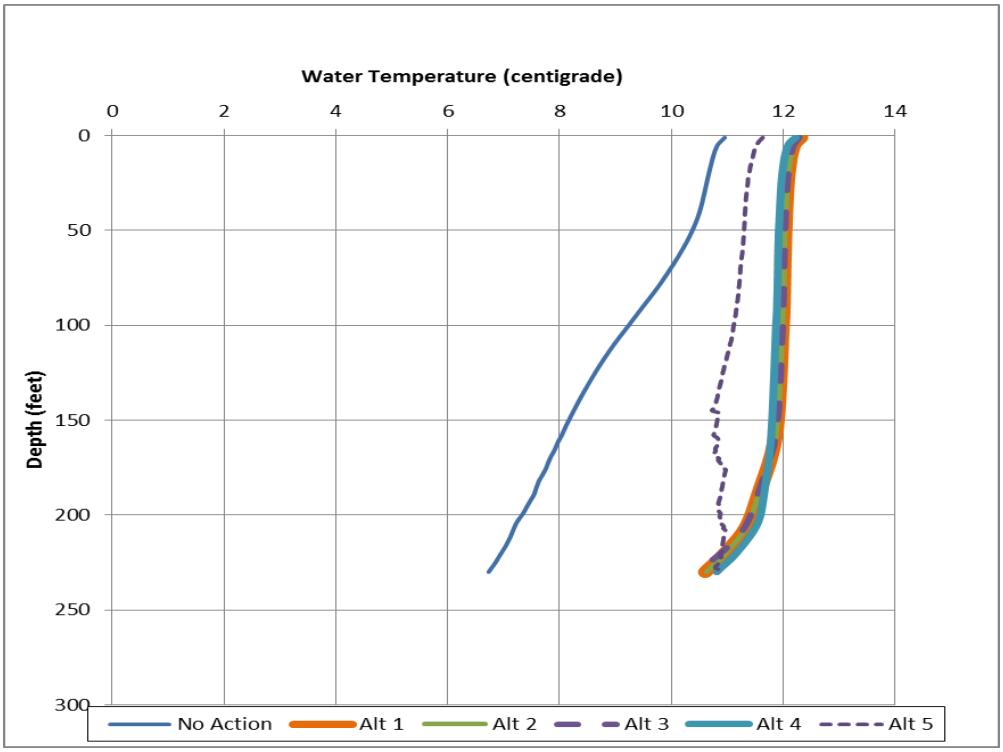


Figure 5-4. Average January Water Temperatures in Millerton Lake Under Future Conditions

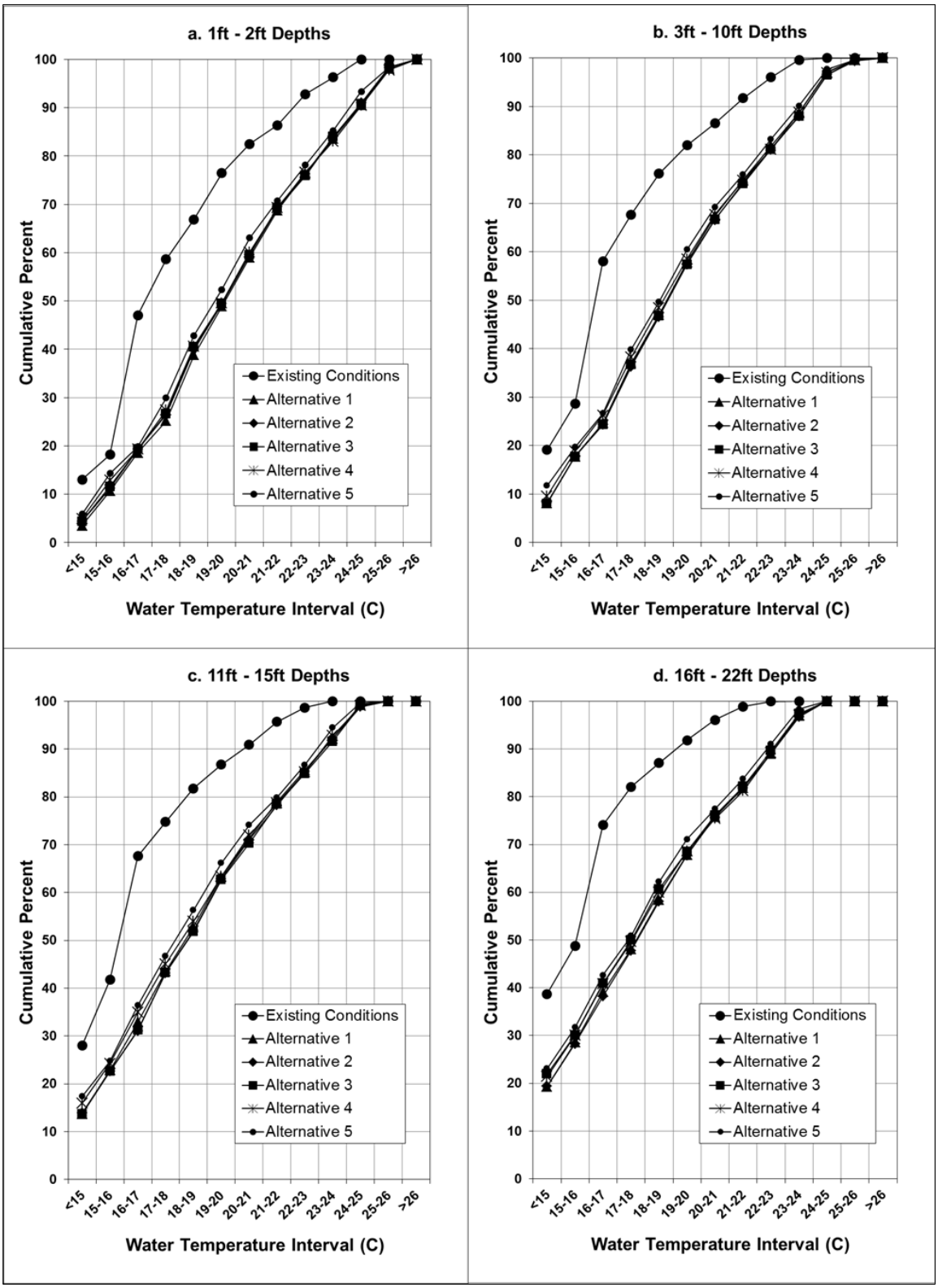


Figure 5-5. Cumulative Frequency of March-Through-June Water Temperatures in Millerton Lake Under Existing Conditions

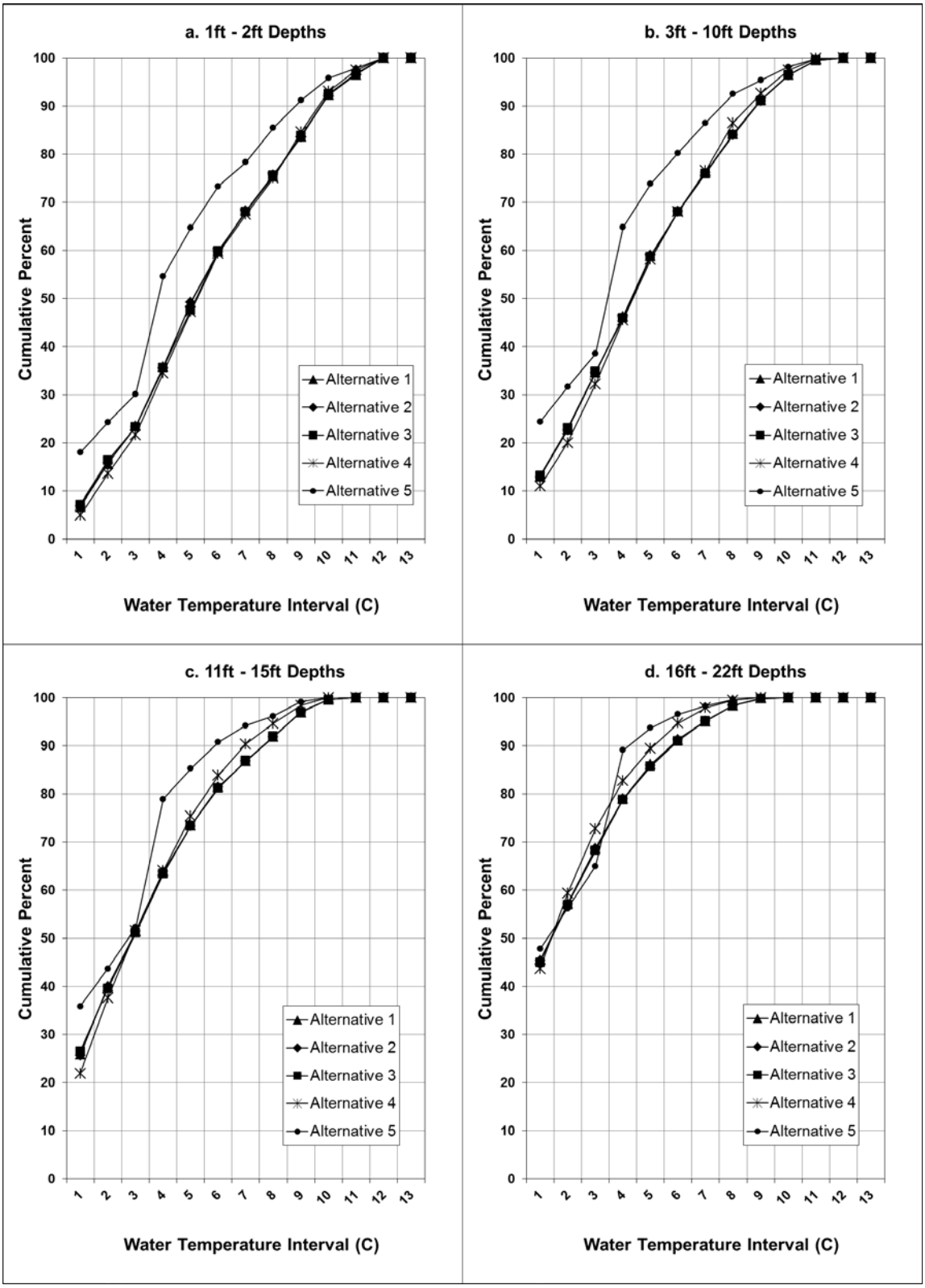


Figure 5-6. Cumulative Frequency of March-Through-June Water Temperatures in Temperance Flat Reservoir Under Existing Conditions

Impact FSH-5: Changes to Reservoir Fish Habitat Caused by Turbidity from Increased Surface Area of Exposed Shoreline

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, variation in reservoir levels of Millerton Lake due to reoperating Friant Dam under the SJRRP would continue within the range of reservoir water surface elevations under existing conditions, with little change in the average conditions. No changes are expected in upslope vegetation, in streams tributary to Millerton Lake, or to the San Joaquin River upstream from Millerton Lake. Therefore, no long-term changes are expected in exposure of shorelines to erosion or to turbidity and suspended sediment runoff from surrounding slopes and tributaries under the No Action Alternative.

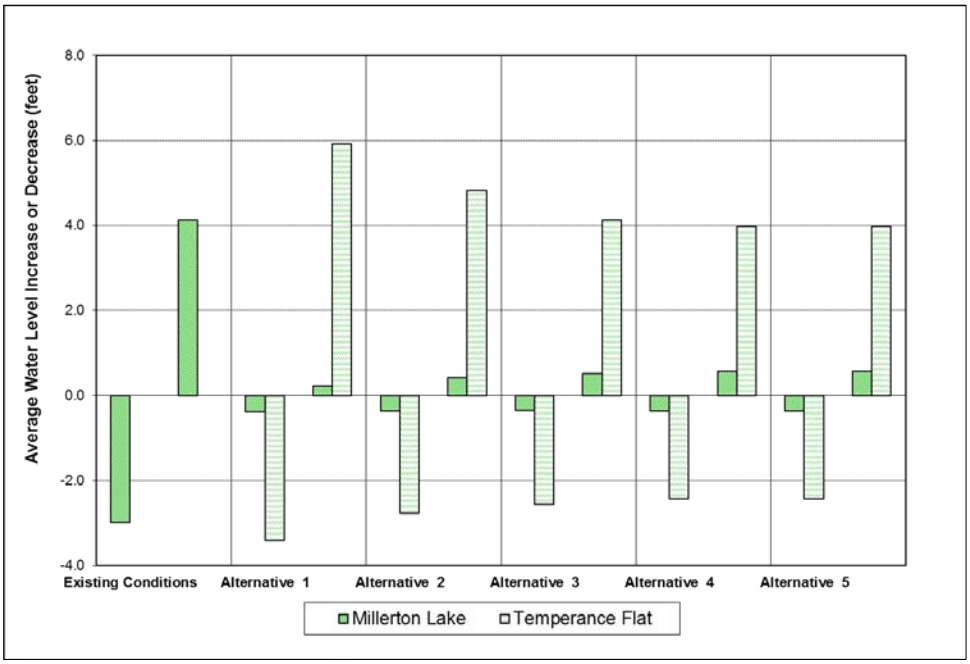
There would be **no impact** under the No Action Alternative.

Action Alternatives Once Temperance Flat RM 274 Dam is constructed and the reservoir filled, shoreline erosion would occur along the zone of reservoir-elevation fluctuation between the top-of-active-storage capacity (985 TAF) and the top of minimum carryover storage capacity (200 TAF under Alternative Plans 1, 2, and 3, 325 TAF under Alternative Plan 4, and 100 TAF under Alternative Plan 5). Average water-level fluctuations in the Temperance Flat RM 274 Reservoir during the April-to-June black bass spawning period would be similar to those currently in Millerton Lake under Alternative Plans 2, 3, 4, and 5 and somewhat greater than those currently in Millerton Lake under Alternative Plan 1 (Figure 5-7 and Figure 5-8). As described in Chapter 11, "Geology and Soils," substantial soil erosion and loss of topsoil would occur in the area of shoreline subject to fluctuating water levels. This shoreline area comprises about 4,300 acres under Alternative Plans 1, 2, and 3, about 3,700 acres under Alternative Plan 4, and about 5,000 acres under Alternative Plan 5. The amount of sediment that could be delivered is not quantifiable because of the size of the reservoir and the number of variables that influence sediment transport and delivery. As discussed in Chapter 15, "Hydrology – Surface Water Quality," the action alternatives would result in an incremental increase in the delivery of suspended sediment and turbidity to Temperance Flat RM 274 Reservoir. The sediment would be largely retained within the reservoir, and therefore have essentially no effect on Millerton Lake or the San Joaquin River downstream.

The rate of shoreline erosion would be greatest during the first several years after construction, and would reduce over time as the new shoreline stabilized.

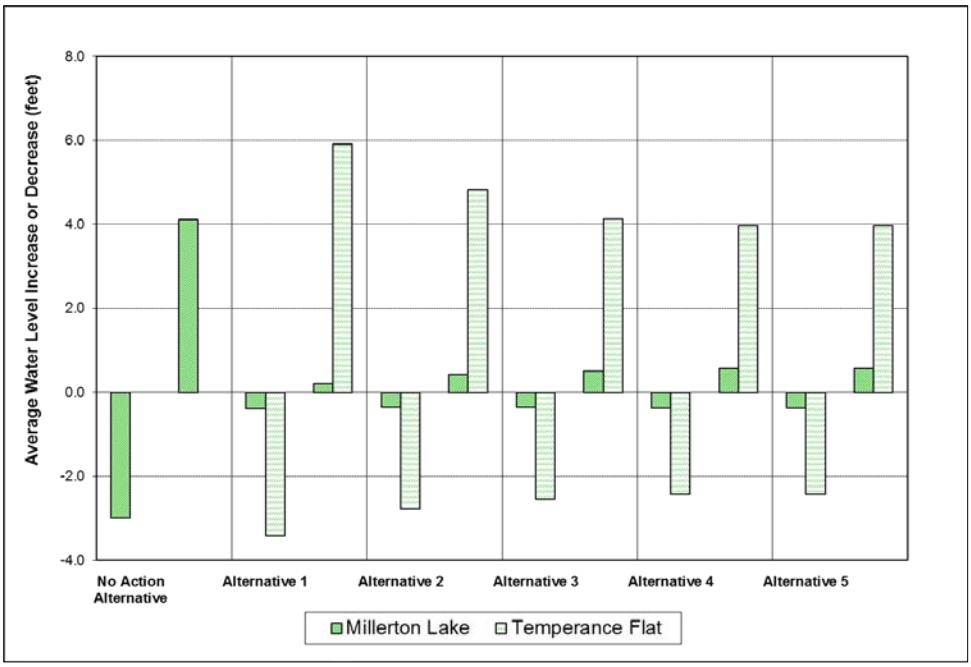
High turbidity and sedimentation have a number of potentially adverse effects on fish, including smothering of eggs, injury to gills, impairment of visual feeding, and reduced food web production (Kerr 1995). However, while these effects would potentially suppress fish production in Temperance Flat RM 274 Reservoir, any such suppression would be offset by improved habitat conditions in Millerton Lake and an overall increase in habitat availability (see also Impact FSH-7: Change in Shallow-Water Habitat for Largemouth Bass, Spotted Bass, Smallmouth Bass and other Sport Fish Species; and Impact FSH-8: Change in Open Water Habitat for Striped Bass and American Shad). Spring (April through June) water level fluctuations in Millerton Lake under all action alternatives are substantially reduced, which would minimize turbidity and erosion levels. This impact would be less than significant and beneficial in Millerton Lake.

Overall, this impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.



Note: Averages include zero change value.

Figure 5-7. Change in Reservoir Water Levels During April Through June Under Existing Conditions



Note: Averages include zero change value.

Figure 5-8. Change in Reservoir Water Levels During April Through June Under Future Conditions

Impact FSH-6: Loss of Reservoir Fish Caused by Entrainment

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, seasonal variations in surface elevation of Millerton Lake are expected to vary similar to those of the reservoir under existing conditions, so the depth of fish with respect to the outlet would remain unchanged (Figure 5-9 and additional figures in the Modeling Appendix). However, reoperation of Friant Dam under the No Action Alternative could potentially change the reservoir storage release and diversion schedule and affect fish entrainment rates, but this effect is expected to be small and not a substantial change from existing conditions.

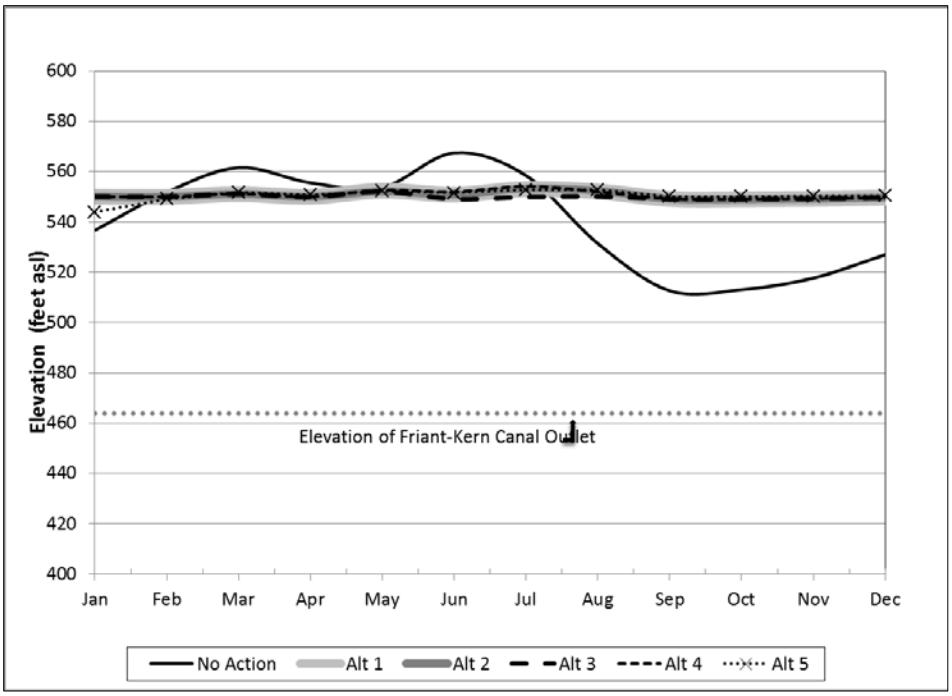


Figure 5-9. Average Water Surface Elevations of Millerton Lake Relative to the Friant-Kern Canal Outlet Elevation in Wet and Above-Normal Water Years

Outlets of large dams may adversely affect the reservoir fish both by entrainment of fish and by washout of food web resources, especially plankton, that support the fish populations (CH2M Hill 2003, Marotz et al. 1996). Rapid washout of the reservoir's food web resources could affect growth and survival of many species in Millerton Lake. However, the average flushing rate for Millerton Lake, which is the average time required for the reservoir's total storage volume to pass through the reservoir, is roughly 4 months. This far exceeds the replacement time needed for the plankton to regenerate. Under average growth conditions, algae generally require no more than a week or two to double in population (Jassby 2008, Kimmel et al. 1990). Growth of zooplankton populations is slower than this, but rapid enough for regeneration. It is therefore concluded that washout of food resources does not affect fish in Millerton Lake.

No studies have been conducted on entrainment of fish at Friant Dam, but it is likely that small, open-water species, particularly threadfin shad, do experience entrainment at the dam. Juvenile striped bass and American shad could also be affected. Small-sized open-water fish species, such as threadfin

shad and the young life stages of striped bass and American shad, are the most vulnerable to entrainment because they are most likely to reside in the vicinity of the reservoir outlets and because, relative to larger fish, they are unable to swim against the currents drawing them to an outlet. Threadfin shad are the primary prey species for striped bass. Fish are most at risk of entrainment when they reside at the same reservoir depth from which water is released. In Millerton Lake, the depth of the epilimnion likely determines the depth at which the open-water fish species reside, because the epilimnion is where food production rates are highest. During spring and summer, when the young, vulnerable life stages of fish are most abundant and when fish are most actively feeding, the epilimnion of Millerton Lake is less than 50 feet deep. Threadfin shad are rarely found at depths greater than about 60 feet (Moyle 2002). Operations modeling indicates that much of the time the outlet from the reservoir to the Friant-Kern Canal, which is the shallowest outlet of the reservoir, is more than 50 feet below the surface (see the Modeling Appendix for additional figures). At such times, fish entrainment rates are likely to be relatively low. However, in late summer and fall of Dry and Critical years, the reservoir surface approaches the depth of the outlet, and increased entrainment would be likely. Under the No Action Alternative, seasonal variations in water surface elevation of Millerton Lake and depth of the fish are expected to vary similar to those of the reservoir under existing conditions,

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The average flushing rate of the proposed Temperance Flat RM 274 Reservoir would be lower than that of Millerton Reservoir, requiring about 9 months to replace the full volume of the reservoir. Therefore, washout of food resources would not affect fish in Temperance Flat RM 274 Reservoir.

Implementation of any of the action alternatives is expected to result in a large and consistent separation of the upper water layers of Millerton Lake, where most fish are expected to reside, from the Friant-Kern outlet under both existing and future conditions (see the Modeling Appendix for figures). This change is expected to result in a reduction in fish entrainment rates.

The depth of the epilimnion in Temperance Flat RM 274 Reservoir during spring and summer, like that in Millerton Lake, is expected to be less than 50 feet under both existing and future conditions. In all months and water year types, the low-level gates, which are the main outlet structures for all five of the action alternatives, are expected to lie more than 100 feet below the average expected surface elevation of Temperance Flat RM 274 Reservoir (see the Modeling Appendix for additional figures). At this depth, fish entrainment is expected to be small relative to the sizes of the fish populations in the reservoir. The low-level gates are the only outlet structures for Alternative Plans 1, 2, 3, and 5, and entrainment of fish is not expected to significantly affect the fish populations under these alternatives, except for Alternative Plan 5, whose average surface elevation approaches the low-level gates in the late summer and fall of Dry and Critical years.

Alternative Plan 4 includes an SLIS, with upper gates at elevations of 700 feet, 800 feet, and 900 feet above sea level. One of these gates lies close to the reservoir surface elevation at all times (see the Modeling Appendix for additional figures). The SLIS gates are operated primarily during late winter, spring, and early summer, when young life stages of threadfin shad, American shad, and striped bass are most abundant. Entrainment from Temperance Flat RM 274 Reservoir is likely to be relatively high under Alternative Plan 4. However, the higher entrainment at Temperance Flat RM 274 Reservoir under Alternative Plan 4 would be offset by the lower entrainment at Friant Dam, resulting in little overall net effect on fish entrainment. Relative to the size of the fish populations, it is unlikely that the change in entrainment in either reservoir would have more than a minor effect.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-7: Change in Shallow-Water Habitat for Largemouth Bass, Spotted Bass, Smallmouth Bass, and Other Sport Fish Species

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative Under the No Action Alternative, the reservoir surface-level fluctuations (see Figure 5-10 and Figure 5-11) and the surface area of shallow-water habitat would be similar to those under existing conditions. Results of the Black

Bass Spawning Production Model show very little difference between existing conditions and the No Action Alternative, with a 0.3 percent reduction in the index for largemouth bass and a 1.5 percent increase for spotted bass. The Black Bass Spawning Production Model integrates effects of surface area, water temperature, surface-level fluctuations, and other habitat factors to produce an overall index of largemouth bass and spotted bass habitat quantity and quality. The No Action Alternative has little effect on shallow-water habitat in Millerton Lake.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementation of any of the action alternatives is expected to result in increased surface area of shallow-water habitat and reduced surface-level fluctuations in Millerton Lake. These changes are expected to increase the availability and improve the quality of shallow-water habitat for black bass and other sport fish. Increases in water temperatures, as previously noted, could benefit or adversely affect habitat quality, depending on the time of year and the level of increase. Results of the Black Bass Spawning Production Model for the action alternatives show substantial increases in spawning production for largemouth bass and spotted bass compared to results for the reservoir under both existing and future conditions. These changes would benefit black bass and other sport fish species.

Changes in shallow-water habitat surface area for Millerton Lake and the Temperance Flat RM 274 Reservoir under the action alternatives are shown in Figure 5-10 and Figure 5-11. Shallow-water habitat is quantified as the mean surface area from the shoreline to a depth of 15 feet during April through September, the principal period of spawning and juvenile rearing for black bass. The action alternatives are expected to increase, relative to the No Action Alternative and existing conditions, in the total surface area (both reservoirs) of shallow-water habitat ranging from 16 to 19 percent. The net habitat increases would result from the increased storage upstream from the Temperance Flat RM 274 Dam. The gains in shallow-water habitat are substantial despite the relatively steep shoreline in most of the area of the basin upstream from the dam and the decreased shallow-water habitat in Millerton Lake under the action alternatives relative to the No Action Alternative.

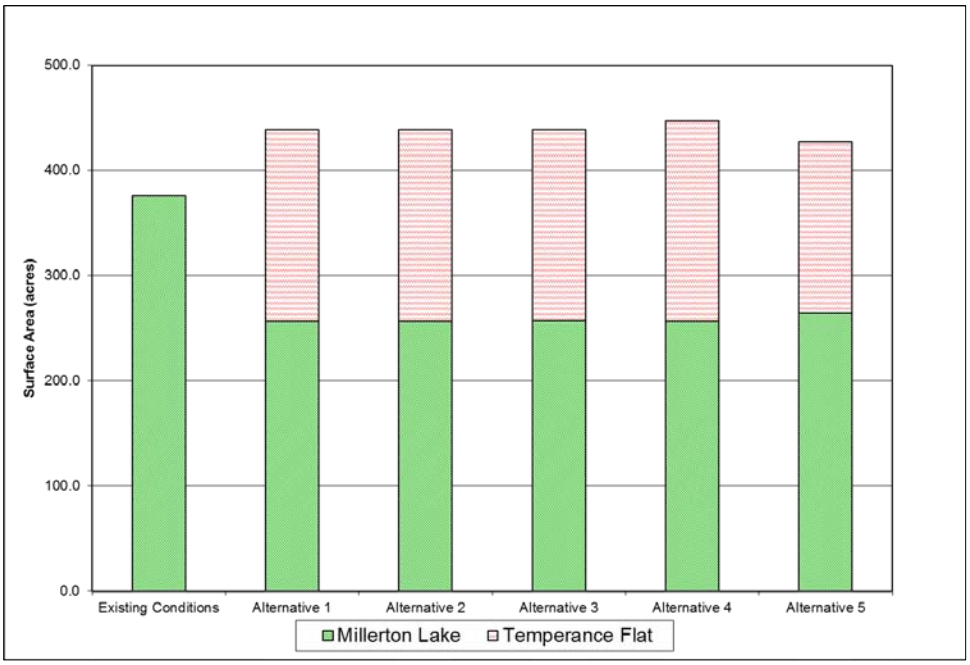


Figure 5-10. Mean April to September Reservoir Shallow Water (0 to 15 feet) Surface Areas Under Existing Conditions

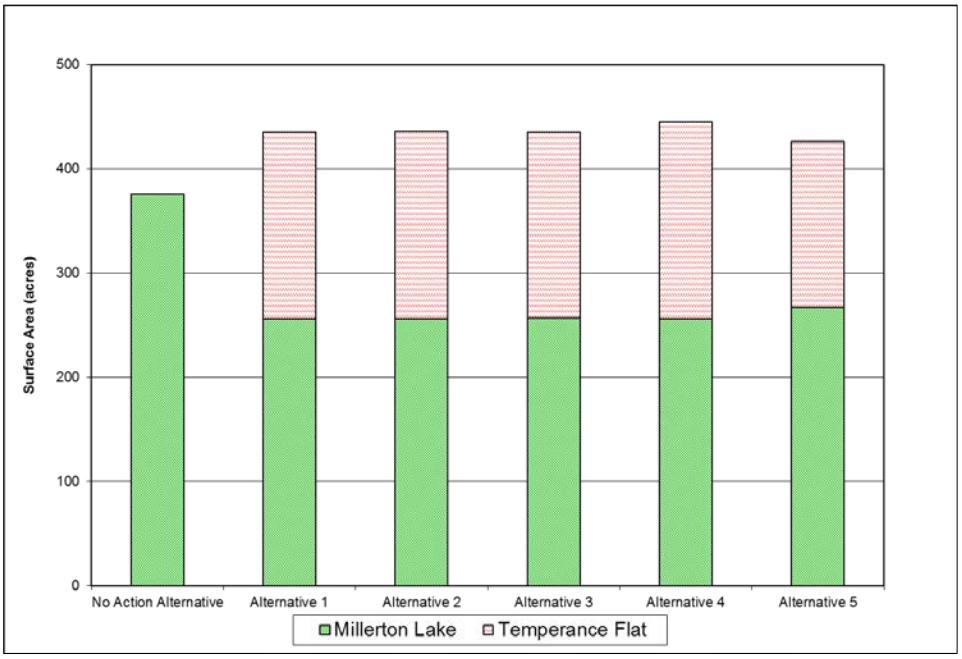


Figure 5-11. Mean April to September Reservoir Shallow Water (0 to 15 feet) Surface Areas Under Future Conditions

Figure 5-7 and Figure 5-8 show the mean expected increases and reductions in reservoir surface elevations over a quarter-month for Millerton Lake and the action alternatives under existing and future conditions, respectively. The means were determined for the March-through-June period of black bass spawning. Water-level fluctuations following implementation of the action alternatives would be much smaller for Millerton Lake, compared to the No Action Alternative and existing conditions. Water level fluctuations in Temperance Flat RM 274 Reservoir are expected to be similar to those in Millerton Lake under the No Action Alternative and existing conditions. The net effect would be an overall reduction in water-level fluctuations during the primary black bass spawning months.

Spawning production indices were computed for largemouth bass and spotted bass for Millerton Lake under existing conditions and the No Action Alternative, and for Millerton Lake and Temperance Flat RM 274 Reservoir under the five action alternatives (Figure 5-12 through Figure 5-15). The model results show substantial increases in overall spawning production for the action alternatives in comparison to the No Action Alternative and existing conditions, especially for spotted bass. For both species, Alternative Plan 4 consistently shows the highest spawning production. For largemouth bass, production in Millerton Lake would be reduced from that of the No Action Alternative and existing conditions (Figure 5-12 and Figure 5-13), which results from the loss of the Millerton Lake shallow-water habitat in the basin upstream from the Temperance Flat RM 274 Dam at RM 274. However, the loss of spawning production in Millerton Lake would be more than offset by the production in the new Temperance Flat RM 274 Reservoir. For spotted bass, production in Millerton Lake under the action alternatives would be similar to the No Action Alternative and existing conditions (Figure 5-14 and Figure 5-15), despite the substantial loss of Millerton Lake shallow-water habitat in the basin upstream from the Temperance Flat RM 274 Dam. The large reduction in reservoir surface-level fluctuations is likely largely responsible for the increased habitat value per area of Millerton Lake under the action alternatives. The increases in spawning production of largemouth bass and spotted bass would be beneficial. Effects of the action alternatives on production of smallmouth bass and other warm-water sport fishes (e.g., crappie and sunfish) would be similar to the results predicted by the model simulations for largemouth and spotted bass. Smallmouth bass, in particular, have very similar reservoir habitat requirements to those of largemouth bass.

This impact would be **beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

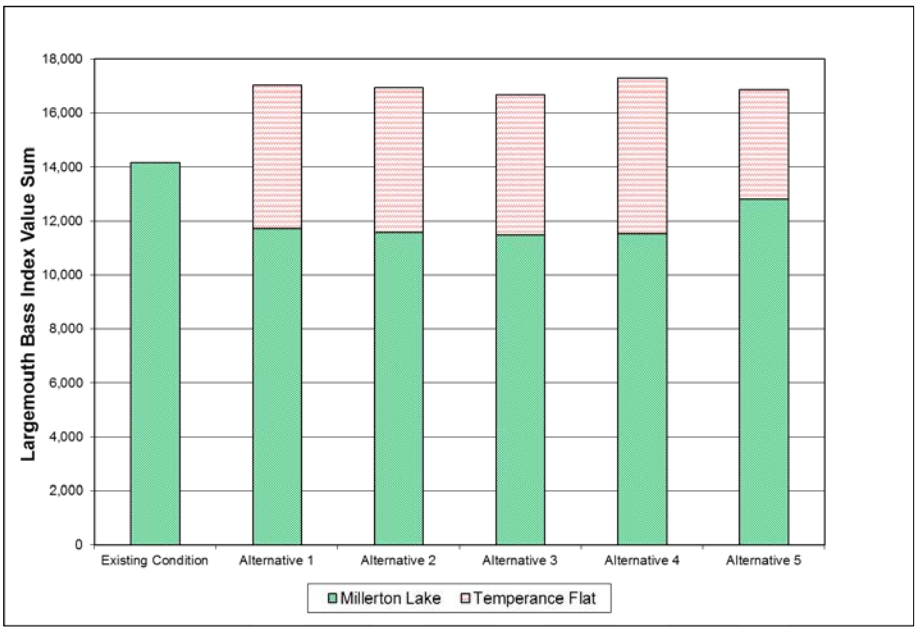


Figure 5-12. Largemouth Bass Spawning Production Indices Under Existing Conditions

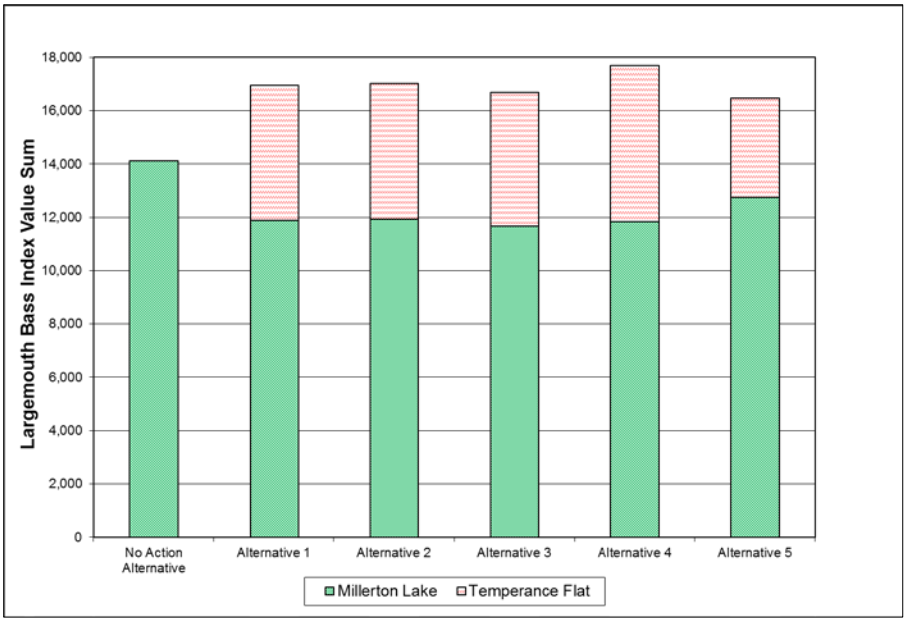


Figure 5-13 Largemouth Bass Spawning Production Indices Under Future Conditions

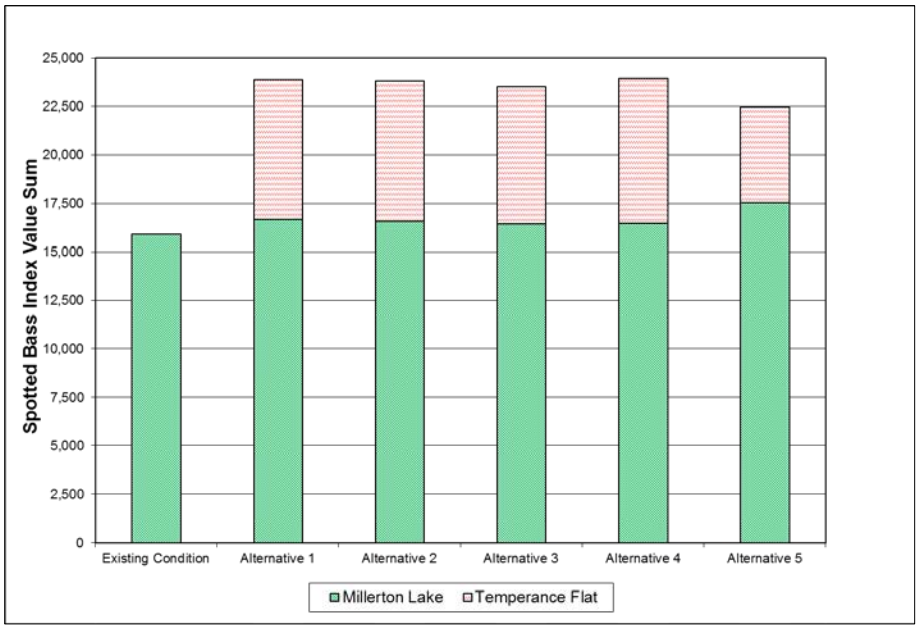


Figure 5-14. Spotted Bass Spawning Production Indices Under Existing Conditions

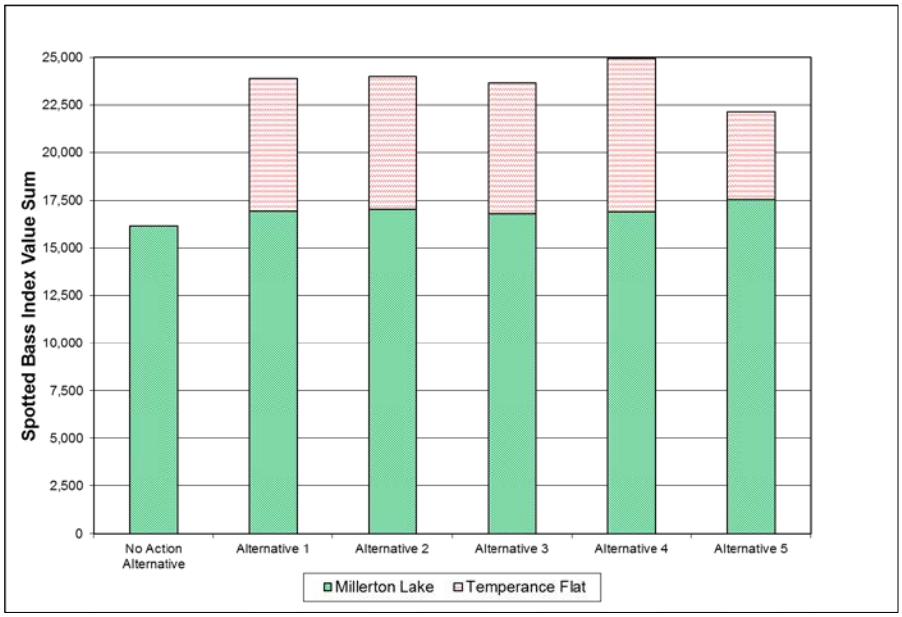


Figure 5-15. Spotted Bass Spawning Production Indices Under Future Conditions

Impact FSH-8: Change in Open-Water Habitat for Striped Bass and American Shad

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative The No Action Alternative would not result in any change in the volume or surface area of open-water habitat for striped bass or American shad.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would result in about a threefold increase in the volume and twofold increase in surface area of deep, open-water reservoir habitat as compared to the No Action Alternative and existing conditions. Striped bass and American shad both forage in the open water of Millerton Lake. Increasing the volume and surface area of this foraging habitat is likely to result in increased food resources, leading ultimately to larger populations of both species.

This impact would be **beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass

Primary Study Area – Millerton Lake and Temperance Flat Reservoir Area

No Action Alternative The upper portion of Millerton Lake and its confluence with the San Joaquin River are currently used for spawning by American shad and may be sporadically used by striped bass. Because Temperance Flat RM 274 Dam would not be constructed under the No Action Alternative, there would be no change in the access of American shad or striped bass (if used) to their current spawning habitat.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would eliminate American shad spawning habitat in the upper portion of Millerton Lake and its confluence with the San Joaquin River. Construction of Temperance Flat RM 274 Dam would prevent American shad within Millerton Lake from spawning upstream.

The loss of potential spawning habitat for striped bass would not significantly affect the striped bass population because this

population is almost completely sustained by stocking. However, American shad are not stocked and the loss of upstream spawning habitat above Millerton Lake would likely eradicate the American shad population in Millerton Lake, which is a unique population because they are the only known self-sustaining inland population; further, stocking these fish would not be a viable option to maintain its unique value.

The action alternatives have the potential to create new spawning habitat for American shad in the upper portion of the Temperance Flat RM 274 Reservoir within the San Joaquin River channel below Kerckhoff Dam. Flows from Kerckhoff Dam into this reach might provide suitable spawning conditions. Even at full pool, the constrained character of this reach of the river would likely produce suitable riverine conditions in the reservoir. Therefore, as long as flow releases from Kerckhoff Dam were sufficient, the reservoir might sustain shad spawning over a broad range of reservoir levels and the Millerton Lake population could become reestablished in Temperance Flat RM 274 Reservoir. However, even if spawning habitat for American shad were available in Temperance Flat RM 274 Reservoir, the population remaining in Millerton Lake would be prevented from accessing this habitat by the presence of the Temperance Flat RM 274 Dam. Some shad might continue to occur in Millerton Lake as a result of entrainment from Temperance Flat RM 274 Reservoir, assuming they were able to survive passage through the power plants, but such shad would be excluded from the spawning population and would not be self-reproducing; any American shad in Millerton Lake would depend on successful shad reproduction and survival in Temperance Flat RM 274 Reservoir and entrainment from this new population into Millerton Lake.

The average surface area of the proposed Temperance Flat RM 274 Reservoir is similar to that of the existing Millerton Lake and the volume is about twice as large. Therefore, assuming the shad population was able to survive, grow, and reproduce successfully in the Temperance Flat RM 274 Reservoir, there is no reason to expect that the relocated population would be any smaller than the current population in Millerton Lake. However, the potential for American shad to be introduced into, and survive, grow, and reproduce successfully in the new reservoir is uncertain, so the loss of the Millerton Lake population creates a moderate risk of eliminating the American shad population upstream from Friant Dam.

This impact would be **significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact FSH-10: Change in Habitat Potential for Spring-Run Chinook Salmon

Extended Study Area – San Joaquin River from Friant Dam to the Merced River

No Action Alternative Under existing conditions the extended study area does not support a spring-run Chinook salmon run. Under the No Action Alternative the SJRRP would be fully implemented, including a self-reproducing population of spring-run Chinook salmon.

This impact would be **beneficial** under the No Action Alternative.

Alternative Plans 1 through 4 Alternative Plans 1 through 4 each have modest but variable effects on spring-run Chinook salmon habitat potential with the effects varying by water year type and SAR scenario. High and low SAR scenario results and the percent change relative to the No Action Alternative are included in Table 5-7 and Table 5-8. Alternative Plans 1 through 4 beneficially improve habitat potential during Dry years, producing increases in habitat productivity, capacity, and equilibrium abundance that exceed significance criteria. These beneficial effects offset scattered negative effects that exceed the habitat productivity significance criterion in Normal-Wet years. Collectively, the EDT model results suggest that the action alternatives will benefit spring-run Chinook because they significantly increase minimum habitat potential during the most extreme conditions.

The largest positive effects occur during Dry years under high SAR conditions. Alternative Plans 1 through 4 increase Dry year habitat capacity and productivity by as much as 10.6 percent to 13.1 percent and 7.6 percent to 9.0 percent, respectively. Dry year equilibrium abundance increases by as much as 13.2 percent to 15.9 percent (Table 5-7). Smaller increases in capacity, productivity, and abundance occur under all action alternatives in Normal-Dry years.

Table 5-7. Modeling Results and Percent Change for High Smolt-to-Adult Survival Rate

Alternative	Habitat Productivity[1]				Habitat Capacity[2]				Equilibrium Abundance[3]				Weighted Average Abundance
	Dry	Normal-Dry	Normal-Wet	Wet	Dry	Normal-Dry	Normal-Wet	Wet	Dry	Normal-Dry	Normal-Wet	Wet	
No Action Alternative	4.32	5.27	5.62	6.6	3,179	4,247	4,911	7,851	2,443	3,441	4,037	6,661	3,895
Alternative Plan 1	4.7	5.3	5.64	6.87	3,596	4,369	5,043	7,726	2,831	3,545	4,149	6,601	4,005
	8.8%	0.6%	0.4%	4.1%	13.1%	2.9%	2.7%	-1.6%	15.9%	3.0%	2.8%	-0.9%	2.8%
Alternative Plan 2	4.69	5.32	5.65	6.84	3,515	4,408	5,054	7,703	2,766	3,579	4,159	6,577	4,003
	8.6%	0.9%	0.5%	3.6%	10.6%	3.8%	2.9%	-1.9%	13.2%	4.0%	3.0%	-1.3%	2.8%
Alternative Plan 3	4.71	5.38	5.49	6.57	3,556	4,327	4,937	7,541	2,801	3,523	4,038	6,393	3,919
	9.0%	2.1%	-2.3%	-0.5%	11.9%	1.9%	0.5%	-3.9%	14.7%	2.4%	0.0%	-4.0%	0.6%
Alternative Plan 4	4.65	5.37	5.86	6.97	3,522	4,446	5,253	7,737	2,765	3,618	4,357	6,627	4,085
	7.6%	1.9%	4.3%	5.6%	10.8%	4.7%	7.0%	-1.5%	13.2%	5.1%	7.9%	-0.5%	4.9%
Alternative Plan 5	4.60	2.92	5.59	6.60	3,693	4,237	4,784	6,738	2,890	2,788	3,928	5,718	3,552
	6.5%	-44.5%	-0.6%	0.1%	16.2%	-0.2%	-2.6%	-14.2%	18.3%	-19.0%	-2.7%	-14.2%	-8.8%

Notes:
[1] Habitat productivity is the number of returning adults per original spawning adult.
[2] Habitat capacity is the number of fish that can be supported by the available habitat.
[3] Equilibrium abundance is the theoretical population size that habitat of a given quantity and quality (capacity and productivity) can support.

Table 5-8. Modeling Results and Percent Change for Low Smolt-to-Adult Survival Rate

Alternative	Habitat Productivity[1]				Habitat Capacity[2]				Equilibrium Abundance[3]				Weighted Average Abundance
	Dry	Normal-Dry	Normal-Wet	Wet	Dry	Normal-Dry	Normal-Wet	Wet	Dry	Normal-Dry	Normal-Wet	Wet	
No Action Alternative	3.09	3.80	4.25	4.83	611	827	944	1,444	413	609	722	1,144	682
Alternative Plan 1	3.29	3.74	4.15	4.96	677	833	943	1,417	471	610	716	1,131	686
	6.5%	-1.6%	-2.4%	2.7%	10.8%	0.7%	-0.1%	-1.9%	14.0%	0.2%	-0.8%	-1.1%	0.6%
Alternative Plan 2	3.28	3.76	4.15	4.94	649	840	945	1,413	451	616	717	1,127	685
	6.1%	-1.1%	-2.4%	2.3%	6.2%	1.6%	0.1%	-2.1%	9.2%	1.1%	-0.7%	-1.5%	0.4%
Alternative Plan 3	3.29	3.79	4.09	4.77	672	832	937	1,389	468	613	707	1,098	678
	6.5%	-0.3%	-3.8%	-1.2%	10.0%	0.6%	-0.7%	-3.8%	13.3%	0.7%	-2.1%	-4.0%	-0.6%
Alternative Plan 4	3.25	3.78	4.29	5.04	663	848	984	1,417	459	624	754	1,136	701
	5.2%	-0.5%	0.9%	4.3%	8.5%	2.5%	4.2%	-1.9%	11.1%	2.5%	4.4%	-0.7%	2.8%
Alternative Plan 5	3.23	2.07	4.14	4.79	696	813	902	1237	480	420	684	979	593
	4.5%	-45.5%	-2.6%	-0.9%	13.9%	-1.7%	-4.4%	-14.3%	16.3%	-31.0%	-5.2%	-14.4%	-13.1%

Notes:
[1] Habitat productivity is the number of returning adults per original spawning adult.
[2] Habitat capacity is the number of fish that can be supported by the available habitat.
[3] Equilibrium abundance is the theoretical population size that habitat of a given quantity and quality (capacity and productivity) can support.

The effects of Alternative Plans 1 through 4 are more mixed in Normal-Wet and Wet water year types. Alternative Plans 1 through 4 negatively affect habitat capacity and productivity in Wet years (Table 5-7). These effects result primarily from a reduction in capacity as a result of smaller channel widths during winter and spring through the capture of flood peaks in Temperance Flat RM 274 Reservoir. Alternative Plans 1, 2, and 4 have comparable negative Wet year effects on capacity and equilibrium abundance, while Alternative Plan 3 has larger negative effects that extend into Normal-Wet years as well.

Under low SAR conditions, Alternative Plans 1 through 4 increase Dry year habitat capacity and productivity by 6.2 percent to 10.8 percent and 5.2 percent to 6.5 percent, respectively. Dry year equilibrium abundance increases from 9.2 percent to 14 percent (Table 5-8). As with the high SAR results, the EDT model predicts smaller increases in capacity and abundance to occur under Normal-Dry years for Alternative Plans 1 through 4. Effects on habitat potential are similarly mixed in Normal-Wet and Wet water year types, with Alternative Plans 1 through 4 having negative effects on habitat capacity and productivity in Wet years, relative to the No Action Alternative.

Alternative Plans 1 through 4 result in a modest increase in weighted average equilibrium abundance ranging from 0.6 percent to 4.9 percent, relative to the No Action Alternative under high SAR conditions (Table 5-7). The increase in equilibrium abundance realized during Dry, Normal-Dry, and Normal-Wet years offsets negative effects during Wet years. These weighted average results are below the significance criterion for equilibrium abundance. These beneficial effects are the result of decreases in water temperature conditions in Reaches 1 and 2. Alternative Plan 4 results in the largest weighted average increase in equilibrium abundance of 4.9 percent (see the Modeling Appendix for tables of results).

Low SAR weighted average abundance change by less than 1 percent under Alternative Plans 1 through 3; Alternative Plan 4 results in an increase of 2.8 percent (Table 5-8). The relatively large increases in equilibrium abundance, capacity, and productivity during Dry and Normal-Dry water year types offset smaller decreases during Wet and Normal-Wet years. Dry year effects exceed the criteria for equilibrium abundance, capacity, and diversity under each action alternative. Generally speaking, these beneficial effects on Dry year habitat potential are likely to outweigh any negative effects during Wet years,

resulting in a net benefit to spring-run Chinook under all alternatives.

This conclusion is based on the assumption that increases in minimum population size during Dry years will support population resilience more than relatively small decreases in maximum population size. For example, under low SAR conditions, EDT results predicted Dry year equilibrium abundance under Alternative Plans 1 through 4 below the effective population size objective of 500 spawning adults specified in the SJRRP Fisheries Management Plan (Reclamation 2012a), but Alternatives 1 through 4 increase predicted equilibrium abundance by 9.2 to 14.0 percent (46 to 70 adult fish). In contrast, predicted Wet year equilibrium abundance decreased by only 0.7 to 4.0 percent (4 to 20 adult fish). While EDT abundance results should not be viewed as actual predictions of future population size, these results suggest that Alternative Plans 1 through 4 could improve habitat conditions in the San Joaquin River and enhance the potential population.

This impact would be **less than significant and beneficial** under Alternative Plans 1 through 4. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 5 For Alternative Plan 5, the largest positive effects occur under the high SAR conditions, during Dry years, where the habitat capacity and productivity is 16.2 percent and 6.5 percent respectively (Table 5-7). In Normal-Dry years, the habitat capacity for Chinook salmon is essentially unchanged (-0.2 percent) but habitat productivity decreases by 44.5 percent (Table 5-7). This results in a decrease in high SAR equilibrium abundance of 19.0 percent. Alternative Plan 5 negatively affects habitat capacity and productivity in Wet years (Table 5-7). These effects result primarily from a reduction in capacity as a result of smaller channel widths during winter and spring as a result of the capture of flood peaks in Temperance Flat RM 274 Reservoir.

Under low SAR conditions, Alternative Plan 5 shows an increased Dry year habitat capacity and productivity by 13.9 percent and 4.5 percent, respectively (Table 5-8). However, in Normal-Dry years, Alternative 5 results in a decrease in habitat capacity by 1.7 percent and decreased habitat productivity by 45.5 percent, a large negative effect reflected in a decrease in equilibrium abundance of 31 percent (Table 5-8). Assuming an effective population size of 500 spawning adults, this would

result in a decrease in 155 fish. Alternative Plan 5 also results in large negative effects on habitat productivity, capacity, and abundance that exceed significance criteria in Normal-Wet and Wet water years.

Alternative Plan 5 would have a **potentially significant** impact. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration

Extended Study Area – San Joaquin River from Friant Dam to the Merced River

No Action Alternative Under the No Action Alternative water temperatures would reflect conditions created by the full implementation of the Settlement in the year 2030.

Simulated conditions under the No Action Alternative vary by water year type through Reach 4A, where water temperatures have effectively reached thermal equilibrium. Water temperatures in Reach 1A immediately downstream from Friant Dam differ substantially from those likely to occur in the remaining 123 river miles from the upstream end of Reach 1B to the Merced River. Under the No Action Alternative, water temperatures remain below threshold throughout the entire January 1 to June 1 period in all water year types in Reach 1A, but threshold exceedence becomes more variable in downstream reaches. Figure 5-16 shows simulated No Action Alternative water temperatures at the downstream end of Reach 1A. As shown, the cooler 10th percentile water temperatures remain below threshold during the entire January 1 to June 1 period, but that period shrinks by approximately 4 to 8 weeks for the typical 50th and warmer 90th percentile temperatures.

It is important to note that the water temperatures shown are modeled daily average temperatures, not daily maximums. The daily maximums vary from about 1-2°F above the average daily water temperature in November to February to about 2-4°F above the daily mean water temperature in July to August. Figure 5-17 shows the distribution of the daily fluctuation at Gravely Ford for the No Action Alternative.

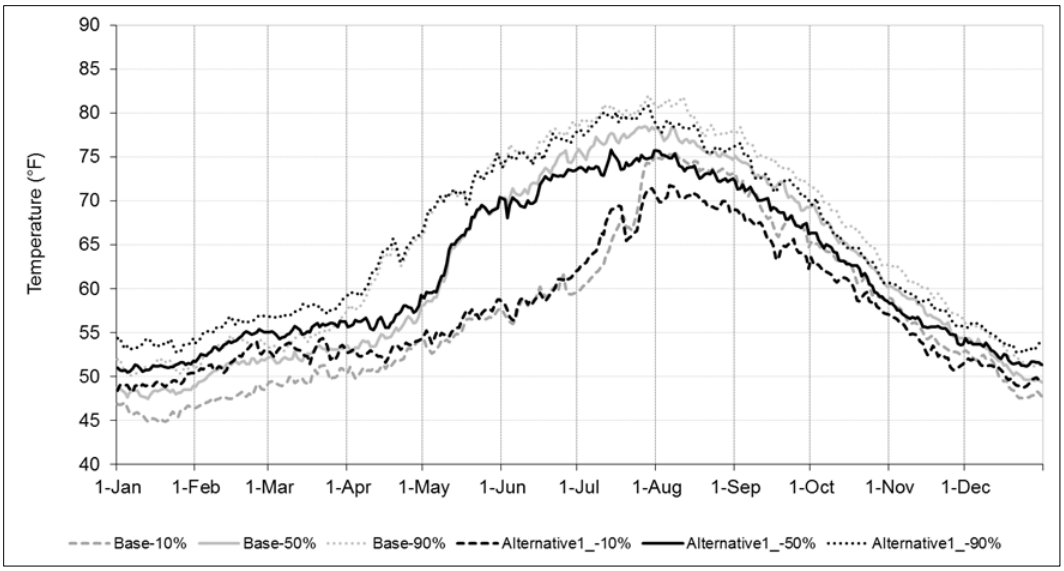


Figure 5-16. San Joaquin River Modeled Water Temperatures at the Upstream End of Reach 2A Under the No Action Alternative and Alternative Plan 1, 10th, 50th, and 90th Percentile Temperature Years

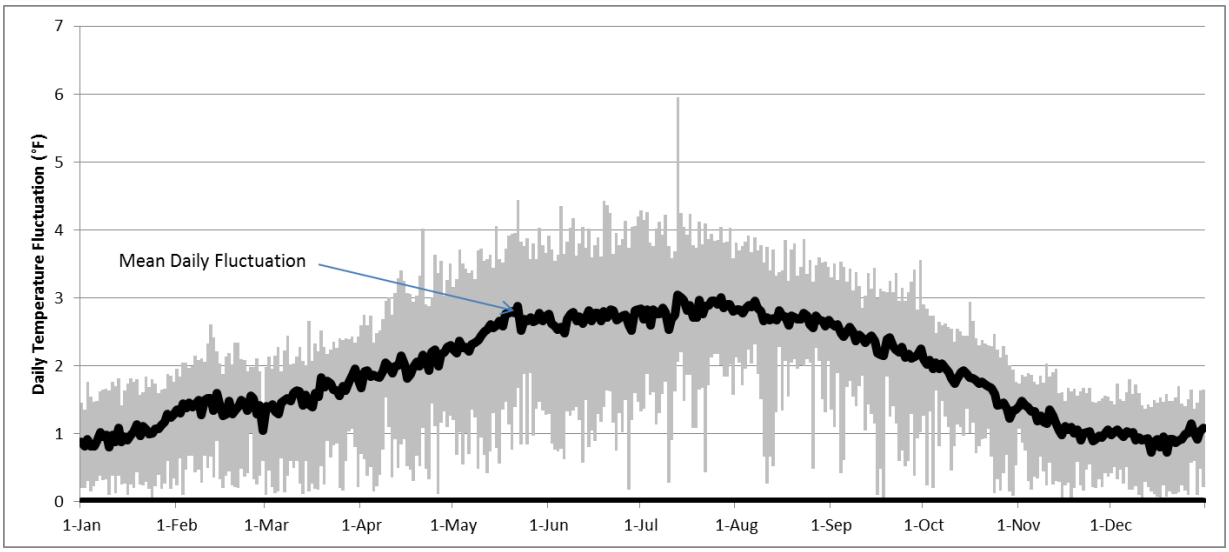


Figure 5-17. San Joaquin River Daily Water Temperature Fluctuation Around the Daily Mean at Gravelly Ford in the No Action Alternative

From Gravelly Ford downstream, water temperatures exceed 55°F over an increasingly large portion of the January 1 to June 1 period in all water year types. The pattern across water year types is similar to that for Reach 1A. For the warmer 90th percentile temperatures, the window with water temperatures below 55°F across the entire stretch of San Joaquin River from

Friant Dam to Merced River, lasts for only 5 weeks and ends in early February. These water temperatures represent a potential limitation on the duration of suitable temperature conditions for salmon and steelhead smolting and outmigration. The temperature conditions are very similar between existing conditions and the No Action Alternative.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Each of the action alternatives would reduce the number of weeks between January 1 and June 1 with 7-day average water temperatures below the 55°F temperature threshold in at least one reach in all water temperature year types, at all exceedence levels, with the largest effects occurring between reaches 1B and 2B2. Simulated effects on threshold exceedence are negligible downstream from Reach 3. The action alternatives decrease the number of weeks below the 55°F water temperature threshold by 2 to 7 weeks at the 90th percentile water temperature in the 51 river miles in reaches 1B and 2A. The warming effect shifts downstream at the typical 50th percentile, with 55°F temperature threshold exceedence occurring from 1 to 7 weeks earlier in reaches 2B1 and 2B2. Weeks below the 55°F threshold decrease by 1 to more than 7 weeks under each action alternative at the cooler 10th percentile water temperature, extending as far downstream as Reach 3.

The action alternatives all increase simulated water temperatures between December and May and decrease temperatures in mid- to late-summer and fall which may improve spawning and holding habitat conditions for spring-run Chinook salmon. The effect on migratory corridor conditions is evident in modeled water temperature conditions, which are summarized in graph and tabular format in the Modeling Appendix. Figure 5-16 displays water temperature conditions in Reach 2A under the No Action Alternative and Alternative Plan 1 (see the Modeling Appendix for additional figures).

As shown, Alternative Plan 1 increases winter and spring water temperatures over baseline conditions. As a consequence, the 55°F 7-day average temperature threshold is exceeded 6 to 7 weeks earlier than the No Action Alternative at the typical 50th and warmer 90th percentile temperatures (see summary table of results in the Modeling Appendix). The effect is more muted at the cooler 10th percentile. However, the effects of Alternative

Plan 1 are small compared with the large differences in water temperature conditions that occur between water year types under the No Action Alternative. Water temperature effects become negligible downstream from Reach 3 where the river essentially meets thermal equilibrium with air temperatures. Small effects are apparent downstream from this point but do not exceed the significance criterion.

Each of the action alternatives produces similar simulated effects on the number of weeks below threshold throughout the 84-mile stretch of river extending from Reach 1A through Reach 3. This has the effect of altering the timing and distribution of water temperatures suitable for juvenile salmon and steelhead migration and smolting throughout a large component of the migratory corridor, increasing both the distance and duration of exposure to water temperatures that inhibit smolting transformation. For example, Alternative Plan 1 has a large effect on the distribution of 50th percentile temperatures below threshold between Reaches 1B and 2B2. Threshold exceedence occurs from 1 to 7 weeks earlier between Reaches 1B and 2B2 (see summary table of results in the Modeling Appendix). This effectively constrains the period of suitable migration water temperatures in these reaches to the first week of February, meaning that juveniles migrating later would face an additional 38 miles of water temperatures unsuitable for maintaining smolting physiology. The effects are similar at the 10th and 90th percentiles, but they are shifted farther upstream and downstream, respectively. Alternative Plans 2, 3, 4, and 5 have generally similar effects, although there are some important differences by reach (see summary table of results in the Modeling Appendix).

This impact would be **significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact FSH-12: Change to Habitat for Moderately Tolerant Native Fish Species from Altered Water Temperatures

Extended Study Area – San Joaquin River from Friant Dam to the Merced River

No Action Alternative Under the No Action Alternative water temperatures would reflect conditions created by the full implementation of the SJRRP.

Simulated temperature conditions for the No Action Alternative are summarized in the Modeling Appendix, including the number of weeks with 7-day average water temperatures below the 77°F threshold (also see the Modeling Appendix for related figures). Water temperatures above this threshold exceed optimal growth conditions for several moderately tolerant resident fish species, including hitch, splittail, Sacramento blackfish, tule perch, and Sacramento pikeminnow, and prickly and riffle sculpin. The extent and duration of temperatures above this threshold represents a limitation on the availability of suitable summer rearing habitat for these species.

The distribution of simulated water temperatures below 77°F varies by reach and water year type. Simulated water temperature conditions are suitable for summer rearing throughout Reaches 1A and 1B. Downstream from Reach 1B, the duration of suitable summer temperatures varies by temperature year. For example, simulated water temperatures in Reach 2A are below the temperature threshold at the cooler10th percentile. In contrast, the 77°F threshold is exceeded by over 4 weeks at the typical 50th percentile and by 3.4 to 5 weeks at the warmer 90th percentile. Downstream from Reach 2A, simulated water temperatures exceed the threshold over longer periods each year, ranging from 15 to 21 weeks in duration (see summary table of results in the Modeling Appendix). Water temperatures exceeding optimal growth ranges in fish typically lead to behavioral avoidance, effectively limiting the amount of habitat available during peak growth periods.

San Joaquin River temperatures are expected to be similar between the existing conditions and the No Action Alternative.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would have a mixed effect on water temperature conditions for moderately tolerant fish species under most, but not all, circumstances (see the Modeling Appendix). Each action alternative increases the extent, duration, and annual frequency of suitable water temperatures for these species, particularly in Reach 2A. This constitutes a beneficial effect on water temperature conditions for certain native fish species.

Water temperatures exceed the 77°F threshold for over 4 weeks in Reach 2A at the 50th percentile. The action alternatives all reduce simulated water temperatures below the threshold for the entire year in this reach. At the warmer 90th percentile the action alternatives all result in a 3 to 5-week increase in the weeks below the threshold, but water temperatures would remain unsuitable for approximately 8 weeks a year.

The beneficial effects of the action alternatives extend downstream into Reaches 2B1 and 2B2 (see the Modeling Appendix). With the exception of Alternative Plan 3, the action alternatives result in year-round water temperatures below the 77°F threshold in Reach 2B1 at the 10th percentile, resulting in optimal growth conditions throughout the summer. Under Alternative Plan 3, peak water temperatures would exceed the threshold for approximately 1 week. The effects of the action alternatives are less pronounced at the 50th percentile and negligible at the 90th percentile years in Reach 2B1. The effects of Alternative Plans 1, 2, and 4 are similar but less pronounced in Reach 2B2. Alternative Plan 3 has a negligible effect on the number of weeks below the threshold in this reach. In contrast, Alternative Plan 5 has a large positive effect on water temperature conditions in Reaches 2B1 and 2B2, increasing the number of weeks below threshold by 1.7 to 5.1 weeks at the 90th and 50th percentile, respectively.

The action alternatives have variable effects downstream from Reach 2B. Alternative Plans 1, 2, and 3 each result in a 1- to 1.6-week decrease in the number of weeks below the threshold in Reach 3 at the 10th percentile, while Alternative Plan 5 results in a 3.6-week increase.

In Reach 4A, the action alternatives result in decreases of 1.3 to 3.6 weeks below the threshold at the 10th percentile. In Reach 4B, all action alternatives result in 1.9- to 2.3-week decreases in weeks below the threshold at the 10th percentile. The effects of the action alternatives are negligible in these reaches at the 50th and 90th percentile. The action alternatives have negligible effects on water temperatures in Reach 5, with the exception of Alternative Plan 5, which decreases the number of weeks below threshold by 3.7 to 4.3 weeks across all year types (see tables in Modeling Appendix).

When averaged across all years, Alternative Plans 1, 2, 3, and 4 either maintain or modestly improve temperature conditions in each reach. In contrast, Alternative Plan 5 negatively affects temperatures in Reaches 4A and 5, resulting in a decrease of

1.4 to 4.0 weeks below 77°F averaged across all water years. When the duration of suitable water temperatures is averaged across all reaches, Alternative Plan 5 temperatures are similar to the No Action Alternative. Therefore, these negative impacts may be offset by the large increases in the number of weeks below threshold in Reaches 2A, 2B1, and 2B2.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-13: Change to Habitat for Highly Tolerant Native Fish Species from Altered Water Temperatures

Extended Study Area – San Joaquin River from Friant Dam to the Merced River

No Action Alternative Under the No Action Alternative water temperatures would reflect conditions created by the full implementation of the Settlement.

Simulated water temperature conditions for the No Action Alternative are shown in figures and summarized in tabular form in the Modeling Appendix. The tabular summary identifies the change in the number of 7-day periods with average water temperatures below the 84°F threshold under each action alternative relative to the No Action Alternative. Water temperatures above this threshold exceed optimal growth conditions for highly tolerant native fish species, including the Sacramento sucker and hardhead.

Simulated 7-day average water temperatures remain below the 84°F threshold throughout the San Joaquin River from Friant Dam to the Merced River confluence at the cooler 10th percentile, and all but Reach 5 at the typical 50th percentile. At the warmer 90th percentile r temperatures), water temperatures exceed threshold from Reach 2B1 through Reach 4B from 6 to 11 weeks per year. The extent and duration of 7-day average temperatures above 84°F represent a potentially significant limitation on the availability of suitable summer rearing habitat for highly tolerant fish species while providing beneficial conditions for nonnative predator and competitor species.

Based on projected water temperature conditions under the No Action Alternative, there would be a limitation in the extent of suitable water temperature conditions for highly tolerant native fish species in specific reaches at the warmer 90th percentile.

Water temperatures remain below this threshold in all reaches in at the typical 50th percentile and cooler 10th percentile levels.

Temperatures near 84°F typically occur in the downstream reaches of the San Joaquin River where the water temperature is at or near the equilibrium temperature. Little if any differences in these temperatures would be expected between the existing conditions and the No Action Alternative.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives are projected to have small but potentially beneficial effects on water temperature conditions for highly tolerant native fish species in specific years and specific reaches. At the 50th percentile, the action alternatives would reduce 7-day average water temperatures to below the 84°F threshold for almost the entire year in Reach 4A, limiting water temperatures above the threshold to less than 2 weeks per year. This would effectively extend suitable summer rearing water temperatures for highly tolerant species throughout the majority of the extended study area downstream from the cold-water habitats used by salmon and trout.

At the warmer 90th percentile, the action alternatives decrease the number of weeks exceeding the threshold (see the Modeling Appendix for additional results) by:

- 1.7 to 4.4 weeks in Reach 2B1 – all action alternatives
- 3.1 to 6.7 weeks in Reach 2B2 – all action alternatives
- 2.1 weeks in Reach 4B – all action alternatives
- 1 week in Reach 3 – Alternative Plan 4
- 7.9 weeks in Reach 5 – Alternative 5

In summary, the action alternatives would produce a mix of water temperature effects that could influence the extent of suitable habitat conditions for highly tolerant fish species at the warmer 90th percentile water temperatures improving conditions in some reaches, and degrading them in others. When averaged across all reaches, the net water temperature effect of each action alternative is small, decreasing the number

of 7-day periods with average water temperatures below 84°F by less than 1 week.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-14: Changes to Spawning and Rearing Habitat from Changes to Flood Pulses and Floodplain Connectivity

Extended Study Area – San Joaquin River from Friant Dam to the Merced River

No Action Alternative Under the No Action Alternative, flow, flood pulse, and restored floodplain habitat inundation would occur consistent with implementation of the Settlement.

Flood pulses at different locations on the San Joaquin River are influenced by operations of various flood control facilities and by flood inflows from other tributaries such as the James Bypass. The influences are not under the control of the project and influence the actual flood flow peaks at various locations. This analysis uses changes to the Friant release to the San Joaquin River as an indicator of change attributable to the project.

Flood pulse conditions under the No Action Alternative were determined by the Restoration Flow schedule and, under certain conditions, by additional spill from Friant Dam. Table 5-9 summarizes the total storage volume allocated to the Restoration Flow schedule by water year type in TAF, average daily flows by season, and the average daily releases required to meet the flow schedule in TAF. The Settlement specifies that the water budget can be flexibly managed across each flow period to mimic the rise, peak, and gradual fall of a natural hydrograph. The Settlement includes provisions for the release of pulse flows in Normal-Wet and Wet Years to perform several geomorphic functions, such as floodplain activation and flushing spawning gravels, unless the Secretary, in consultation with the RA, determines that such flows are not needed. Flushing flows would be accomplished with a quantity of water based on an average flow of 4,000 cfs from April 16 to 30, and include a peak release as close to 8,000 cfs as possible for several hours, within the constraints of then-existing channel capacity (Reclamation 2012b).

The annual Restoration Flow release schedule for the San Joaquin River ranges from 673.5 TAF for Wet years to 116.9 TAF in Critical-Low years (Table 5-9). These represent the minimum amount of water storage available for instream flow releases in each respective water year type. In some years, annual inflow will exceed the storage capacity of Millerton Lake, requiring spill. These spill events would add additional flow volume during the spring flexible flow period and perhaps other periods during the year. This would in turn result in larger flood pulses with their size determined by channel capacity and the ability to manage the additional flows using the extensive network of existing flood control bypass channels.

Table 5-9. SJRRP Settlement Agreement Restoration Flow Schedule by Period with Estimated Daily Release Equivalents

Flow Allocation Period	Wet cfs (TAF)	Normal-Wet cfs (TAF)	Normal-Dry cfs (TAF)	Dry cfs (TAF)	Critical-High cfs (TAF)	Critical-Low cfs (TAF)
March 1 – 15 (15 days)	500 (0.98)	500 (0.98)	500 (0.98)	500 (0.98)	500 (0.98)	130 (0.26)
March 16–31 (16 days)	1,500 (2.95)	1,500 (2.95)	1,500 (2.95)	1,500 (2.95)	1,500 (2.95)	130 (0.26)
April 1–15 (15 days)	2,500 (4.95)	2,500 (4.95)	2,500 (4.95)	350 (0.7)	200 (0.4)	150 (0.3)
April 16–30 (15 days)	4,000 (7.85)	4,000 (7.85)	350 (0.7)	350 (0.7)	200 (0.4)	150 (0.3)
May 1–Jun 30 (61 days)	2,000 (3.94)	350 (0.7)	350 (0.7)	350 (0.7)	215 (0.42)	190 (0.38)
July 1–August 30 (62 days)	350 (0.7)	350 (0.7)	350 (0.7)	350 (0.7)	255 (0.5)	230 (0.46)
September 1–30 (30 days)	350 (0.7)	350 (0.7)	350 (0.7)	350 (0.7)	260 (0.51)	210 (0.42)
October 1–31 (31 days)	350 (0.7)	350 (0.7)	350 (0.7)	350 (0.7)	160 (0.31)	160 (0.31)
November 1–6 (6 days)	700 (1.4)	700 (1.4)	700 (1.4)	700 (1.4)	120 (0.24)	120 (0.24)
November 7–10 (4 days)	700 (1.4)	700 (1.4)	700 (1.4)	700 (1.4)	400 (0.79)	130 (0.26)
November 11–December 31 (51 days)	350 (0.7)	350 (0.7)	350 (0.7)	350 (0.7)	120 (0.24)	120 (0.24)
January 1–February 28 (59 days)	350 (0.7)	350 (0.7)	350 (0.7)	350 (0.7)	110 (0.22)	110 (0.22)
Annual Flow Allocation (TAF)	673.5	473	365.	279	187	116.9

Notes:
* Critical-High and Critical-Low water years are grouped with Dry years for CalSim II modeling.
Key:
cfs = cubic feet per second
TAF = thousand acre-feet

The San Joaquin River Flood Control Project Agency (2013) determines channel capacities for managing flood flows. San

Joaquin River channel capacities in the Friant Dam-to-Merced River component of the extended study area are summarized by reach in Table 5-5.

Reaches 1A and 1B are incised in the alluvial fan of the San Joaquin River and they have an accessible floodplain that is largely unconfined by artificial structures, providing sufficient capacity to contain the largest likely flood events. Reach 5 is located downstream from the major flood bypasses. It is relatively unconfined by levees and a large amount of accessible floodplain provides significant channel capacity. These unconfined reaches would experience the greatest flood pulse variability and presumably realize the largest habitat benefits, particularly in those areas targeted for floodplain restoration under the SJRRP. The remaining reaches are confined by levees, have limited available floodplain, and have less flow capacity than upstream and downstream reaches. Flood pulses in excess of capacity are diverted into flood control bypasses. The controlled flows and relative lack of floodplain habitat limit the extent to which flood pulses can influence and enhance aquatic habitat conditions.

Given existing constraints in the San Joaquin River from Friant Dam to Merced River, the ability to achieve Restoration Flow releases at Friant Dam is assumed to provide the flexibility necessary for managing ecologically beneficial floodplain functions in areas with suitable conditions. Any change in the ability to achieve those Restoration Flows would constitute an adverse effect.

Figure 5-3 shows the distribution of projected peak flow releases under the No Action Alternative. Effectively, Figure 5-3 displays what implementation of the Restoration Flow schedule would look like over an 82-year period with water year conditions similar to those from 1922 through 2003. As shown, the 4,000-cfs flow objective with capacity to achieve peak flows of 8,000 cfs would be achieved 50 percent of the time, consistent with the Settlement. Millerton Lake storage capacity would be exceeded in 7 of those years, requiring controlled or uncontrolled spill exceeding 8,000 cfs. Flood pulses of 2,500 cfs would be achieved in 24 of the remaining 41 years, and lower flows would be allowed in drier years consistent with the Settlement. This represents a substantial improvement over existing conditions. Simulated peak flows under current conditions would exceed 4,000 cfs in only 21 of 82 model years and 2,500 cfs in only 24 of those years. These results indicate that the No Action Alternative would

substantially increase the number of years with flood pulse flows sufficient to manage for desired floodplain habitat functions.

This impact would be **potentially significant and beneficial** under the No Action Alternative.

Action Alternatives The proposed Temperance Flat RM 274 Reservoir is designed to capture peak flood flows and store this water primarily for consumptive use. Because this would allocate storage volume for purposes other than instream flows, it is necessary to determine if the action alternatives would have any effect on the ability to meet the Restoration Flow schedule. Any change in the ability to meet the flow schedule would infer a change in the ability to manage for ecologically desirable floodplain functions. Flood pulses in excess of the Settlement may also have beneficial ecological functions in reaches with adequate flow capacity. However, these beneficial effects may be offset in other areas by damaging floods that degrade floodplain conditions and potentially strand focal fish species behind overtopped levees, and by increases in low flows due to deliveries under the action alternatives.

As discussed in the Methods and Assumptions section, several of the native fish species considered in this analysis are dependent on floodplain habitats to varying degrees. For example, juvenile Chinook salmon exhibit higher growth rates and greater survival when they have access to inundated floodplain habitat. This effect is reflected in EDT model results developed to analyze the effects of specific floodplain restoration alternatives in Reach 2B under the SJRRP (Reclamation 2013b). These results found that floodplain restoration anticipated under the SJRRP would increase habitat potential for spring-run Chinook, but the benefits were constrained by the limiting effects of high water temperatures on survival. These benefits would presumably extend to fall-run Chinook salmon, which also make extensive use of floodplain habitats during rearing and migration (Sommer et al. 2001). Splittail are obligate floodplain spawners, and juveniles rear in floodplain habitats for extended periods. The other non-salmonid fish species occurring in this component of the extended study area are also dependent on floodplain habitats to varying degrees, and all species benefit from increased food web productivity associated with flood pulses (Matella and Merenlender 2014; Sommer et al. 2004a, 2004b).

The action alternatives are designed to capture flood flows, resulting in a reduction in peak and annual average spill rates relative to the No Action Alternative. Because each action alternative captures flood peaks, each affects both the size and frequency of extreme flow events exceeding 8,000 cfs at Friant Dam, and the size and frequency of flow peaks between the Restoration Flows and 8,000 cfs. The Restoration Flows would be met under any of the action alternatives.

Projected peak flow releases under Alternative Plan 1 provide a useful example. Figure 5-18 displays projected flow releases under this action alternative over the same modeled period. As noted previously, modeled peak flows exceeding 8,000 cfs occur in 7 of 82 years under the No Action Alternative, with a projected peak of 28,304 cfs in the highest flow year. Under Alternative Plan 1, they would occur in only 4 of 82 years with a maximum flow peak of 19,586 cfs (Figure 5-18). However, the action alternatives would alter the duration of peak flows above 4,000 cfs because they would reallocate a portion of the total volume of available water to uses other than streamflows. Therefore, while the ability to achieve desired flood pulse and peak flows would be retained, the duration of peak flows would change. All flood peaks exceeding 8,000 cfs are functionally similar from the standpoint that this threshold marks the upper limit of downstream channel capacity in Reaches 1A, 1B, and 2A and exceeds the downstream channel capacity by a minimum of 6,700 cfs in all reaches except Reach 5 (Table 5-5).

Figure 5-18 provides an example of flow effects likely to occur under Alternative Plan 1 relative to the No Action Alternative. Figure 5-18 includes the assumption that restoration flows in Wet and Normal-Wet years would not be manipulated to produce the 8,000 cfs peak flows during the spring flexible flow period. Flood pulse flows under Alternative Plans 2 and 4, including flows exceeding 8,000 cfs, are essentially identical to those under Alternative Plan 1. Peak flows exceeding 8,000 cfs are slightly (40 to 550 cfs) lower under Alternative Plan 3. Alternative Plan 5 has the largest effect, producing peak flows in excess of 8,000 cfs in only 3 out of 82 years. The maximum peak flow under Alternative Plan 5 would remain effectively the same but the frequency of large flood events would decrease.

Figure 5-19 shows how Friant Dam releases would change under Alternative Plan 1 relative to the No Action Alternative. As shown, sustained pulse flows between 4,000 and 8,000 cfs

would occur more frequently under the No Action Alternative. This suggests that the duration of peak flows between 4,000 and 8,000 cfs would be reduced under Alternative Plan 1, but the ecological significance of changes in flood pulse frequency exceeding this threshold is unclear. The effects of the remaining action alternatives on flood pulse volumes and, by extension, the duration of flood pulses larger than 4,000 cfs, are similar to those described for Alternative Plan 1.

Reach 5 has a flow capacity of 26,000 cfs, suggesting that reducing the frequency of peak flows in excess of 8,000 cfs could affect floodplain conditions in this reach. However, this reach also receives inflows from regional flood bypasses and from the Kings River via the San Joaquin River that must also be managed to remain within the capacity limitations of the system.

This impact would be minimal under the action alternatives on the basis that, at minimum, the restoration flow requirements in the Settlement would be achieved in all years under each of the action alternatives. Some effects on the duration of flow volumes between 4,000 and 8,000 cfs may occur.

This impact would be **less than significant** under the action alternatives.

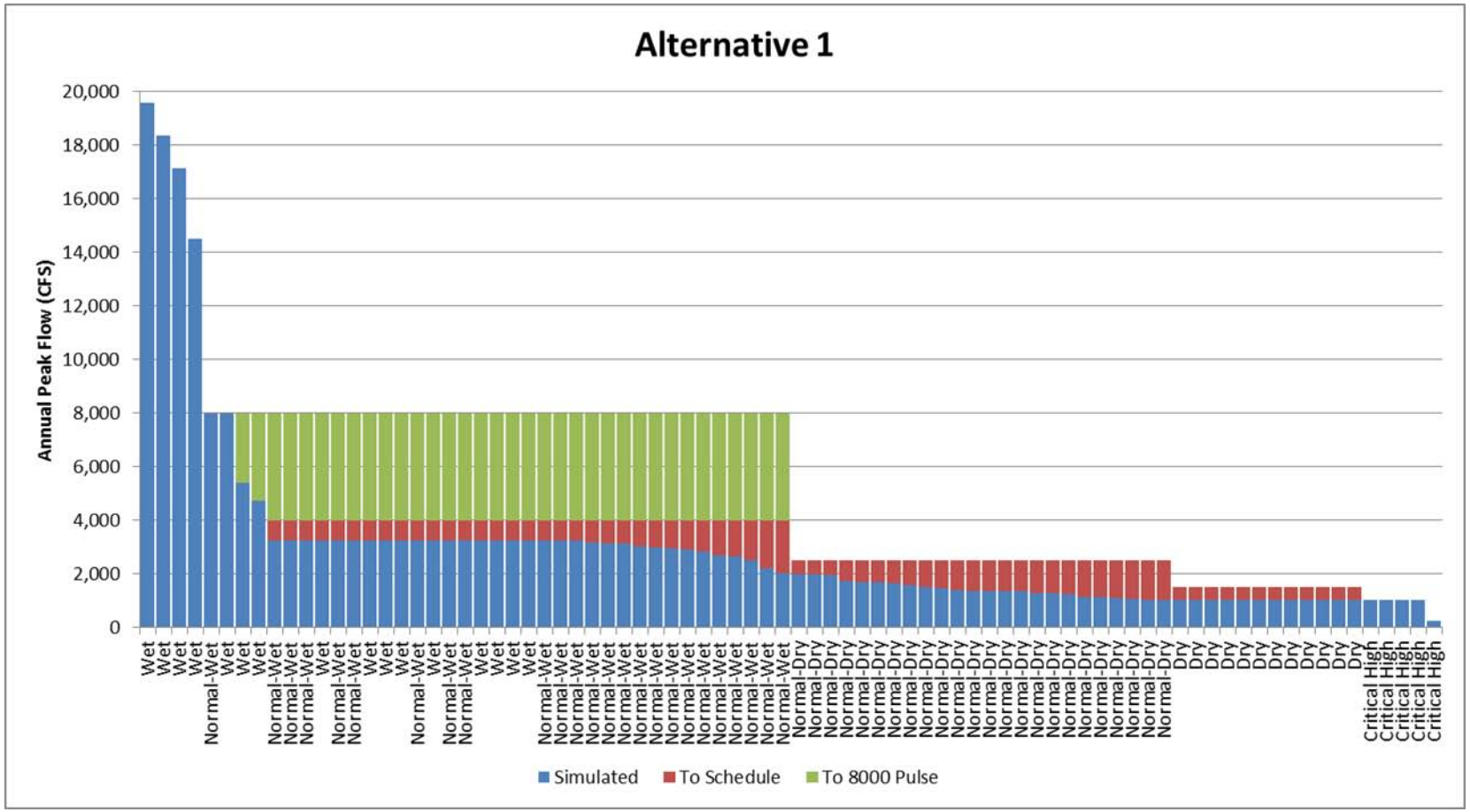


Figure 5-18. Achievable San Joaquin River Peak Flow Releases at Friant Dam under Alternative Plan 1, Including Sustained and Peak Flood Pulse Flows Under the SJRRP Restoration Flow Schedule

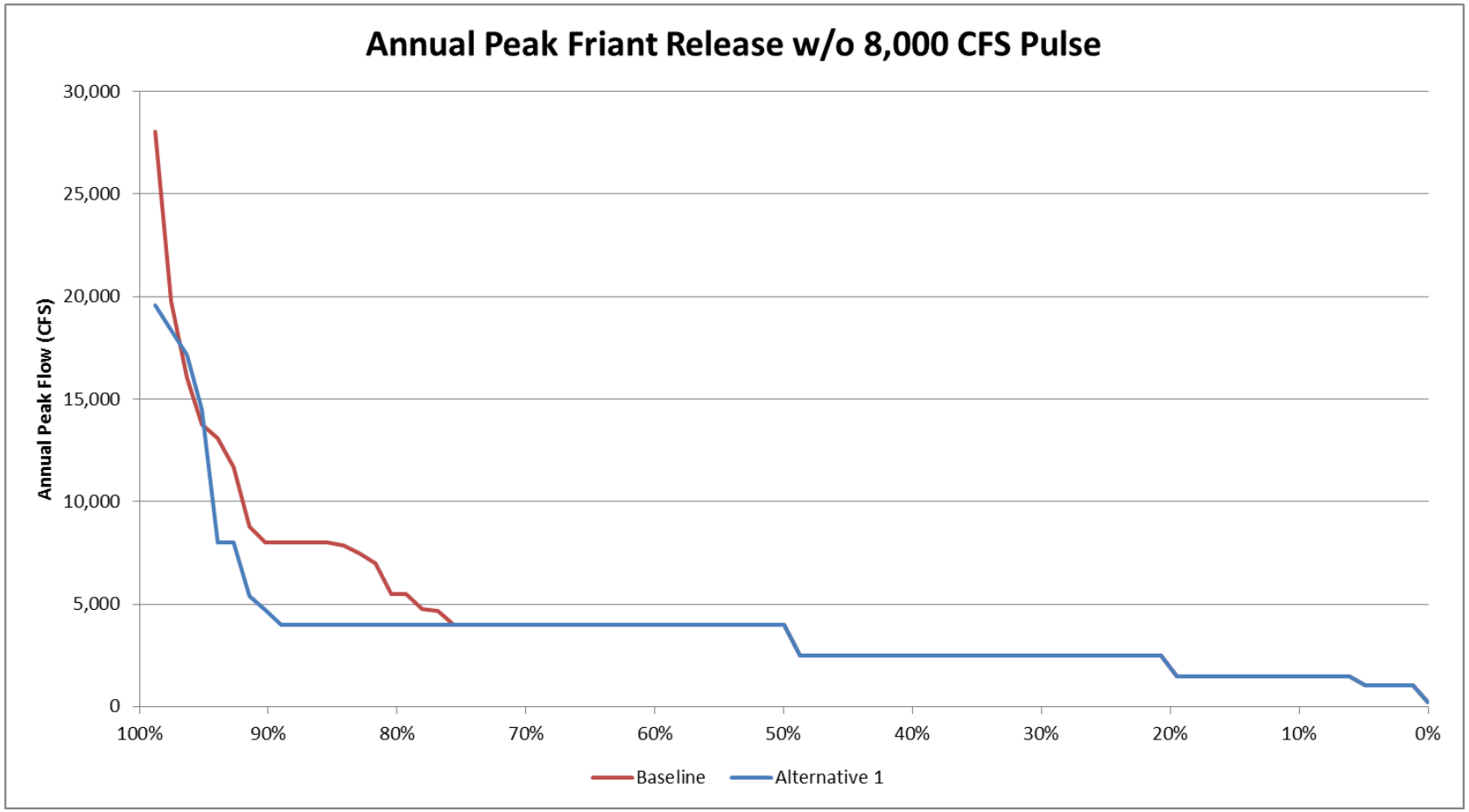


Figure 5-19. Percentile Distribution of San Joaquin River Annual Peak Flow Releases at Friant Dam Under Alternative Plan 1 Excluding 8,000 cfs Peak Flow

Impact FSH-15: Change in Fish Habitat and Migratory Behaviors from Changes in Water Temperatures

Extended Study Area – San Joaquin River from Merced to Delta

No Action Alternative Water temperature in the San Joaquin River between the Merced River and the Delta is typically in equilibrium with air temperature during the hottest summer months, but not at other times of the year, such as spring and fall. Under the No Action Alternative, water temperatures are often warmer than is optimal (often over 70°F between May and October at Patterson, based on California Data Exchange Center [CDEC] gage data) for migratory species; however, steelhead and fall-run Chinook salmon do migrate through the lower San Joaquin River to and from the tributaries.

There is no anticipated change in the water temperatures in this reach of the San Joaquin River between the existing conditions and the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Action Alternatives As mentioned under the No Action Alternative, San Joaquin River water temperature is strongly affected by air temperatures. Additionally, the SJR5Q water temperature model results indicate that the action alternatives would not affect water temperatures in the San Joaquin River immediately downstream from the confluence with the Merced River under both existing and future conditions (see Figure 5-16, Figure 5-17 and the Modeling Appendix for additional figures). Therefore, it is reasonable to conclude that water temperatures in the San Joaquin River downstream from the Merced River would not be affected by the action alternatives.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-16: Change in Fish Habitat and Migratory Behaviors from Changes in Flows

Extended Study Area – San Joaquin River from Merced to Delta

No Action Alternative Under the No Action Alternative, Friant Dam and downstream flow control structures would be operated to meet the full Restoration Flow targets. The change in flows in this reach between the existing conditions, and the No Action Alternative would be relatively small.

This impact would be **less than significant and beneficial** under the No Action Alternative.

Action Alternatives In the San Joaquin River below the Merced River confluence, project-related flow reductions would generally be greatest in winter and spring, when flood flows are being captured and stored by the project. Similarly, in the San Joaquin River at Vernalis, project-related flow reductions are generally greatest in late winter and spring. However, for all months at both locations, flow reductions greater than 5 percent to 10 percent only occur in years when river flows are well above average, with essentially no change at times when flows are at or below the median monthly flow.

Juvenile Chinook salmon, both fall-run and spring-run, as well as steelhead, use spring pulse flows for juvenile outmigration. They also require flows high enough to allow them to track and then migrate through to their natal stream as an adult to spawn. As shown in Figure 5-20 and in additional figures in the Modeling Appendix, large reductions in San Joaquin River flows relative to the No Action Alternative would occur primarily during the highest flow events. The action alternatives have few monthly incidences where they result in flow reductions when flows are less than 10,000 cfs at Vernalis, or less than 6,000 cfs at the Merced River confluence.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

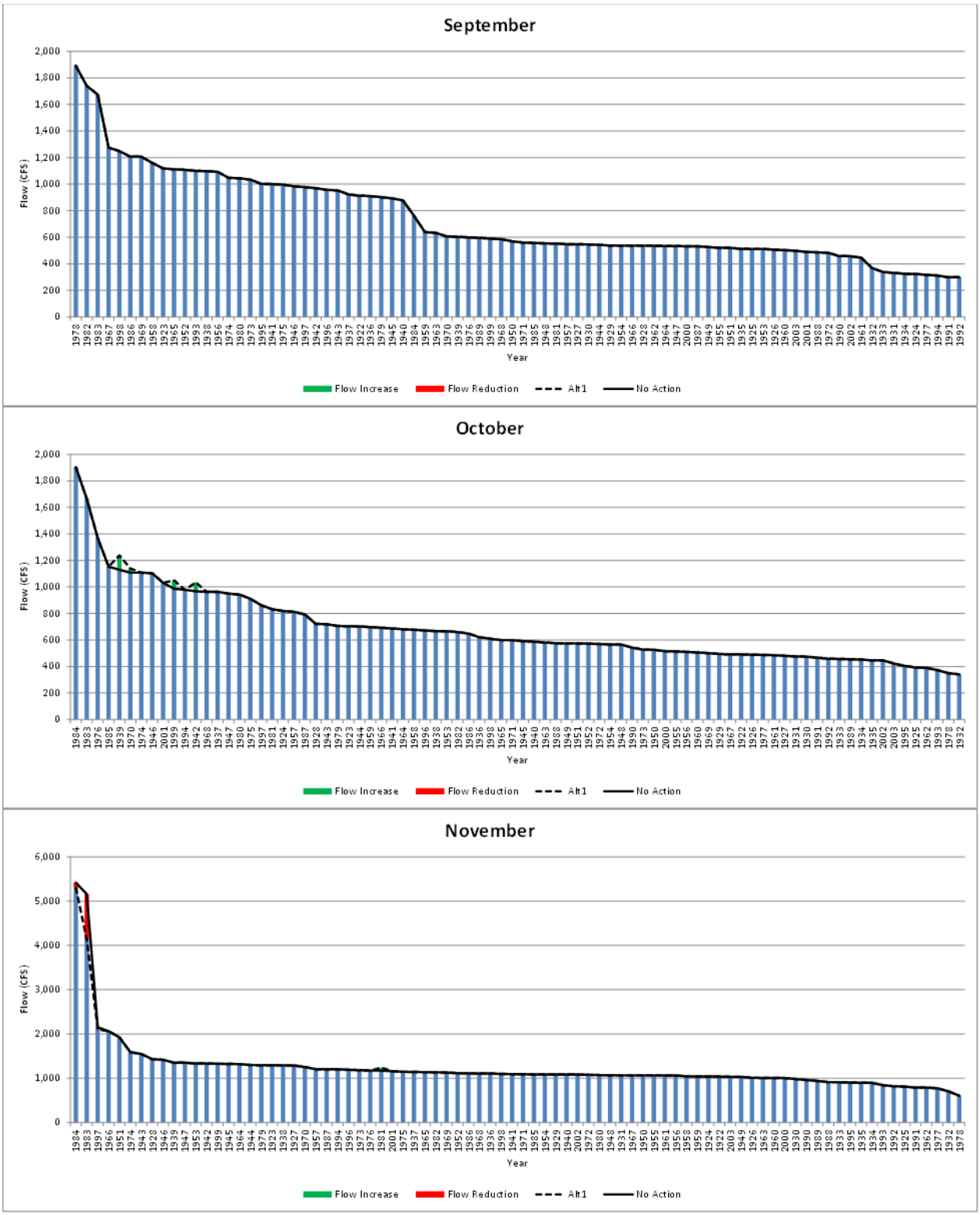


Figure 5-20. Simulated San Joaquin River Flows Downstream from the Merced River Confluence During September, October, and November

Impact FSH-17: Loss of Fish Habitat from Changes in Tributary Flows

Extended Study Area – San Joaquin River Tributaries

No Action Alternative Under the No Action Alternative, flows in the tributaries frequently would not meet the flow standards presented in Table 5-6 that are assumed to provide maximum habitat. Table 5-6 is a simplification of the flow standards on the tributaries implemented in the CalSim II model. Specifics on the standards included in the CalSim II modeling are included in the Modeling Appendix. Comparison of the mean monthly CalSim II flows to these simplified standards may overestimate the magnitude and number of deviations from these flow conditions assumed to provide maximum habitat. Table 5-6 also includes partial month standards, which also may overstate the magnitude and number of deviations.

The Merced River downstream from McClure Reservoir would meet the standards shown in Table 5-6 for spawning, incubation/fry rearing, and juvenile rearing/migration just over 50 percent of the time (see Modeling Appendix for tables of results). However, as the river moves downstream toward the San Joaquin confluence, the flows rarely meet the standards shown in Table 5-6 for either juvenile rearing and migration or adult migration. Because the flows in the Merced River are very similar between the existing conditions and the No Action Alternative, the Merced River is expected to continue to experience similar effects under the No Action Alternative.

The Tuolumne River downstream from Don Pedro Reservoir would typically meet the flow standards identified in Table 5-6 for both Chinook salmon and steelhead. However, as the river approaches the San Joaquin River confluence, the flow standards for juvenile migration are more difficult to meet during the Dry and Critical water years (see Modeling Appendix for tables of results), and juvenile salmonids would migrate through less-than-optimal conditions. Because the flows in the Tuolumne River are very similar between the existing conditions and the No Action Alternative, the Tuolumne River is expected to continue to experience similar effects under the No Action Alternative.

The Stanislaus River periodically has difficulty meeting the standard established for juvenile migration for both Chinook salmon and steelhead (2,000 cfs). However, these flows are often not substantially less than 2,000, nor are there significantly too many months below the 4-month migration

period in which they would be substantially under 2,000 cfs (see Modeling Appendix for tables of results). Because the flows in the Stanislaus River are very similar between the existing conditions and the No Action Alternative, the Stanislaus River is expected to continue to experience similar effects under the No Action Alternative conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, flows in the Merced River below McClure Dam or at the confluence, in the Tuolumne River below Don Pedro Dam or at the confluence, and the Stanislaus at Goodwin Dam and at the confluence would not change relative to the No Action Alternative (see Modeling Appendix for tables of results). Therefore, there would be no change to all life stages of Chinook salmon and steelhead under the action alternatives relative to the No Action Alternative under all hydrologic conditions. However, flows under the No Action Alternative do not always meet the flow standard for Chinook salmon and steelhead, therefore, the flow standard are not met under the action alternatives either.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations

Extended Study Area – Delta

No Action Alternative As described in Impact FSH-15, water temperatures in the San Joaquin River as it enters the Delta are typically in equilibrium with air temperatures. By the time the river has traveled the 190 miles from Friant Dam, the releases from Friant Dam no longer have an effect on water temperatures in the San Joaquin River. Therefore, the No Action Alternative would not affect water temperatures in the Delta.

DO levels near the Stockton Deep Water Ship Channel are at times directly affected by San Joaquin River inflow, with low inflow resulting in reduced DO concentrations (Lee and Jones-Lee 2003). Under the No Action Alternative, average monthly San Joaquin River inflow during the September-through-November period of adult fall-run salmon upstream migration would be less than 2,000 cfs for about 15 percent of months.

When comparing the No Action Alternative to existing conditions, there would be minor changes in the magnitude of San Joaquin River inflow in all months, the only difference being substantial increases in April of all year types except Critical years. Additionally, there would be increases in the number of months with flows less than 2,000 cfs during the September through November period of adult fall-run Chinook salmon upstream migration, reducing suitable conditions for fall-run Chinook salmon (see Figure 5-20 and the Modeling Appendix for additional figures).

This impact would be **potentially significant** under the No Action Alternative.

Action Alternatives The action alternatives would not directly affect water temperatures of the San Joaquin River flowing into the Delta and, except in late winter through early summer months of Wet years, would have minimal effects on the volume of San Joaquin River inflow. There would be minimal changes to the frequency of San Joaquin River inflows less than 2,000 cfs during the fall-run Chinook salmon adult migration period of September through November. Therefore, effects on water temperature and DO would be minimal and adverse effects on fish habitat would be minor.

None of the action alternatives would significantly change the inflow from the San Joaquin River to the Delta when compared to either existing conditions or the No Action Alternative (see Figure 5-20 and the Modeling Appendix for additional figures). The largest change would occur during winter and spring of Wet years, with average reductions in inflows relative to existing conditions for all five action alternatives ranging between about 2 percent in December and 8 percent in May.

Inflows to the Delta are normally relatively high during winter and spring of Wet years, with water temperatures generally low, so the Wet year reductions in San Joaquin River inflow (see Figure 5-20 and the Modeling Appendix for additional figures) would not affect DO conditions for any Delta fishes. There were no changes in the frequency of inflows less than 2,000 cfs under any of the action alternatives relative to either existing conditions or the No Action Alternative. Future conditions unrelated to the action alternatives would be anticipated to create DO levels considered unsuitable for adult Chinook salmon, as described for the No Action Alternative. Although the anticipated changes to DO levels under the action

alternatives would be small, they could further exacerbate the unsuitable conditions anticipated in the Delta.

Water temperatures in the south Delta would not be affected by the action alternatives. The SJR5Q water temperature model results show the action alternatives do not affect water temperatures on the San Joaquin River at the Merced River confluence under both existing and future conditions. Therefore, it is reasonable to conclude that water temperatures of San Joaquin River inflow into the Delta would not be affected by the action alternatives.

This impact would be **potentially significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact FSH-19: Loss of Suitable Fish Habitat from Salinity Changes in the Delta

Extended Study Area – Delta

No Action Alternative As discussed in Chapter 15, "Hydrology – Surface Water Quality," the No Action Alternative would result in moderate increases (less than 7 percent) in the long-term average salinity of the Delta in Dry and Critical years as compared to existing conditions. However, these changes would not violate any of the Delta salinity standards, including the D-1641 salinity objectives and X2 standard. As noted previously, the D-1641 salinity objectives and X2 standard are designed to protect sensitive Delta species such as delta smelt.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would cause both increases and decreases in salinity as compared with existing conditions and the No Action Alternative, as shown in the Modeling Appendix. Simulated long-term average salinities in the San Joaquin River near Vernalis were lower than under the existing conditions in all months, particularly in January and April (with decreases of over 12 percent). Under the action alternatives, on a long-term average basis, all increases in simulated salinity were less than 2 percent across all year types, and less than or equal to 2 percent in Dry and Critical

years as compared with existing conditions or the No Action Alternative. None of these changes to Delta salinity would result in any violations of the Delta standards.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-20: Loss of Suitable Fish Habitat from Change in Flow Patterns in the South Delta

Extended Study Area – Delta

No Action Alternative The No Action Alternative would result in minimal changes in upstream (reverse) Old and Middle river flow (Table 5-10).

Under the No Action Alternative, no simulated flows between January and June are more negative than -5,000 cfs. Additionally, the presence of listed fish species dictates how the Delta will be operated. Per the take requirements and the USFWS 2008 and NMFS 2009 BO RPAs, resource agency representatives provide recommendations to the Water Operations Management Team (WOMT), which then considers recommendations from multiple work teams to inform changes in water operations. Therefore, operations could cease that would otherwise be detrimental to listed fish species.

Similarly, the I:E ratios prescribed in NMFS RPA Action IV.2.1 (NMFS 2009) would continue to be met during January through June, consistent with applicable laws, regulations, BOs, and court orders in place at the time the project is implemented and long-term operations would remain subject to existing permitting processes.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would have little effect on San Joaquin River inflows, except for some reductions in late winter through early summer of Wet years. The greatest average reductions in simulated inflows, under the action alternatives as compared with the No Action Alternative, range between about 2 percent in December and 8 percent in May. These changes in inflow during Wet years are considered too small to significantly affect fish in the south Delta.

Table 5-10. Comparison of Old and Middle River Flows Between Alternatives

Month	Water Year Type	No Action Alternative Flow (cfs)	Difference in Flow under Alt 1 (cfs)	Difference in Flow under Alt2 (cfs)	Difference in Flow under Alt 3 (cfs)	Difference in Flow under Alt 4 (cfs)	Difference in Flow under Alt 5 (cfs)
January	All Years	-3,590	-116	-114	-120	-110	-124
	Wet	-2,136	-393	-388	-407	-375	-421
	Above-Normal	-3,656	-59	-59	-59	-59	-59
	Below-Normal	-4,244	63	63	63	63	63
	Dry	-4,706	0	0	0	0	0
	Critical	-4,268	4	4	4	4	4
February	All Years	-3,345	-127	-126	-126	-111	-125
	Wet	-2,281	-421	-419	-416	-368	-413
	Above-Normal	-4,125	-18	-18	-19	-18	-18
	Below-Normal	-3,670	-2	-2	-2	-1	-1
	Dry	-4,138	-1	-1	-1	0	0
	Critical	-3,255	1	0	1	0	0
March	All Years	-2,875	-162	-162	-162	-162	-157
	Wet	-1,317	-558	-558	-557	-557	-540
	Above-Normal	-4,459	5	5	5	5	7
	Below-Normal	-4,298	0	0	0	0	0
	Dry	-2,948	0	0	0	0	0
	Critical	-2,411	0	0	0	0	0
April	All Years	1,057	-77	-77	-77	-63	-81
	Wet	3,097	-241	-240	-241	-192	-253
	Above-Normal	1,449	0	0	0	0	0
	Below-Normal	533	0	0	0	0	0
	Dry	-210	-43	-43	-43	-43	-43
	Critical	-937	-0	-0	-0	0	0
May	All Years	418	18	23	22	27	13
	Wet	2,110	62	63	61	77	27
	Above-Normal	542	0	0	0	0	0
	Below-Normal	42	0	0	0	0	0
	Dry	-548	0	0	0	0	0
	Critical	-1,151	1	24	24	24	24
June	All Years	-3,728	-22	-22	-22	-27	-33
	Wet	-4,421	-76	-75	-75	-91	-113
	Above-Normal	-4,605	0	0	0	0	0
	Below-Normal	-4,174	0	0	0	0	0
	Dry	-2,892	0	0	0	0	0
	Critical	-2,125	0	0	0	0	0
July	All Years	-9,321	-41	-41	-42	-30	-52
	Wet	-8,476	-148	-148	-150	-111	-185
	Above-Normal	-10,187	11	11	11	11	11
	Below-Normal	-10,915	7	7	7	7	6
	Dry	-10,618	-10	-10	-11	-12	-11
	Critical	-7,373	4	4	4	4	4
August	All Years	-8,817	6	7	7	7	7
	Wet	-10,208	-19	-19	-19	-19	-19
	Above-Normal	-10,386	0	0	0	0	0
	Below-Normal	-10,343	-5	-5	-5	-5	-5
	Dry	-7,689	2	3	1	-1	0
	Critical	-4,837	64	67	66	71	68

Table 5-10. Comparison of Old and Middle River Flows Between Alternatives (contd.)

Month	Water Year Type	No Action Alternative Flow (cfs)	Difference in Flow under Alt 1 (cfs)	Difference in Flow under Alt 2 (cfs)	Difference in Flow under Alt 3 (cfs)	Difference in Flow under Alt 4 (cfs)	Difference in Flow under Alt 5 (cfs)
September	All Years	-8,325	-19	-19	-18	-17	-19
	Wet	-9,287	0	0	0	0	0
	Above-Normal	-9,170	-52	-53	-48	-47	-56
	Below-Normal	-9,637	0	0	0	0	0
	Dry	-8,266	14	14	15	17	16
	Critical	-5,018	-55	-56	-56	-56	-55
October	All Years	-5,995	11	13	13	13	5
	Wet	-6,229	28	28	28	28	3
	Above-Normal	-6,947	-7	0	0	0	0
	Below-Normal	-5,470	26	26	26	26	26
	Dry	-6,036	-1	0	0	0	0
	Critical	-5,084	3	3	3	3	3
November	All Years	-6,051	-138	-139	-132	-137	-142
	Wet	-6,542	-155	-155	-155	-155	-170
	Above-Normal	-7,273	-160	-163	-142	-164	-166
	Below-Normal	-5,890	-133	-132	-133	-132	-135
	Dry	-5,711	-246	-247	-234	-234	-233
	Critical	-4,502	-7	-6	-6	-6	-6
December	All Years	-6,611	-59	-87	-84	-68	-87
	Wet	-6,343	-150	-150	-138	-85	-150
	Above-Normal	-5,821	-59	-67	-68	-66	-65
	Below-Normal	-7,247	-17	-17	-17	-17	-17
	Dry	-8,310	-4	-4	-4	-1	-2
	Critical	-5,905	-2	-138	-139	-138	-139

Key:
Alt = Alternative Plan
cfs = cubic feet per second

The differences in Old and Middle river flows under the action alternatives relative to the No Action Alternative and existing conditions are minor. There are no occasions in which flows are pushed from under -5,000 cfs (less negative) to over -5,000 cfs (more negative) under any alternative during the December-through-June period (Table 5-10).

Expected changes in the I:E ratio are generally small and limited to Wet years, when they are expected to have less impact on habitat in the south Delta habitat. However, more substantial increases in the I:E ratio are expected for July in Critical years, as compared with existing conditions. The simulated increases in the I:E ratio result primarily from reductions in exports; little change is expected for San Joaquin River inflow in July (see Figure 5-21 and the Modeling Appendix for additional figures).

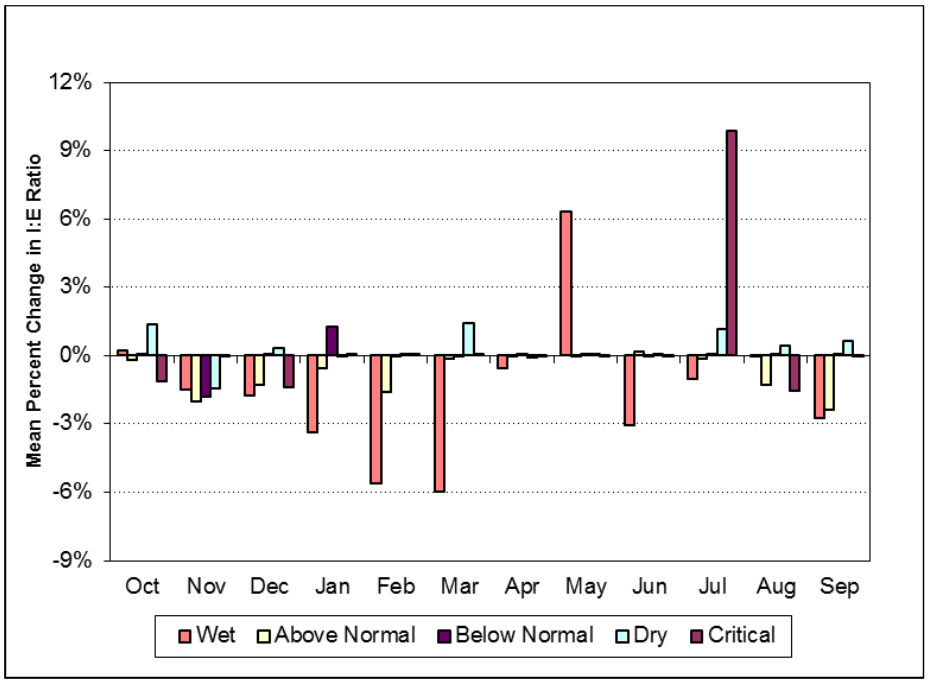


Figure 5-21. Change in Inflow:Export Ratio Between Existing Conditions and Alternative Plan 1

During the April and May period of San Joaquin River salmonid emigration, the frequency of I:E ratios below those prescribed in the NMFS RPA differed little between the action alternatives and existing conditions. As compared with the No Action Alternative, Alternatives Plans 1, 2, and 4 reduced the frequency of the low I:E ratios by about 6 percent in Wet years. There were no differences for other water year types. The reductions in the frequency of low I:E ratios is expected to benefit Delta fish species.

The action alternatives would result in both impacts and benefits to flow patterns that affect south Delta fish habitat. Additional protection would be provided to the fish because the action alternatives would be operated consistent with applicable laws, regulations, BOs, and court orders in place at the time the project is implemented.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-21: Reduction in Fish Abundance from Changes in Exports and Entrainment in the South Delta

Extended Study Area – Delta

No Action Alternative The No Action Alternative would result in changes in exports at the Banks and Jones pumping facilities relative to the existing conditions. Between December and June, simulated monthly average exports increased over existing conditions by more than 5 percent in April of all year types except Critical years, and in June of Above-Normal years (Figure 5-22) under the No Action Alternative.

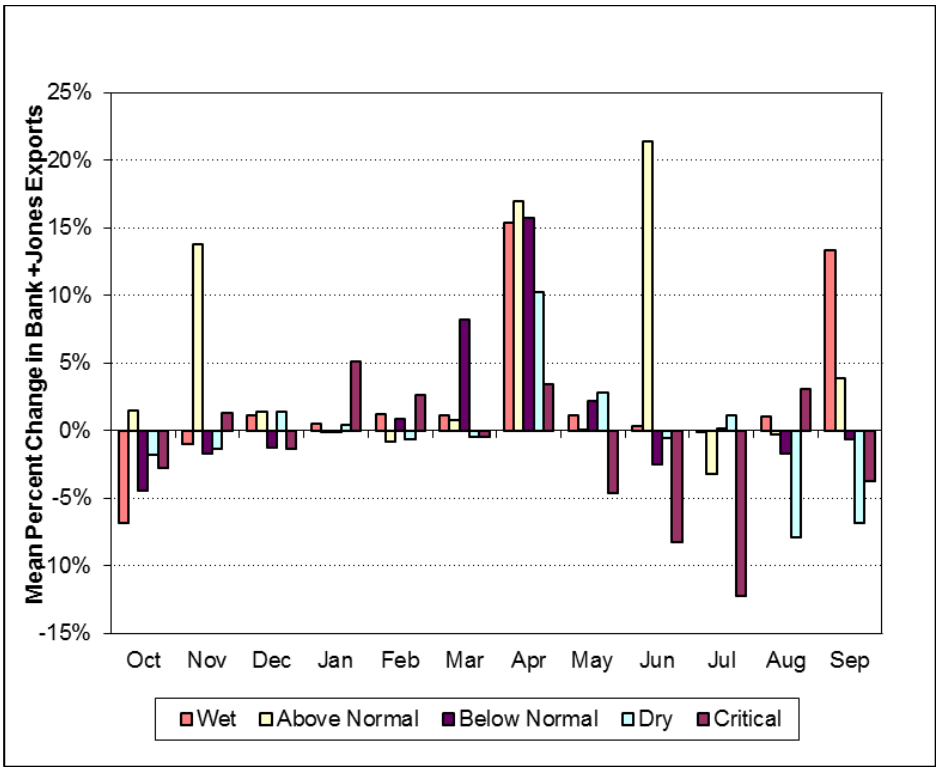


Figure 5-22. Mean Percent Changes in Exports at the Banks and Jones Facilities Between Existing Conditions and the No Action Alternative

Increases in south Delta exports could adversely affect sensitive fish species, including fall-run, spring-run, and winter-run Chinook salmon; steelhead; longfin smelt; and delta smelt. April and June are important months for migration or residency in the Delta of young life stages of most of these species. The young life stages are especially vulnerable to entrainment and other potentially adverse effects resulting from increased exports. Delta smelt spawn in late winter and spring,

and the larvae are typically most abundant in April and May (Bennett 2005). Juvenile steelhead, fall-run Chinook salmon, and winter-run Chinook salmon migrate through or rear in the Delta in April. The increased exports, especially those in April, are expected to adversely affect these species. Many of the export increases during the December-through-June period of increased risk are expected to be more than 5 percent.

As stated previously, real-time fish monitoring that determines the presence of listed fish species at the export facilities dictates export pumping levels during critical months. Per the take requirements and the USFWS 2008 and NMFS 2009 BO RPAs, the WOMT considers recommendations from multiple work teams to inform changes in water operations. Therefore, operations may be ceased that could otherwise be detrimental to listed fish species. Therefore, potential increased diversions and fish entrainment estimated above by models may not necessarily happen in real-time because of regulatory limits that are triggered to reduce diversions and minimize entrainment.

This impact would be **potentially significant** under the No Action Alternative.

Action Alternatives The action alternatives would result in minor changes of Delta exports. Under the action alternatives, the mean level of Banks and Jones exports is expected to change less than 1 percent under all five of the action alternatives in most months and water year types. The largest increases in exports, ranging between 5 and 6 percent, would occur in September of Wet years. For November, increases in exports of greater than 5 percent would occur in about 10 percent to 14 percent of years at the 2005 level of development. During the December-through-June period of increased risk, increases of greater than 5 percent would be infrequent, occurring in a maximum of 6 percent of years for March under all action alternatives.

The largest reductions in exports, ranging between about 3 and 10 percent, would occur in April and May of Wet years and in July of Critical years under all the action alternatives.

The fish at greatest risk of entrainment at the Banks and Jones export facilities are small fish, particularly fish larvae. The increases in exports resulting from the action alternatives are expected to occur primarily during November and September, when few larval fish occur in the south Delta (Grimaldo et al.

2009b). Juvenile stages of Chinook salmon, steelhead trout, sturgeon, and others, as well as adults of smaller bodied species such as delta smelt, longfin smelt, and splittail, are also entrained at the Jones and Banks facilities, but few of these fish occur in the south Delta during September and November. Late fall-run Chinook salmon and green and white sturgeon are salvaged at the Banks and Jones facilities in September and November (Williams 2006, NMFS 2009, Harvey and Stroble 2013, DWR 2013a), but entrainment risk for the sturgeon species is relatively low (DWR 2013b) and the anticipated increase in exports is not considered to be large enough to affect populations of any of these species.

The reductions in exports for April and May of Wet years are likely to benefit steelhead, spring-run Chinook salmon, fall-run Chinook salmon, delta smelt, longfin smelt, and Sacramento splittail, all of whose early life stages are likely to occur in the south Delta during these months. The reduced exports in May would reduce entrainment in the south Delta, resulting in a beneficial effect to fish.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact FSH-22: Loss of Suitable Fish Habitat Resulting from Changes in X2

Extended Study Area – Delta

No Action Alternative Modeling results indicate that the No Action Alternative would generally have small effects on X2. The maximum monthly upstream shift in simulated X2 is about 3 km for October in Above-Normal years, and most of the maxima are less than 2 km. Table 5-11 shows the maximum shifts in simulated X2 for each month and water year type; the average mean monthly shifts (averaging upstream and downstream shifts) are, however, consistently less than 0.3 km and therefore substantially less than criteria for a 1 km upstream shift.

Table 5-11. Maximum Shift in X2 Between Existing Conditions and the No Action Alternative

Month	Wet	Above-Normal	Below-Normal	Dry	Critical	Number of Years Greater than 1 km Upstream
January	0.7	0.3	0.2	0.3	2.5	1
February	0.6	0.1	0.1	0.9	2.6	1
March	0.1	0.9	1.1	2.7	0.2	2
April	0.2	0.3	0.1	0.7	1.1	1
May	0.7	0.5	0.3	1.3	1.6	4
June	1.2	1.0	0.7	1.0	0.9	2
July	0.8	0.4	0.5	0.4	0.1	0
August	1.2	0.2	0.5	0.3	0.3	1
September	1.9	0.2	0.1	1.5	0.8	3
October	1.4	3.0	0.3	0.2	1.1	3
November	1.5	0.7	0.2	0.5	0.6	1
December	0.9	1.5	0.5	0.8	0.1	1

Key:
km = kilometer

D-1641 establishes the X2 standard, which is reinforced by the fisheries requirements established in the USFWS 2008 and NMFS 2009 BO RPAs. CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641 and BO RPAs, and this would not change under the No Action Alternative. It is therefore anticipated that the No Action Alternative would continue to operate under these standards. However, neither the future events related to fish locations nor behaviors of the decision-making process of the resource agencies can be determined at this time.

This impact would be **potentially significant** under the No Action Alternative.

Action Alternatives Modeling results indicate that the action alternatives would have little effect on X2 (Table 5-12 and additional information in the Modeling appendix). The average differences in simulated X2 between the action alternatives and the No Action Alternative and existing conditions range between 0.2 and -0.2 km. The maximum mean monthly upstream difference in simulated X2 for all the action alternatives, as compared with existing conditions and the No Action Alternative, is around 1 km for May in Wet years. The maximum mean monthly upstream shift in simulated X2, as compared with the No Action Alternative, was just over 2.5 km

in November of a single Wet year for Alternative Plan 1; and about 2.5 km in November of Wet years, and in December of Critical years, for Alternative Plans 2, 3, and 4. Most of the simulated maxima for both existing and future conditions are less than 1 km.

Table 5-12. Number of Years X2 is Located More than 1 Kilometer Upstream from the Location Under Existing Conditions and No Action Alternative

Existing Condition	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
January	0	0	0	0	0
February	0	0	0	0	0
March	0	0	0	0	0
April	0	0	0	0	0
May	1	1	1	1	1
June	1	1	1	1	2
July	1	1	1	1	2
August	0	0	0	0	1
September	0	0	0	0	0
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
No Action Alternative	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
January	0	0	0	0	1
February	0	0	0	0	0
March	0	0	0	0	0
April	0	0	0	0	0
May	0	0	0	0	0
June	0	0	0	0	0
July	2	2	2	2	3
August	0	0	0	0	1
September	0	0	0	0	0
October	0	0	0	0	0
November	1	1	1	1	1
December	1	2	2	2	2

Key:
Alt = Alternative Plan

The effects of the action alternatives on the X2 location during the September-through-November period and the January-through-June period would be minor, and are not expected to significantly affect fish habitat. Additionally, the Delta facilities are operated to provide protection to listed fish species, and this would not change under the action alternatives. The action alternatives would be operated

consistent with applicable laws, regulations, BOs, and court orders in place at the time the project is implemented.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each potentially significant and significant impact described in the environmental consequences section.

No mitigation is required for Impacts FSH-2 through FSH-8 in the primary study area, as these impacts would have no impact or be less than significant, less than significant and beneficial, or beneficial under the action alternatives. No mitigation is required for Impacts FSH-10 through FSH-22 in the primary study area, as there would be no impact under the action alternatives.

In the extended study area, there would be no impact under the action alternatives under Impacts FSH-1 through FSH-9. No mitigation is required for Impacts FSH-10 (under Alternative Plans 1 through 4), or for FSH-12 through FSH-17 and FSH-19 through FSH-22 (under all action alternatives) in the extended study area as these impacts would have no impact, or be less than significant or less than significant and beneficial for all action alternatives.

Impacts FSH-1 and FSH-9 within the primary study area would be significant under the action alternatives. No feasible mitigation measures are available to reduce these impacts to a less-than-significant level. Therefore, Impacts FSH-1 and FSH-9 in the primary study area would be **significant and unavoidable** under all action alternatives.

Impact FSH-10 within the extended study area would be potentially significant under Alternative Plan 5. No feasible mitigation measures are available to reduce this impact to a less-than-significant level. Therefore, Impact FSH-10 in the extended study area would be **potentially significant and unavoidable** under Alternative Plan 5.

Impact FSH-11 within the extended study area would be significant under all action alternatives. No feasible mitigation measures are available to reduce this impact to a less-than-significant level. Therefore, Impact FSH-11 in the extended

study area would be **significant and unavoidable** under all action alternatives.

Impact FSH-18 within the extended study area would be potentially significant under all action alternatives. No feasible mitigation measures are available to reduce this impact to a less-than-significant level. Therefore, Impact FSH-18 in the extended study area would be **potentially significant and unavoidable** under all action alternatives.

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Chapter 6
Biological Resources – Botanical and Wetlands

This chapter describes the affected environment for botanical and jurisdictional wetland resources, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion focuses on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake downstream from RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

Biological resources addressed in this section include terrestrial plant communities, special-status plants, designated critical habitat, special-status natural communities, and wetlands and other waters of the United States. Information in this section is based on descriptions of biological resource conditions documented during biological resources studies conducted in 2007, 2008, and 2010, as discussed below, and additional documents describing historical and potential conditions for biological resources in the primary and extended study areas. The following documents were reviewed in support of preparing this section:

- *Riparian Vegetation of the San Joaquin River* (DWR 2002)
- *San Joaquin River Restoration Study Background Report* (McBain & Trush 2002)
- *Temperance Flat Reservoir Alternatives Botanical Resources Baseline Report* (Reclamation 2007)
- *Preliminary Delineation of Waters of the United States, Including Wetlands, for the Temperance Flat Reservoir* (Reclamation 2008)

- *Final Environmental Assessment/Initial Study: Water Year 2010 Interim Flows Project*. San Joaquin River Restoration Program (Reclamation 2009)

- *Mapping Standard and Land Use Categories for the Central Valley Riparian Mapping Project* (DWR 2009)

- *Supplemental Preliminary Delineation of Waters of the United States, Including Wetlands, for the Temperance Flat Reservoir Alternatives* (Reclamation 2010)

- SJRRP PEIS/R (SJRRP 2012)

With the exception of the database searches, all the sources cited in the Affected Environment section of this chapter regarding the extended study area are sources cited in the SJRRP PEIS/R (SJRRP 2012).

Vegetation Communities

For purposes of this analysis, vegetation community nomenclature follows the Holland (1986) classification system. Some modifications were made to account for local variability and communities that are not specifically described in Holland, such as willow scrub and bush lupine scrub. California Wildlife Habitat Relationships (CWHR) nomenclature (Airola 1988, Mayer and Laudenslayer 1988) was used for unvegetated cover types, such as lacustrine and riverine areas that could not be classified using Holland's terrestrial natural community types. A crosswalk analysis between the Holland vegetation community types, CWHR classification types, *A Manual of California Vegetation Second Edition* (Sawyer et al. 2009), and the plant community types for the action alternatives is provided in Table 6-1.

Sensitive habitats include those that are of special concern to resource agencies or are afforded specific consideration through CEQA, Section 1602 of the California Fish and Game Code, Section 404 of the CWA, and the State's Porter-Cologne Water Quality Control Act (Porter-Cologne Act), as discussed in Chapter 28, "Other NEPA and CEQA Considerations." Sensitive habitats may be of special concern to these agencies and conservation organizations for a variety of reasons, including their locally or regionally declining status or because they provide important habitat to common and special- status species. Many of the vegetation communities and unvegetated habitat types in the primary and extended study areas qualify as waters of the United States subject to USACE jurisdiction under

Section 404 of the CWA and/or as waters of the State. In addition, riparian communities are generally subject to regulation under Section 1602 of the California Fish and Game Code. Vegetation communities that may be subject to regulation under Section 404 of the CWA or Section 1602 of the California Fish and Game Code are so noted in the community descriptions below.

The CDFW maintains a list of terrestrial natural communities that are native to California. Within that list, CDFW identifies "special-status natural communities" (also known as sensitive natural communities), which it defines as "communities that are of limited distribution statewide or within a county or region and often vulnerable to environmental effects of projects" (CNDDB 2013a). These communities may not contain special-status species or their habitat. Special-status natural communities are tracked in the California Natural Diversity Database (CNDDB), a statewide inventory of the locations and conditions of the State's rarest plant and animal taxa and vegetation types; however, no new special-status natural community data have been added to the CNDDB since 1990 when funding was cut for this portion of the program. Several vegetation communities that occur within the primary and extended study areas are designated as special-status natural communities, as noted in the community descriptions below.

The following discussion describes the vegetation communities present in the primary study area, and in the San Joaquin River portion of the extended study area from Friant Dam downstream to the confluence with the Merced River (San Joaquin River Reaches 1–5). Greater detail is provided for these portions of the Study Area because the project would have more varied and substantially greater potential impacts on botanical and wetland resources within these areas than along the San Joaquin River from the Merced River downstream to the Delta, within the Delta, or within CVP and SWP water service areas. The extent to which the communities are present in the primary study area and the San Joaquin River between Friant Dam and Merced River portion of the extended study area is identified in Table 6-2. Their locations and extents in the primary study area are shown in Figure 6-1.

Table 6-1. Crosswalk for Different Vegetation Community Nomenclatures Used in the Upper San Joaquin River Basin Storage Investigation

A Manual of California Vegetation Nomenclature (Sawyer et al. 2009)	Global and State Rank	Wildlife Habitat Relationships Nomenclature (Airola 1988, Mayer and Laudenslayer 1988)	Holland (1986) Nomenclature	Upper San Joaquin River Basin Storage Investigation Nomenclature
Woodland Communities				
Quercus douglasii Alliance	G4 S4	Blue Oak Woodland	Blue Oak Woodland	Blue Oak Woodland
Quercus wislizeni-Quercus douglasii- Pinus sabiniana Association	G4 S4	Blue Oak Woodland	Interior Live Oak Woodland	Live Oak Woodland
Pinus sabiniana-grass Association	G4 S4	Blue Oak-Foothill Pine	Open Digger Pine Woodland	Foothill Pine Woodland
Pinus sabiniana-Quercus wislizeni/Ceanothus cuneatus Association	G4 S4	Blue Oak-Foothill Pine	Digger Pine-Oak Woodland	Foothill Pine Oak Woodland
Pinus sabiniana/Ceanothus cuneatus-Heteromeles arbutifolia Alliance *Pinus sabiniana/Ceanothus cuneatus-Rhamnus ilicifolia* Association *Pinus sabiniana-Quercus wislizeni/Ceanothus cuneatus* Association	G4 S4	Blue Oak-Foothill Pine	Nonserpentine Digger Pine-Chaparral Woodland	Foothill Pine Chaparral Woodland
Riparian Communities				
Alnus rhombifolia-Fraxinus latifolia Association	G4 S4	Valley-Foothill Riparian	White Alder Riparian Forest	White Alder Riparian
		Valley-Foothill Riparian	Great Valley Willow Scrub	Fig-Willow Riparian
		Valley-Foothill Riparian	—	Fig Riparian
Platanus racemosa Woodland Alliance	G3 S3	Valley-Foothill Riparian	Great Valley Mixed Riparian Forest	Sycamore Riparian Woodland
Populus fremontii-Acer negundo-Rubus armeniacus Association *Populus fremontii*-Salix Association	G2 S2	Valley-Foothill Riparian	—	Mixed Riparian
Populus fremontii Alliance	G2 S2	Valley-Foothill Riparian	Great Valley Cottonwood Riparian Forest	Cottonwood Riparian Forest
Quercus lobata Alliance	G3 S3	Valley-Foothill Riparian	Great Valley Valley Oak Riparian Forest	Valley Oak Riparian
Salix laevigata-Salix lasiolepis Association	G3 S3	Valley-Foothill Riparian	Great Valley Mixed Riparian Forest	Willow Riparian Forest
Salix exigua Shrubland Alliance	G5 S4	Valley-Foothill Riparian	Great Valley Willow Scrub	Willow Scrub
Salix laevigata/Salix lasiolepis/Artemisia douglasiana Association *Rubus armeniacus* Semi-Natural Stands	G3 S3 —	Valley-Foothill Riparian	Great Valley Willow Scrub	Riparian Scrub

Table 6-1. Crosswalk for Different Vegetation Community Nomenclatures Used in the Upper San Joaquin River Basin Storage Investigation (contd.)

A Manual of California Vegetation Nomenclature (Sawyer et al. 2009)	Global and State Rank	Wildlife Habitat Relationships Nomenclature (Airola 1988, Mayer and Laudenslayer 1988)	Holland (1986) Nomenclature	Upper San Joaquin River Basin Storage Investigation Nomenclature
Riparian Communities (contd.)				
Cephalanthus occidentalis Association	G5 S2	Valley-Foothill Riparian	Buttonbush Scrub	Buttonbush Scrub
Broom Semi-Natural Shrubland Alliance	—	—	Broom Scrub	Spanish Broom Scrub
Sambucus nigra Association	G3 S3	—	Elderberry Savanna	Elderberry Savanna
Arundo donax Semi-Natural Herbaceous Stands	—	Fresh Emergent Wetland	Giant Reed	Giant Reed
Upland Shrub Communities				
Ceanothus cuneatus Shrubland Alliance	G4 S4	Mixed Chaparral	Buckbrush Chaparral	Buckbrush Chaparral
Lupinus albifrons Association	G4 S4	Mixed Chaparral	Northern Mixed Chaparral	Bush Lupine Scrub
Herbaceous Upland Communities				
Avena Semi-Natural Herbaceous Stands *Bromus-Brachypodium distachyon* Semi-Natural Herbaceous Stands	—	Annual Grassland	Nonnative Grassland	Annual Grassland
Herbaceous Wetland Communities				
Eleocharis macrostachya Herbaceous Alliance	G4 S4	Freshwater Emergent Wetland	Freshwater Seep	Freshwater Seep
Carex barbarae Herbaceous Alliance *Mimulus* (*guttatus*) Herbaceous Alliance	G2 S2 G4 S3	Wet Meadow	Coastal and Valley Freshwater Marsh	Seasonal Wetland
Typha Herbaceous Alliance *Schoenoplectus acutus* Herbaceous Alliance	G5 S5 G5 S4	Freshwater Emergent Wetland	Coastal and Valley Freshwater Marsh	Emergent Wetland
Allenrolfea occidentalis Shrubland Alliance	G4 S3	Alkali Desert Scrub	Valley Sink Scrub	Alkali Sink
Lasthenia fremontii–Downingia Herbaceous Alliance *Lasthenia fremontii–Distichlis spicata* Herbaceous Alliance	G3 S3 G4 S3	—	Northern Hardpan Vernal Pool Northern Claypan Vernal Pool	Vernal Pool
Aquatic Communities				
—	—	Riverine	River	Riverine Other Waters
—	—	Lacustrine	—	Lacustrine Unconsolidated Bottom
—	—	—	—	Lacustrine Unconsolidated Shoreline

Table 6-1. Crosswalk for Different Vegetation Community Nomenclatures Used in the Upper San Joaquin River Basin Storage Investigation (contd.)

A Manual of California Vegetation Nomenclature (Sawyer et al. 2009)	Global and State Rank	Wildlife Habitat Relationships Nomenclature (Airola 1988, Mayer and Laudenslayer 1988)	Holland (1986) Nomenclature	Upper San Joaquin River Basin Storage Investigation Nomenclature
Other Habitats				
—	—	Cropland	—	Agriculture
—	—	Barren	—	Barren
—	—	—	—	Developed
—	—	Urban	—	Developed Nonnative Tree

Notes:

[1] Global and State Rank Definitions:

The global rank (G-rank) is a reflection of the overall status of an element throughout its global range.

G2: Imperiled—At high risk of extinction because of extreme rarity, very few occurrences (20 or fewer), steep declines, or other factors.

G3: Vulnerable—At moderate risk of extinction because of restricted range, relatively few occurrences (80 or fewer), recent and widespread declines, or other factors.

G4: Apparently Secure—Uncommon but not rare; some cause for long-term concern because of declines or other factors.

G5: Secure—Common; widespread, and abundant.

The state rank (S-rank) is assigned in much the same way as the global rank, but it refers to the imperilment status within California's state boundaries.

S2: Imperiled—Imperiled in the state because of very restricted range, very few occurrences (20 or fewer), steep declines, or other factors making it vulnerable to extirpation from the nation or state.

S3: Vulnerable—Vulnerable in the state because of restricted range, relatively few occurrences (fewer than 80), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4: Apparently Secure—Uncommon but not rare in the state; some cause for long-term concern because of declines or other factors.

S5: Secure—Common; widespread, and abundant in the state.

Table 6-2. Vegetation Communities in the Primary Study Area and San Joaquin River between Friant Dam and Merced River Portion of the Extended Study Area

Vegetation Community/Habitat	Primary Study Area		Extended Study Area – San Joaquin River Between Friant Dam and Merced River	
	Area[1] (acres)	Percent of Primary Study Area	Area[1] (acres)	Percent of Extended Study Area
Woodland Communities				
Foothill Pine Oak Woodland	5,029	42	0	0
Blue Oak Woodland	1,388	11	0	0
Live Oak Woodland	57	<1	0	0
Foothill Pine Woodland	9	<1	0	0
Foothill Pine Chaparral Woodland	5	<1	0	0
Upland Shrub Communities				
Buckbrush Chaparral	25	<1	0	0
Bush Lupine Scrub	9	<1	0	0
Herbaceous Communities				
Annual Grassland	317	2	0	0
Grassland and Pasture	0	0	8,971	41
Riparian Communities				
Cottonwood Riparian Forest	0	0	922	4
Willow Riparian Forest	4	<1	2,028	9
White Alder Riparian	25	<1	0	0
Mixed Riparian Forest	12	<1	660	3
Valley Oak Riparian Forest	0	0	391	2
Sycamore Riparian Woodland	<1	<1	0	0
Willow Scrub	0	0	1,087	5
Riparian Scrub	0	0	561	3
Elderberry Savanna	0	0	68	<1
Buttonbush Scrub	<1	<1	0	0
Fig Riparian/Fig-Willow Riparian[2]	3	<1	0	0
Spanish Broom Scrub	<1	<1	0	0
Giant Reed	0	0	13	<1

Table 6-2. Vegetation Communities in the Primary Study Area and San Joaquin River between Friant Dam and Merced River Portion of the Extended Study Area (contd.)

Vegetation Community/Habitat	Primary Study Area		Extended Study Area – San Joaquin River Between Friant Dam and Merced River	
	Area[1] (acres)	Percent of Primary Study Area	Area[1] (acres)	Percent of Extended Study Area
Herbaceous Wetland Communities				
Emergent Wetlands	0	0	1,056	5
Seasonal Wetlands[3]	268	2	0	0
Vernal Pool[4]	6	<1	0	0
Alkali Sink	0	0	2	<1
Freshwater Seep	1	<1	0	0
Aquatic Communities				
Lacustrine[5]	4,607	42	0	0
Riverine[6]	200	2	3,233	15
Riverwash	0	0	347	2
Other Waters[7]	25	<1	0	0
Other Habitats				
Nonnative Tree	0	0	81	<1
Agriculture	0	0	735	3
Disturbed Areas	0	0	455	2
Developed Areas	6	<1	1	<1
Barren Areas	31	<1	0	0
No Data[8]	0	0	1,052	5
Total	**12,030**	**100**	**21,663**	**100**

Sources: Reclamation 2007; DWR 2002, 2011

Notes:

[1] Acres rounded to the nearest whole number except where less than 0.5, which is shown as <1.

[2] Fig Riparian and Fig-Willow Riparian habitat types were mapped separately at the time of the field survey. However, because of similarities in habitat, these two habitat types were grouped for this analysis.

[3] Seasonal wetland acreage reported in this table also includes 1.4 acres of swale habitat.

[4] Vernal pools are present within the transmission line corridor in the southwestern portion of the primary study area. Potential wetted acreage reported here is overestimated because detailed analysis for this area is scheduled after release of this report.

[5] Lacustrine habitat reported above consists of Lacustrine Unconsolidated Bottom and Lacustrine Unconsolidated Shoreline.

[6] The data set for the extended study area uses the term “open water”; however, this corresponds to the open water section of the San Joaquin River.

[7] Other waters within the primary study area consist of ephemeral, intermittent, and perennial streams and instream pools and ponds.

[8] No data exist for portions of the extended study area that were not assigned a vegetation community classification by DWR (2002).

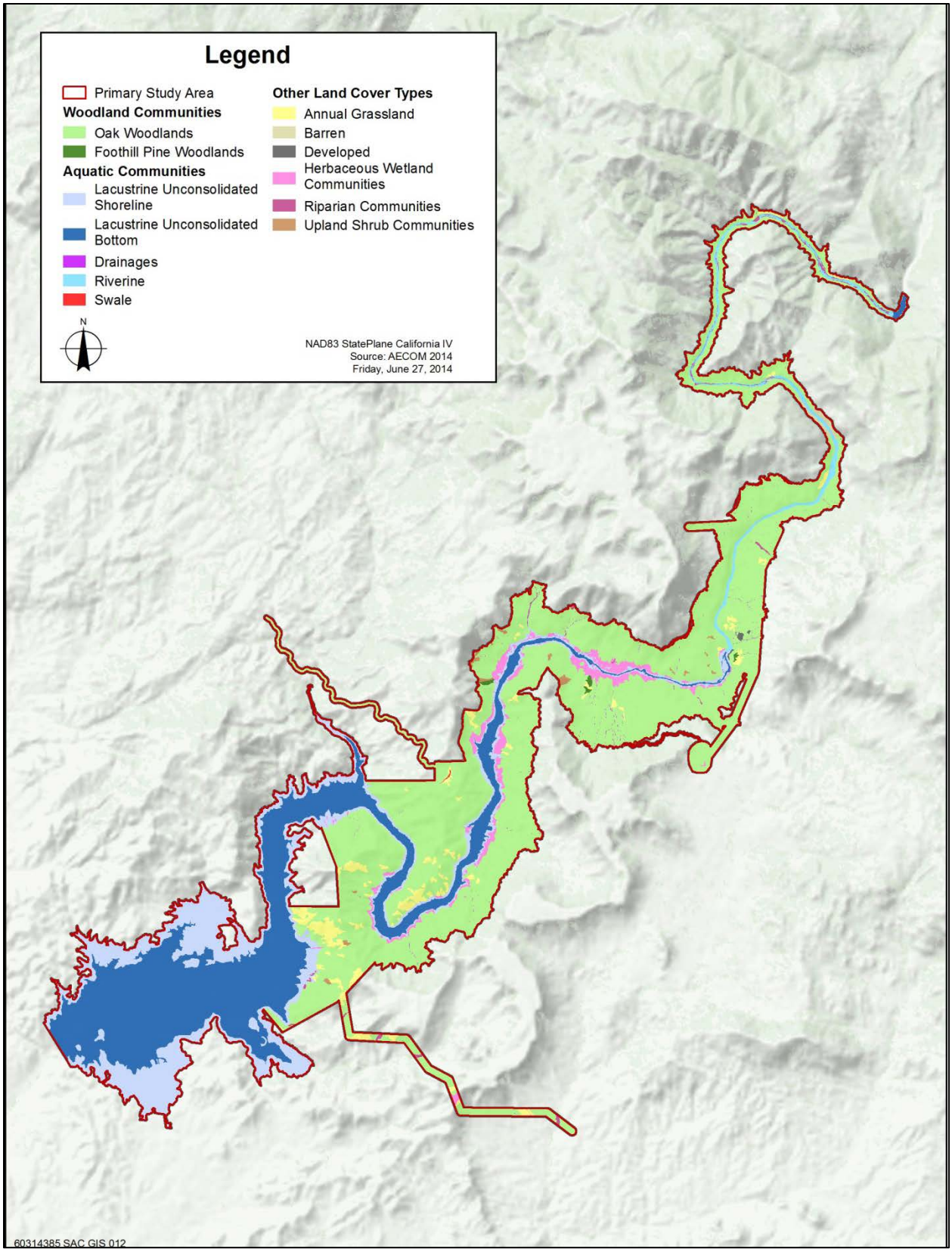


Figure 6-1. Vegetation Communities in the Primary Study Area

The following discussion presents a more detailed breakdown of vegetation community acreages in the areas that make up the primary study area and the San Joaquin River Reaches 1–5 portion of the extended study area. Greater detail is provided for these portions of the Study Area than for those portions of the extended study area beyond the San Joaquin River confluence with the Merced River because the project would have more varied and substantially greater potential impacts on botanical and wetland resources in Reaches 1–5. Plant species nomenclature used in this report follows *The Jepson Manual: Vascular Plants of California* (Baldwin et al. 2012).

Woodland Communities

Foothill Pine Oak Woodland Foothill pine (*Pinus sabiniana*) is codominant with blue oak (*Quercus douglasii*) and/or interior live oak (*Quercus wislizeni*) in this community and comprises 15 to 50 percent of the relative tree canopy cover. In some areas, interior live oak is more prevalent than blue oak and is codominant with foothill pine, particularly in shady ravines and on north-facing slopes. There are three overstory layers in this community: a shrub layer, an intermediate oak tree layer, and a taller foothill pine tree layer. Associated shrubs include California buckeye (*Aesculus californica*), poison-oak (*Toxicodendron diversilobum*), buckbrush (*Ceanothus cuneatus*), redbud (*Cercis occidentalis*), whiteleaf manzanita (*Arctostaphylos viscida*), and hollyleaf redberry (*Rhamnus ilicifolia*). California laurel (*Umbellularia californica*) is often present in this community at higher elevations.

The herbaceous layer is characterized primarily by annual grasses and forbs, with nonnative species making up most of the herbaceous cover. Characteristic species found in the herbaceous layer include fiesta flower (*Pholistoma auritum*), small baby blue eyes (*Nemophila heterophylla*), miner's lettuce (*Claytonia perfoliata*), and common chickweed (*Stellaria media*). Other common nonnative forbs include filarees (*Erodium botrys*, *E. cicutarium*), foothill clover (*Trifolium ciliolatum*), tocalote (*Centaurea melitensis*), dovefoot geranium (*Geranium molle*), and hedge parsley (*Torilis arvensis*). Common grasses include ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), wild oats (*Avena barbata*, *A. fatua*), and rattail fescue (*Festuca myuros*).

Snags with cavities are typically present, and downed pine trees in varying stages of decay are an important component of the understory. Tree canopy cover is relatively dense in the

foothill pine oak woodland community. Structural diversity is high in this community because of the presence of three overstory layers, the variety of tree and shrub sizes and shapes, varying shrub distribution patterns from dense thickets to more scattered distribution, and downed woody debris and snags.

Blue Oak Woodland Blue oak makes up 85 to 100 percent of the tree canopy cover of this community. Foothill pine and interior live oak may also be present, but provide less than 15 percent of the relative tree cover. Annual grasses and forbs typically characterize the understory, but a sparse shrub layer may also be present. Associated herb species are the same as described for the foothill pine oak woodland community.

Buckbrush is the most common shrub associate. The tree canopy tends to be more open in this community than in the foothill pine oak woodland community. Snags with cavities are also typically present, although they occur less frequently in this community type than in the foothill pine oak woodland community. Structural diversity is much lower in blue oak woodland than in foothill pine oak woodland because this vegetation community tends to be primarily a two-layer community of oak trees and annual grassland with few shrubs and emergent pines and because downed trees are much less common.

Live Oak Woodland Interior live oak makes up 85 to 100 percent of the tree canopy in this vegetation community. Scattered blue oak and foothill pine trees may be present but represent less than 15 percent of the relative tree cover. A shrub layer is also typically present, and shrub species likely to be found in this community are similar to those found in the blue oak woodland community. This community is generally restricted to steep and rocky, north-facing slopes. Nonnative annual grasses typify the understory.

Foothill Pine Woodland Foothill pine is the sole dominant in the tree canopy of this vegetation community, making up 85 to 100 percent of tree cover. These communities are open, savanna-like woodlands that are generally lacking shrub layers and have only scattered oak trees. Annual grasses and forbs typical of the woodland and annual grassland communities characterize the understory. Snags may also be present.

Foothill Pine Chaparral Woodland In this vegetation community, foothill pine makes up 50 percent or more of the tree canopy, and the understory is characterized by dense cover

of evergreen sclerophyllous (hard-leaved) shrubs or small trees, such as whiteleaf manzanita, toyon (*Heteromeles arbutifolia*), buckbrush, interior live oak, and hollyleaf redberry. A shrub layer and a tall foothill pine layer are characteristic in this vegetation community, but an intermediate oak tree layer is generally lacking. Oaks are typically reduced to shrubs or small trees because of the harsh growing conditions. This community is restricted to extremely dry, shallow soils.

Upland Shrub Communities

Buckbrush Chaparral This vegetation community is typically characterized by near monocultures of buckbrush, but in some cases, chaparral whitethorn (*Ceanothus leucodermis*) is also a major component. Other scattered broad-leaved sclerophyllous shrubs such as toyon and interior live oak may also be present. Shrub cover is typically dense, and the herbaceous understory is sparse. Widely scattered trees may be present but make up less than 10 percent of the total vegetative cover.

Bush Lupine Scrub Silver bush lupine (*Lupinus albifrons*) is the dominant shrub, and generally the only shrub in this community, comprising at least 10 percent of the relative cover in this community type. The understory is composed of species characteristic of the annual grassland vegetation community described below.

Herbaceous Communities

Annual Grassland This vegetation community is characterized by a dense cover of annual grasses and annual and perennial forbs, mostly nonnatives, and contains less than 10 percent cover of trees or shrubs. Grass species observed include ripgut brome, soft chess, wild oats, and rattail fescue. Common nonnative forbs include filarees, foothill clover, tocalote, dovefoot geranium, and hedge parsley. Native forbs commonly observed in annual grassland include rusty popcornflower (*Plagiobothrys nothofulvus*), miniature lupine (*Lupinus bicolor*), common fiddleneck (*Amsinckia intermedia*), elegant brodiaea (*Brodiaea elegans*), and foothill poppy (*Eschscholzia caespitosa*).

Grassland and Pasture Grassland and pasture is a forb- and grass-dominated vegetation community. Generally, sites with grassland or pasture are well drained and flood only occasionally under typical hydrologic conditions. The grassland and pasture vegetation community is composed of an assemblage of nonnative annual and perennial grasses and

occasional nonnative and native forbs. The most abundant species are nonnative grasses (ripgut brome, rattail fescue, and foxtail barley [*Hordeum murinum* ssp. *leporinum*]) and forbs (red-stemmed filaree [*Erodium cicutarium*] and horseweed [*Conyza canadensis*]).

Riparian Communities

Riparian communities contain at least one dominant tree or shrub species that is typically associated with streams, such as willow (*Salix* spp.), cottonwood (*Populus* spp.), or alder (*Alnus* spp.). Riparian communities include cottonwood riparian forest, willow riparian forest, white alder riparian forest, mixed riparian forest, valley oak riparian forest, sycamore riparian woodland, willow scrub, riparian scrub, elderberry savanna, buttonbush scrub, fig riparian, fig/willow riparian, and Spanish broom scrub.

Cottonwood Riparian Forest Cottonwood riparian forest is a multilayered riparian forest. It is found on the active low floodplain of the San Joaquin River. Older and decadent stands of cottonwood riparian forest also exist in areas that were formerly active floodplains, but are now on terraces above the ordinary high-water mark (OHWM) because of the reduction in the high-flow regime following completion of Friant Dam and its associated diversion canals. Common dominant trees in the overstory include Fremont cottonwood (*Populus fremontii*) and Goodding's black willow (*Salix gooddingii*). California wild grape (*Vitis californica*) is a conspicuous vine found growing within the canopy of this forest. The midstory is often dominated by shade-tolerant shrubs and trees, such as Oregon ash (*Fraxinus latifolia*) or California box elder (*Acer negundo* ssp. *californica*). Other shrubby species of willow may also be present within the midstory. The understory typically is dominated by native grasses and forbs, such as creeping wild rye (*Elymus triticoides*), stinging nettle (*Urtica dioica*), and Santa Barbara sedge (*Carex barbarae*). This vegetation community is designated as a special-status natural community by CDFW.

Willow Riparian Forest Willow riparian forest is dominated by willows, frequently almost exclusively by Goodding's black willow. Red willow (*Salix laevigata*) and arroyo willow (*Salix lasiolepis*) are also common. Occasional scattered cottonwoods, ashes, or white alders (*Alnus rhombifolia*) may be present but are never an important part of the canopy cover. Cover is typically dense. California buttonbush (*Cephalanthus occidentalis* var. *californicus*) is often present and may even

dominate the riverbank for stretches. This vegetation community is designated as a special-status natural community by CDFW.

White Alder Riparian White alder riparian is found primarily in the upper reaches of the San Joaquin River. It occurs as a narrow, discontinuous band of 10- to 20-foot-tall white alder trees. Associated species include Oregon ash in the tree layer and narrow-leaved willow (*Salix exigua*), arroyo willow, dusky willow (*Salix melanopsis*), and California buttonbush in the shrub layer.

Mixed Riparian Forest Mixed riparian forest is a multilayered forest generally found on intermediate terraces within the floodplains of perennial streams, such as the San Joaquin River. Species dominance in mixed riparian forest depends on site conditions, such as availability of groundwater and frequency of flooding. Typical dominant trees in the overstory and midstory include Fremont cottonwood, California box elder, Goodding's black willow, Oregon ash, and western sycamore (*Platanus racemosa*). The understory of mixed riparian forest is similar to that of cottonwood riparian forest. This vegetation community is designated as a special-status natural community by CDFW.

Valley Oak Riparian Forest Valley oak riparian forest is characterized by an open to closed canopy of valley oaks. This forest type is found on the higher elevations of the floodplain and is therefore exposed to less flood-related disturbance than other riparian vegetation communities. Valley oak (*Quercus lobata*) is the dominant tree in this vegetation type; western sycamore, Oregon ash, and Fremont cottonwood are present in small numbers. Common understory species in this vegetation type include creeping wild rye, California wild rose (*Rosa californica*), California wild grape, California blackberry (*Rubus ursinus*), and the nonnative Himalayan blackberry (*Rubus armeniacus*). This vegetation community is designated as a special-status natural community by CDFW.

Sycamore Riparian Woodland Sycamore riparian woodland is dominated by western sycamore. Associated species in the sycamore woodland include Oregon ash, spicebush (*Calycanthus occidentalis*), and white alder. This vegetation community is designated as a special-status natural community by CDFW.

Willow Scrub Willow scrub is characterized by a dense assemblage of willow shrubs and is often found within the active floodplain of the river. Sites with willow scrub are subject to more frequent scouring flows than sites supporting riparian forests. Willow scrub often occupies stable sand and gravel point bars immediately above the active channel. Dominant shrubs in willow scrub include narrow-leafed willow, arroyo willow, and red willow. Occasional emergent Fremont cottonwood may also be present in willow scrub.

Riparian Scrub Areas characterized as riparian scrub support woody shrubs and herbaceous species and are dominated by different species depending on river reach. Some areas are dominated by mugwort (*Artemisia douglasiana*), stinging nettle, and various tall weedy herbs; others are dominated either by blackberry (usually the introduced Himalayan blackberry) or by wild rose in dense thickets, with or without scattered small emergent willows. Riparian scrub may be maintained by periodic disturbance, such as flood control clearing of woody vegetation. The riparian scrub vegetation community dominated by willow and mugwort is designated as a special-status natural community by CDFW.

Elderberry Savanna Elderberry savanna is a shrub-dominated vegetation community characterized by widely spaced blue elderberry shrubs (*Sambucus nigra* ssp. *caerulea*) with a herbaceous understory typically dominated by nonnative grasses and forbs that are characteristic of the annual grassland vegetation community. Elderberry savanna is found on fine-textured, rich alluvium outside active channels but in areas that are subject to periodic flooding (Holland 1986). This vegetation community is designated as a special-status natural community by CDFW. Elderberry shrubs also provide suitable habitat for the valley elderberry longhorn beetle, a species Federally listed as threatened, although it has been proposed for delisting (see Chapter 7, “Biological Resources – Wildlife”).

Buttonbush Scrub The buttonbush scrub community is characterized by a riparian shrub layer dominated by California buttonbush. Other riparian shrubs, such as Himalayan blackberry and spicebush, may also be present in this community. This vegetation community is designated as a special-status natural community by CDFW.

Fig Riparian/Fig-Willow Riparian Some intermittent and perennial drainages have heavy infestations of edible fig (*Ficus*

carica), which have displaced the natural riparian vegetation. These stands were mapped as fig riparian (pure fig stands) or fig-willow riparian (figs mixed with willow species).

Spanish Broom Scrub Riparian scrub areas infested by Spanish broom (*Spartium junceum*) and Scotch broom (*Cytisus scoparius*) were mapped as Spanish broom scrub. Spanish and Scotch broom are invasive species that displace native species and tend to form dense single-species stands. These species are native to the Mediterranean region of Europe and were introduced to California as ornamental species. They are common in disturbed places, such as riverbanks and road cuts, but can colonize undisturbed grasslands, shrublands, and open canopy woodlands.

Giant Reed This vegetation community is characterized by dense stands of the invasive grass species giant reed (*Arundo donax*). These stands are up to 13 feet tall and consist solely of giant reed with no other plant species present. This vegetation community represents an infestation of an invasive species.

Herbaceous Wetland Communities

Emergent Wetlands Emergent wetlands within the extended study area typically occur in the river bottom immediately adjacent to the low-flow channel. Sites such as backwaters and sloughs where water is present through much of the year support emergent marsh vegetation, including common tule (*Schoenoplectus acutus* var. *occidentalis*) and cattails (*Typha* spp.). Wetlands that are more ephemeral, especially those occurring along the margins of the river and in swales adjacent to the river, support an array of native and nonnative herbaceous species, including western goldenrod (*Euthamia occidentalis*), smartweed (*Persicaria* spp.), Mexican rush (*Juncus mexicanus*), horseweed, willow herb (*Epilobium* spp.), saltgrass (*Distichlis spicata*), sunflower (*Helianthus* spp.), and nonnative curly dock (*Rumex crispus*). Emergent wetlands are considered sensitive habitats because they may be regulated under Section 404 of the CWA or under the Porter-Cologne Act.

Seasonal Wetlands Vegetation communities at Millerton Lake below the OHWM, as defined by USACE, were mapped as one of three cover types: lacustrine unconsolidated bottom, lacustrine unconsolidated shoreline, or seasonal wetland. The lacustrine vegetation communities are described under the Aquatic Communities section, below. Seasonal wetlands are considered sensitive habitats because they may be regulated

under Section 404 of the CWA or under the State's Porter-Cologne Act.

The seasonal wetland community consists of three cover types that are periodically inundated to varying degrees depending on the timing and duration of inundation in Millerton Lake. The highest elevation type is dominated by Santa Barbara sedge and creeping wild rye. These two species grow together or separately in dense stands near the top of the inundation zone only in the vicinity of Big Sandy Creek.

The second seasonal wetland type is dominated by bog yellowcress (*Rorippa palustris*) and cocklebur (*Xanthium strumarium*). This seasonal wetland type occurs on low-relief shoreline areas with varying timing and duration of inundation. The low-relief areas are natural basins associated with tributary channels, former floodplain, and lower hillslope or shoreline positions. Bog yellowcress germinates in the lowest relief mudflats from fall through early spring following receding seasonal high reservoir levels. The plants achieve peak growth in late spring and complete seed production before inundation by rising reservoir levels. Bog yellowcress does not extend as far up the shoreline slope as cocklebur. Associated species for bog yellowcress-dominated seasonal wetlands include many of the early-season annual species listed below in the description of the mixed herbaceous seasonal wetland.

Cocklebur seed germinates following receding high reservoir levels in midsummer to late summer. Plant growth peaks and seed production is completed in fall. The upper elevation extent of cocklebur on the shoreline was observed to be directly related to the maximum Millerton Lake inundation level in 2007 (Reclamation 2008). Late-season associated species include green carpetweed (*Mollugo verticillata*), common purslane (*Portulaca oleracea*), Bermuda grass (*Cynodon dactylon*), and, in some locations, bog yellowcress as seedlings and resprouting plants that survived from the previous spring.

The third seasonal wetland type is a mixed herbaceous community that supports a diverse mixture of upland and hydrophytic plant species that make up 10 percent or more of the cover. Seep monkeyflower (*Mimulus guttatus*), little quakinggrass (*Briza minor*), rabbitsfoot grass (*Polypogon monspeliensis*), small fescue (*Festuca microstachys*), smooth cat's ear (*Hypochaeris glabra*), silver hairgrass (*Aira caryophyllea*), clammy clover (*Trifolium obtusiflorum*), tomcat clover (*Trifolium willdenovii*), soft chess, miniature lupine,

hairy brome (*Bromus japonicus*), and red maids (*Calandrinia ciliata*) are among the more common of many annual species observed along the exposed shoreline of Millerton Lake. This mixed herb composition forms the dominant cover early in the growing season but largely disappears, leaving the perennial species, Bermuda grass, as the only dominant species remaining on these sites later in summer. Associated species of this late-season assemblage include horseweed, green carpetweed, small fescue, soft chess, ripgut brome, prickly lettuce (*Lactuca serriola*), and tomcat clover.

Vernal Pool Vernal pools are ephemeral wetlands that fill with precipitation during winter and spring months. A restrictive hardpan prevents water from percolating into deeper soil horizons. Vernal pools can be densely or sparsely vegetated depending on location, land use, and other geophysical and ecological variables. Hydrophytic species, including Great Valley button celery (*Eryngium castrense*), stalked popcornflower (*Plagiobothrys stipitatus* var. *micranthus*), marsh spikerush (*Eleocharis macrostachya*), and rabbitsfoot grass, are typically present in vernal pool wetlands in the primary study area. Vernal pools are considered sensitive habitats because they are regulated under Section 404 of the CWA or under the Porter-Cologne Act and are identified as special-status natural communities by CDFW.

Vernal pool wetlands may also provide habitat for a variety of special-status plant and wildlife species, many of which are Federally listed (see discussions of special-status plant and wildlife species below and in Chapter 7, “Biological Resources – Wildlife”).

Alkali Sink Alkali sinks are shallow, seasonally flooded areas or playas that are dominated by salt-tolerant plants. Soils in alkali playas are typically fine- textured with an impermeable caliche layer or clay pan. Salt encrustations typically form on the surface as the playa dries. Alkali sinks support valley sink scrub, which is a low-growing open-to-dense succulent shrubland vegetation community dominated by alkali-tolerant members of the goosefoot family, especially iodine bush (*Allenrolfea occidentalis*) and seablites (*Suaeda* spp.). A herbaceous understory usually is lacking, but a sparse cover of annual grasses, such as the nonnatives Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*) and red brome (*Bromus madritensis* ssp. *rubens*), may be present. Alkali sinks flood seasonally after local thunderstorms, but they may not flood every year. This vegetation community is considered a special-

status natural community by CDFW and may be regulated under Section 404 of the CWA or the Porter-Cologne Act.

Freshwater Seep Freshwater seeps are inundated or saturated areas characterized by dense cover of herbaceous wetland plants, especially sedges and perennial forbs. Dominant species vary relative to the magnitude and timing of seepage flows. Freshwater seeps are found in the primary study area where the most common species assemblage is white hedge nettle (*Stachys albens*), watercress (*Nasturtium officinale*), water smartweed (*Persicaria punctata*), clustered dock (*Rumex conglomeratus*), tall flatsedge (*Cyperus eragrostis*), and seep monkeyflower. Freshwater seeps are considered sensitive habitats because they may be regulated under Section 404 of the CWA or under the Porter-Cologne Act.

Aquatic Communities

Lacustrine Water levels in Millerton Lake fluctuate seasonally in response to direct inflows and releases from Friant Dam. The open water portion of Millerton Lake is mapped as lacustrine unconsolidated bottom. The seasonally exposed inundation area of Millerton Lake below the full pool elevation was mapped as lacustrine unconsolidated shoreline. Lacustrine unconsolidated shoreline represents shoreline sections observed to support less than 10 percent plant cover; these areas are frequently steep, subject to erosion, and excessively well-drained. They often are too rocky to support significant plant cover. These habitats are considered sensitive because they are regulated under Section 404 of the CWA.

Riverine Riverine is also an aquatic community that includes the free-flowing portion of the San Joaquin River both upstream from the limits of Millerton Lake and downstream from Friant Dam that maintains flowing river channel characteristics. These habitats are considered sensitive because they are regulated under Section 404 of the CWA.

Riverwash Riverwash consists of alluvial sands and gravel associated with the active channel of perennial streams such as the San Joaquin River. Generally, riverwash areas exist as sand and gravel point bars within the floodplain of the river. Woody and herbaceous plant cover can be low, although controlled hydrologic releases from Friant Dam that prevent scour can allow denser plant growth on some point bars between high-flow releases. Numerous herbaceous species occur in riverwash areas; however, most of these plant species are relatively common. The nonnative plants rattail fescue,

Bermuda grass, and red-stemmed filaree, and the native plants tall willow herb (*Epilobium brachycarpum*) and lupine species (*Lupinus* spp.) are typically the most abundant plant species on riverwash. These habitats are considered sensitive because they are generally regulated under Section 404 of the CWA.

Other Waters Other waters apply to drainage features in the primary study area that convey flowing water. Other waters in the primary study area consist of ephemeral, intermittent, and perennial streams. Some of these drainage features include small instream pools where the topography flattens and the channel is wider and deeper. One ephemeral drainage includes two natural ponds formed in natural granitic basins within the channel. Other waters are considered sensitive because they may be regulated under Section 404 of the CWA or the Porter-Cologne Act.

Other Habitats

Nonnative Tree These are areas where the dominant vegetative cover consists of tree species that are not native to California and are considered invasive by the California Invasive Plant Council (Cal-IPC). Tree species in this category include blue gum (*Eucalyptus globulus*), tree-of-heaven (*Ailanthus altissima*), and red sesbania (*Sesbania punicea*).

Agriculture Agricultural lands consist primarily of annual crops, orchards, and vineyards. Annual crops include field crops, such as cotton, sweet corn, and safflower; truck, nursery, and berry crops, such as lettuce, bell peppers, strawberries, melons, and tomatoes; and rice. Orchards consist of citrus and subtropical crops, including lemons, nectarines, olives, and oranges, and deciduous fruit and nut crops, including almonds, apples, peaches, pistachios, plums, and walnuts. Vineyards produce raisin, table, and wine grapes.

Disturbed Areas Disturbed areas include existing roads, canals, levees, and aggregate pits. Also included are areas used by off-highway vehicles and sites where rubble or fill has been deposited. Active and former aggregate mines are included if they are dry or unvegetated. As with agricultural communities, these areas have low vegetative cover and species diversity.

Developed Areas Developed areas within the primary study area are limited to areas of development, including low-density residential housing and recreational facilities. Low-density housing in a rural environment typically includes patches of surrounding woodland. Developed areas in the extended study

area also include urban development. Urban areas are areas of moderate- to high-density development and impervious surfaces. These areas have low vegetative cover and species diversity and are dominated by horticultural plantings, lawns, landscaping, and weed species.

Barren Areas Barren areas were mapped in the primary study area and consist of areas of exposed bedrock, escarpments, and vertical rock faces that do not support vegetative cover.

Primary Study Area

Area of Project Features Vegetation communities located within the dam site, haul roads, borrow areas, and transmission line alignments are depicted in Figure 6-1, and their acreage is presented in Table 6-3.

Table 6-3. Vegetation Communities in the Area of Project Features Within the Primary Study Area

Vegetation Community/Habitat	Area (acres) of Habitat Within Area of Project Features[1]
Woodland Communities	
Foothill Pine Oak Woodland	1,215
Blue Oak Woodland	298
Live Oak Woodland	6
Subtotal	1,519
Upland Shrub Communities	
Bush Lupine Scrub	5
Subtotal	5
Herbaceous Communities	
Annual Grassland	165
Subtotal	165
Riparian Communities	
Mixed Riparian Forest	9
Subtotal	9
Herbaceous Wetland Communities	
Seasonal Wetlands	1
Swale	1
Vernal Pool[2]	6
Subtotal	8
Aquatic Communities	
Lacustrine Unconsolidated Shoreline[3]	6
Other Waters[4]	2
Subtotal	8
Total	1,714

Table 6-3. Vegetation Communities in the Area of Project Features Within the Primary Study Area (contd.)

Source: Reclamation 2007

Notes:

[1] Acres have been rounded to the nearest whole number except where less than 0.5 acre, which is shown as <1.

[2] Acreage of vernal pool likely overestimated because detailed analysis for this area is scheduled after release of this report. Area mapped as vernal pool grassland within transmission route.

[3] Lacustrine Unconsolidated Shoreline is below the OHWM of Millerton Lake.

[4] Other waters are composed of 0.59 acre of intermittent drainage and 1.04 acre of ephemeral drainage, and 0.15 acre of natural instream ponds.

Temperance Flat Reservoir Area Vegetation communities within the Temperance Flat Reservoir Area are depicted in Figure 6-1, and their acreages are presented in Table 6-4.

Table 6-4. Vegetation Communities in the Temperance Flat Reservoir Area

Vegetation Community/Habitat	Area (acres) of Habitat Within Temperance Flat Reservoir Area[1]
Woodland Communities	
Foothill Pine Oak Woodland	3,802
Blue Oak Woodland	1,088
Live Oak Woodland	51
Foothill Pine Woodland	9
Foothill Pine Chaparral Woodland	5
Subtotal	4,955
Upland Shrub Communities	
Buckbrush Chaparral	25
Bush Lupine Scrub	4
Subtotal	29
Herbaceous Communities	
Annual Grassland	152
Subtotal	152
Riparian Communities	
White Alder Riparian	25
Mixed Riparian Forest	3
Sycamore Riparian Woodland	<1
Willow Riparian Forest	2
Fig Riparian/Fig-Willow Riparian	3
Spanish Broom Scrub	<1
Subtotal	33
Herbaceous Wetland Communities	
Seasonal Wetlands	264
Swale	0
Vernal Pool	0
Freshwater Seep	1
Subtotal	265

Table 6-4. Vegetation Communities in the Temperance Flat Reservoir Area (contd.)

Vegetation Community/Habitat	Area (acres) of Habitat Within Temperance Flat Reservoir Area[1]
Aquatic Communities	
Lacustrine Unconsolidated Bottom	425
Lacustrine Unconsolidated Shoreline[2]	282
Other Waters[3]	23
Riverine	200
Subtotal	930
Other Habitats	
Barren Areas	31
Developed Areas	6
Subtotal	37
Total	**6,401**

Notes:
[1] Acres have been rounded to the nearest whole number except where less than 0.5 acre, which is shown as <1.
[2] Lacustrine Unconsolidated Shoreline is below the OHWM of Millerton Lake.
[3] Other waters are composed of 8.07 acres of ephemeral drainage, 15.25 acres of intermittent drainage, and 0.02 acre of perennial drainage.

Millerton Lake Below RM 274 Vegetation communities within Millerton Lake downstream from RM 274 are restricted to lacustrine aquatic habitats and seasonal wetland and riparian communities growing below the maximum inundation level of Millerton Lake. Acreages of Lacustrine Unconsolidated Bottom, Lacustrine Unconsolidated Shoreline, and vegetation growing below the high water level are presented in Table 6-5 and depicted in Figure 6-1.

Table 6-5. Vegetation Communities in the Millerton Lake Area Downstream from RM 274

Vegetation Community	Area (acres) of Habitat[1]
Aquatic Communities	
Lacustrine Unconsolidated Bottom	2,425
Lacustrine Unconsolidated Shoreline	1,469
Seasonal Wetland	3
Mixed Riparian	<1
Willow Woodland	3
Total	**3,900**

Note:
[1] Acres have been rounded to the nearest whole number
Key:
RM = River Mile

Extended Study Area

San Joaquin River from Friant Dam Downstream to Merced River Sections describing the biological resources within the specific reaches of this portion of the extended study area are based on McBain & Trush (2002), DWR (2002), and Reclamation (1998a, 1998b). In these prior analyses, study areas were used that encompassed 1,000 feet from the edge of levees (e.g., the upper portion of Reach 1 and most of Reaches 3 and 4) or the extent of riparian vegetation (e.g., portions of Reaches 1 and 2) if those features were present. When no levee, escarpment, or clear, discrete outer boundary of riparian vegetation was present but riparian vegetation extended more or less continuously from the mainstem to adjacent sloughs or side channels, the boundary was set at 2,000 feet from the centerline of the main channel of the San Joaquin River (e.g., portions of Reach 5) (McBain & Trush 2002, DWR 2002).

Because the extended study area varies somewhat from this definition, land cover in some areas of the San Joaquin River from Friant Dam to Merced River portion of the extended study area was not mapped in the previous studies. Descriptions of reach-specific vegetation communities are based on the above-listed studies for the San Joaquin River Restoration Area and the CNDDB.

Vegetation communities found in the San Joaquin River from Friant Dam to Merced River portion of the extended study area, including the bypass system, were mapped by DWR in 2002 and 2011 (DWR 2002, 2011) using a modified Holland classification system (Holland 1986). Table 6-6 provides acreages for the vegetation communities and habitats in the various reaches and bypass systems of this portion of the extended study area.

San Joaquin River from Merced River to the Delta
Sections describing the biological resources within the specific reaches of this portion of the extended study area are based on the SJRRP PEIS/R (SJRRP 2012). The San Joaquin River downstream from the Merced River confluence is similar to the river upstream from the confluence. The upstream portion of the reach below the Merced River is more incised than the downstream area, with generally drier conditions in the riparian zone and a less developed understory.

Table 6-6. Vegetation Communities and Habitats in the San Joaquin River from Friant Dam to Merced River Portion of the Extended Study Area

Vegetation Community/ Habitat	Reaches (acres)									Bypasses (acres)
	Reach 1A	Reach 1B	Reach 2A	Reach 2B	Reach 3	Reach 4A	Reach 4B1	Reach 4B2	Reach 5	
Cottonwood Riparian Forest	138	193	61	48	410	16	12	16	28	0
Willow Riparian Forest	194	119	43	111	94	78	242	404	743	0
Mixed Riparian Forest	359	274	2	0	0	6	0	0	1	20
Valley Oak Riparian Forest	207	<1	1	0	0	48	16	8	35	78
Willow Scrub	263	144	200	50	220	0	100	31	80	0
Riparian Scrub	25	46	193	63	46	60	55	3	71	0
Elderberry Savanna	2	0	3	63	0	0	0	0	0	0
Giant Reed	3	4	6	0	<1	0	0	0	<1	0
Grassland and Pasture	156	66	281	88	71	194	200	768	2,320	4,828
Emergent Wetlands	90	5	11	59	3	39	79	47	185	539
Alkali Sink	0	0	0	0	0	0	0	0	2	0
Riverine	659	219	327	279	299	110	139	96	434	670
Riverwash[1]	30	47	170	4	20	67	3	<1	6	0
Nonnative Tree	49	20	1	0	0	0	0	0	12	0
Agriculture	7	<1	33	74	271	28	0	0	310	11
Disturbed Areas	113	0	51	39	65	51	31	48	57	0
Developed Areas	1	0	0	0	1	0	0	0	0	0
No Data[2]	5	<1	6	346	101	0	7	0	587	0
Total[3]	2,300	1,140	1,387	1,223	1,601	696	883	1,421	4,871	6,146

Source: DWR 2002, DWR 2011

Notes:

[1] Riverwash partially depends on flow at the time of the survey/photograph, and values should not be presumed to be precise.

[2] No data exist for areas within the extended study area that were not mapped by DWR (2002).

[3] Columns do not all sum exactly to total acreage because of round-off error. Acres have been rounded to the nearest whole number except where less than 0.5 acre, which is shown as <1.

Agricultural land use has encroached on the riparian habitat along most of the river. Along much of the river, only a narrow ribbon of riparian habitat is supported. However, riparian habitat is more extensive locally, especially near the confluence with tributary rivers, within cutoff oxbows, and in the 6,500-acre San Joaquin River NWR between the confluences with the Tuolumne and Stanislaus Rivers. Remnant common tule- and cattail-dominated marshes may occur in these areas.

Habitats found in the San Joaquin River from the Merced River to the Delta were identified using the California Fire and Resource Assessment Program (FRAP) (CAL FIRE 2005). The FRAP provides a single information source for habitat types that encompasses the entire extended study area. However, because of the methodology used, FRAP mapping does not capture all community types present or the full extent of each type. FRAP is a compilation of the best available land cover data as of 2005 (CAL FIRE 2005). The land cover data, provided as a 100-meter grid, were compiled into the CWHR classification system. The CWHR system does not include categories for plant communities associated with vernal pools and seasonal wetlands and has only two categories for riparian communities (montane riparian and valley and foothill riparian). Seasonal wetlands are ephemeral and not easily identified without on-the-ground investigations and are therefore not typically included in regional-scale land cover data. Because project impacts on botanical and wetland resources in the San Joaquin River beyond the Merced River confluence are expected to be negligible to none, detailed habitat descriptions for this area are not provided in this chapter, but Table 6-7 summarizes the habitats in this portion of the extended study area.

Delta The Delta is divided into numerous islands by hundreds of miles of waterways. Historically, the Delta had extensive areas of wetlands. Nearly all of the Delta's wetlands have been reclaimed for agricultural and other land uses. However, some small islands remain in a quasi-natural state. (These quasi-natural islands include "flooded islands" that were once reclaimed land but that were abandoned after levee failures.) The portion of the Delta under consideration within the extended study area is limited to open waterways because the impacts of the upstream project would be limited to the conveyance of water that would be contained within the bed, bank, and channels of the existing waterways within the Delta.

Table 6-7. Habitats Mapped in the San Joaquin River from Merced River to the Delta and Delta Portions of the Extended Study Area

Habitat and Description	San Joaquin River from Merced River to the Delta	Delta
Riparian and Open-Water Habitats		
Valley Foothill Riparian:[1] A wide variety of forest, woodland, and scrub communities dominated by broadleaved, deciduous trees and shrubs. The climax valley foothill riparian type is a dense, multilayered forest with a tree canopy dominated by any combination of cottonwood, sycamore, and valley oak; a subcanopy of shorter, shade-tolerant tree species such as box elder and Oregon ash; and an understory of shrubs such as willow, wild rose, and buttonbush.	Yes	Yes
Open Water[1] Aquatic habitats that include both riverine and lacustrine communities. Riverine communities are in sloped stream channels with intermittent or continually flowing water. Lacustrine habitats are in inland depressions or dammed river channels containing standing water. Submerged aquatic vegetation may be sparse to dense in shallower depths (generally less than 10 feet).	Yes	Yes
Perennial Wetland Habitats		
Freshwater Emergent Wetland[1] Dense, tall herbaceous community dominated by perennial hydrophytic plant species (plants that grow in water or saturated soil), typically monocots up to 7 feet tall. Occurs throughout the Sacramento and San Joaquin Valleys and foothills in permanently flooded or saturated soils in depressions or at the edges of streams, rivers, ponds, and lakes. Distinct vegetation zones often form, as rings, strips, or patches, in response to varying water depths and hydroperiods.	Yes	Yes
Saline Emergent Wetland[1] Dense herbaceous community dominated by perennial hydrophytic species adapted to saline or brackish conditions. Found in the Delta–Suisun Marsh within the intertidal zone or on lands that historically were subject to tidal exchange (i.e., diked wetlands). This type category includes both saltwater and brackish marshes.	No	Yes
Other Sensitive Habitats		
Seasonal Wetlands[1] Herbaceous wetlands that are subject to inundation during the winter months; these features generally occur in topographically low areas. Seasonal wetlands are generally dominated by hydrophytes during the winter and spring months. The vegetation of these features may transition to species that are characteristic of surrounding nonwetland habitat as the drying down process occurs. Evidence of hydrology including algal matting, flow patterns, or presence of decedent hydrophytes, is usually evident in the dry season upon close inspection.	Yes	Yes
Alkali Seasonal Wetlands[1] Herbaceous communities on alkaline soils that remain inundated or saturated for prolonged periods during the growing season; these seasonal wetlands are in a surrounding matrix of grassland. At low elevations, found at seasonal drainages, historical lake beds, and basin rims.	No	Yes

Source: CAL FIRE 2005

Notes:

Acreages are not provided. The lateral extent of the San Joaquin River to Delta and Delta portions of the extended study area is limited to the top of existing channels because water releases from Friant Dam would not exceed existing channel capacity. Because the project is not expected to affect aquatic botanical resources within the San Joaquin River from the confluence with the Merced River to the Delta and the Delta portions of the extended study area, these resources are not discussed in detail.

[1] Sensitive habitat.

Because project impacts on botanical and wetland resources in the Delta are expected to be negligible to none, detailed habitat descriptions for this area are not provided in this chapter but are summarized in Table 6-7.

CVP and SWP Water Service Areas The project is not expected to affect terrestrial botanical resources within the CVP and SWP SOD service areas; therefore, these resources are not discussed in detail.

The CVP and SWP SOD service areas cover a vast area spread across portions of 10 biogeographic regions: the northern, central, and southern coast; the central Coast Ranges; the southern mountains and valleys; the Central Valley; the Sierra Nevada and foothills; and the Mojave and Sonoran Deserts. These areas range in elevation from sea level to more than 10,000 feet and vary from very wet coastal areas receiving up to 60 inches of annual rainfall to the dry deserts where annual precipitation is 3 to 6 inches. The high-mountain areas can receive up to 50 inches of precipitation a year, mostly in the form of snow. The coastal areas experience a cool climate with a long growing season, whereas the high-mountain areas have a cold climate and a short growing season. The deserts have a hot climate and a long growing season. Therefore, this portion of the Study Area has even greater topographic, climatic, edaphic, and geologic variation than the Sacramento and San Joaquin Valleys and foothills and the Sacramento and San Joaquin Valley watersheds; even greater diversity of habitat types (Table 6-8); and structure and species compositions that vary widely.

Table 6-8. Habitats Mapped in the CVP and SWP South-of-Delta Service Areas

Habitat	Acreage[1]
Riparian Habitats	
Valley Foothill Riparian[2]	41,200
Desert Riparian[2]	7,400
Montane Riparian[2]	37,600
Palm Oasis[2]	100
Perennial Wetland Habitats	
Freshwater Emergent Wetland[2]	24,900
Saline Emergent Wetland[2]	32,000
Wet Meadow	4,800
Grassland Habitats	
Annual Grassland	3,978,600
Perennial Grassland[2]	34,500

Table 6-8. Habitats Mapped in the CVP and SWP South-of-Delta Service Areas (contd.)

Habitat	Acreage[1]
Anthropogenic (Human-Made) Habitats	
Agriculture	4,050,800
Pasture	1,400
Urban	3,321,600
Barren	178,200
Chaparral and Scrub Habitats	
Bitterbrush Scrub	3,000
Sagebrush Scrub	122,000
Chamise Chaparral	468,800
Coastal Scrub	1,109,000
Desert Succulent Shrub	80,400
Desert Wash[2]	51,000
Desert Scrub	4,171,800
Mixed Chaparral	1,644,000
Montane Chaparral	37,700
Alkali Desert Scrub	750,700
Woodland and Hardwood Forest Habitats	
Blue Oak Woodland[2]	576,200
Blue Oak-Foothill Pine Woodland[2]	244,400
Coastal Oak Woodland[2]	654,000
Juniper	96,900
Pinyon-Juniper	396,400
Montane Hardwood	281,700
Montane Hardwood-Conifer	88,000
Valley Oak Woodland[2]	89,100
Joshua Tree[2]	39,800
Coniferous Forest Habitats	
Sierran Mixed Conifer Forest	87,000
Closed-Cone Pine-Cypress[2]	6,000
Eastside Pine[2]	500
Redwood	14,500
Subalpine Conifer	100
Jeffrey Pine	118,200
Lodgepole Pine	<100
White Fir	1,000
Red Fir	600
Douglas Fir Forest	7,800
Ponderosa Pine Forest	15,900

Source: CAL FIRE 2005

Notes:

[1] Acreages are rounded to the nearest 100 acres.

[2] Sensitive habitat.

Key:

CVP = Central Valley Project

SWP = State Water Project

The CVP and SWP water service areas contain a large diversity of both lowland and upland habitats and species, although agricultural and urban growth has reduced the area and

connectivity of important habitats that are critical to sustaining a wide variety of unique plants and animals. The agricultural land and urban development that dominate the CVP and SWP water service areas, respectively, are dominated by nonnative and ornamental plant species.

Special-Status Plants

Special-status plants are defined as plants that are legally protected or that are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. Special-status plant taxa are species, subspecies, or varieties that fall into one or more of the following categories, regardless of their legal or protection status:

- Officially listed by California or the Federal government as endangered, threatened, or rare
- A candidate for State or Federal listing as endangered or threatened
- Taxa that meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the State CEQA Guidelines
- Taxa designated as a special-status, sensitive, or declining species by other State or Federal agencies or nongovernmental organizations (including species classified as sensitive by BLM)
- Taxa considered by CDFW to be "rare, threatened, or endangered in California" and assigned a California Rare Plant Rank (CRPR). The CDFW system uses the following five rarity and endangerment ranks to categorize plant species of concern:
    - **CRPR 1A** – Plants presumed extinct in California
    - **CRPR 1B** – Plants rare, threatened, or endangered in California and elsewhere
    - **CRPR 2A** – Plants presumed to be extinct in California
    - **CRPR 2B** – Plants rare, threatened, or endangered in California but more common elsewhere
    - **CRPR 3** – Plants about which more information is needed—a review list

- **CRPR 4** – Plants of limited distribution—a watch list

All plants with a CRPR are considered "special plants" by CDFW. The term "special plants" is a broad term used by CDFW to refer to all of the plant taxa inventoried in the CNDDB, regardless of their legal or protection status. Plants ranked as CRPR 1A, 1B, 2A, or 2B may qualify as endangered, rare, or threatened species within the definition of State CEQA Guidelines Section 15380. CDFW recommends, and local governments may require, that CRPR 1 and 2 species be addressed in CEQA documents. Species ranked as CRPR 1B meet the definitions of Sections 2062 and 2067 of the California Fish and Game Code and are eligible for State listing. In general, CRPR 3 and 4 species do not meet the definition of endangered, rare, or threatened under State CEQA Guidelines Section 15380; however, these species may be evaluated by the lead agency on a case-by-case basis to determine significance criteria under CEQA.

The following sources were reviewed to support compilation of information on special-status plant species:

- *Inventory of Rare and Endangered Plants of California* (CNPS 2001, 2010)
- CNDDB (2013b, 2013c)
- Special Vascular Plants, Bryophytes, and Lichens List (CNDDB 2013a)
- USFWS's Federal endangered and threatened species list (USFWS 2012)
- SJRRP PEIS/R (SJRRP 2012)
- *Temperance Flat Alternatives Botanical Resources Baseline Report* (Reclamation 2007)

Primary Study Area

Area of Project Features Most of the area of project features within the primary study area was surveyed in 2007 and 2010 for rare plants. Rare plant surveys have not been conducted within the new and relocated transmission line corridors, construction staging area 2, the Wellbarn Road haul route outside of the Temperance Flat Reservoir Area, the Road 216 haul route, and portions of the relocated trails. Figure 6-2

shows the areas that have been surveyed at a protocol level for special-status plants and areas that have not.

Temperance Flat Reservoir Area The *Temperance Flat Reservoir Alternatives Botanical Resources Baseline Report* (Reclamation 2007) describes focused plant studies and rare plant surveys that were conducted from February through July 2007 for the investigation within the area inundated by the Temperance Flat RM 274 Reservoir and the buffer area. A supplemental focused survey was conducted in April 2010 to survey haul routes, potential quarry sites, other project features, and areas associated with dam construction outside of the Temperance Flat Reservoir Area. Table 6-9 provides information on special-status plants that are known to occur or have the potential to occur within the primary study area. Figure 6-3 shows the locations of CNDDB special-status plant occurrence records within 1 mile of the primary study area.

Millerton Lake Below RM 274 This portion of the primary study area is limited to the elevation below the high-water inundation line, corresponding to approximately 580 feet above msl. The habitats present within this portion of the primary study area are limited to lacustrine unconsolidated shoreline and lacustrine unconsolidated bottom. The sandy granitic soils associated with the lacustrine unconsolidated shoreline provide marginal suitable habitat for two special-status plant species: slender-flowered monkeyflower (*Mimulus gracilipes*) and Farnsworth's jewelflower (*Streptanthus farnsworthianus*). Farnsworth's jewelflower was documented below the high-water mark of Millerton Lake in 2007. The CNDDB was searched to obtain additional information on documented rare plants within this portion of the primary study area (Figure 6-3). No occurrences of rare plants were identified below the high-water mark of Millerton Lake (CNDDB 2013b).

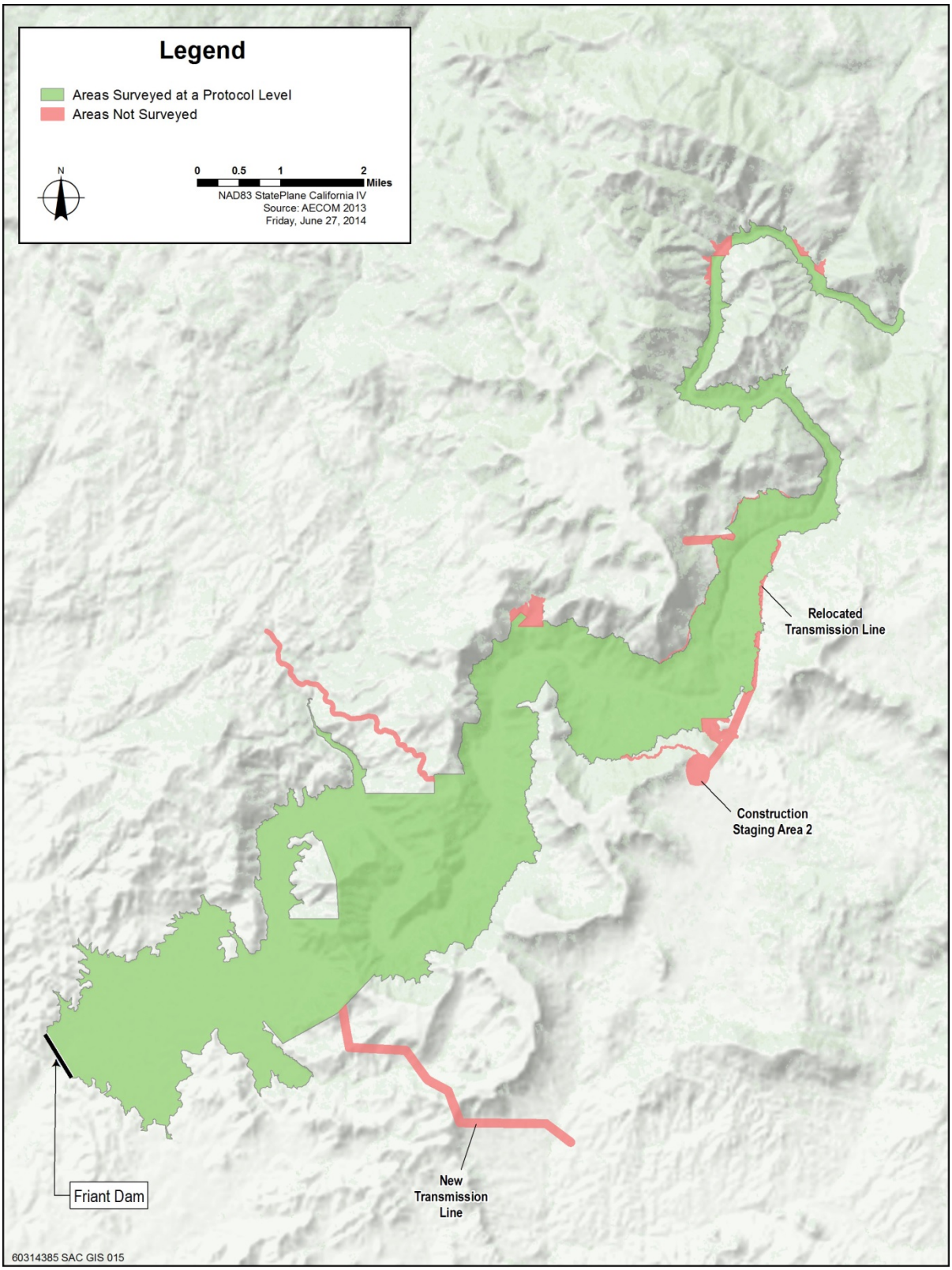


Figure 6-2. Areas Surveyed at a Protocol Level and Areas Not Surveyed (Mapped and Evaluated from Aerial Imagery)

Table 6-9. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Mariposa pussypaws *Calyptridium pulchellum*	T	—	CRPR 1B.1	Known from bare sandy, gravelly granitic substrates at elevations between 1,300 to 4,000 feet in chaparral and woodland Flowering: April to August	Unlikely • Known to occur at higher elevations near but outside the Study Area • Suitable habitat is limited in the primary study area • Species was not documented during 2007 and 2010 surveys
Tree anemone *Carpenteria californica*	—	T	CRPR 1B.2	Species generally occurs at elevations between 1,500 to 3,000 feet; occurs on granitic soils in chaparral or forests with shrub layer Flowering: May to July	Present • One known occurrence in primary study area and two occurrences very near inundation line at higher elevations • Known occurrence was relocated during 2007 surveys
Succulent owl's clover *Castilleja campestris* ssp. *succulenta*	T	E	CRPR 1B.2	Known from northern basalt flow vernal pools on table tops in the region and northern hardpan vernal pools downstream from Friant Dam Flowering: April to May	Possible • Documented on top of tables above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in the Temperance Flat Reservoir Area, but suitable habitat is present within the transmission line corridor • Neither the species nor its habitat was documented during 2007 and 2010 surveys, but the survey area did not include the transmission line corridor
Ewan's larkspur *Delphinium hansenii* ssp. *ewanianum*	—	—	CRPR 4.2	Rocky soils, bluffs, often acidic soils associated with woodland and grassland at elevations ranging from 200 to 2,000 feet. Flowering: March to May	Present • Abundant potential habitat in the Study Area • Increasing discoveries of this taxon in the Sierra Nevada foothills • Species was documented in the Study Area during 2007 surveys
Dwarf downingia *Downingia pusilla*	—	—	CRPR 2B.2	Northern basalt flow vernal pools on top of tables tops in the region and northern hardpan vernal pools downstream from Friant Dam Flowering: March to May	Possible • Documented on top of tables above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in the Temperance Flat Reservoir Area, but suitable habitat is present within the transmission line corridor • Species was not documented during 2007 and 2010 surveys, but the survey area did not include the transmission line corridor

Table 6-9. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Spiny-sepaled button-celery *Eryngium spinosepalum*	—	—	CRPR 1B.2	Vernal pools, wet swales below 1,000 feet, Tulare County to San Joaquin County Flowering: April to May	Possible • Documented on top of tables above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in the Temperance Flat Reservoir Area, but suitable habitat is present within the transmission line corridor • Species was not documented during 2007 and 2010 surveys, but the survey area did not include the transmission line corridor
Boggs Lake hedge-hyssop *Gratiola heterosepala*	—	E	CRPR 1B.2	Found in shallow water margins of vernal pools, also margins of small lakes and ponds, wet meadows Flowering: April to August	Unlikely • Not known in Study Area but occurs in nearby vernal pools on top of tables • Vernal pools not recorded in Study Area, but possible for species to occur in the transmission line corridor • Neither the species nor its habitat was documented during 2007 and 2010 surveys, but the survey area did not include the transmission line corridor
Madera leptosiphon *Leptosiphon serrulatus*	—	—	CRPR 1B.2 BLM Sensitive	Cismontane woodland, lower montane coniferous forest Flowering: April to May	Present • Previously documented occurrence in the Study Area was not relocated during 2007 surveys, but two new occurrences were found in the Study Area, and another occurrence has been documented near the inundation line in the vicinity of Kerckhoff Dam
Congdon's lewisia *Lewisia congdonii*	—	R	CRPR 1B.3	Occurs in mesic rocky/outcrop habitats in chaparral, woodland, and coniferous forest at elevations between 1,500 and 8,400 feet Flowering: April to June	Unlikely • Many potential habitats in the Study Area, but species was not found during 2007 surveys, and Study Area is below typical elevation range • Occurs in Merced River and Kings River canyons to north and south, respectively
Orange lupine *Lupinus citrinus* var. *citrinus*	—	—	CRPR 1B.2 BLM Sensitive	Often occurs on decomposed granite in chaparral, cismontane woodland, or lower montane coniferous forest Flowering: April to June	Unlikely • Known to occur at higher elevations near but outside the Study Area • A limited amount of suitable habitat occurs in Study Area, but this species was not found during 2007 and 2010 surveys

Table 6-9. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Slender-stalked monkeyflower *Mimulus gracilipes*	—	—	CRPR 1B.2	Decomposed granite, disturbed sites often following fire in chaparral, woodland, and coniferous forest at elevations between 1,500 and 3,900 feet Flowering: April to July	Possible • Known to occur in the vicinity of the Study Area • Loose, bare granitic sands provide at least marginal habitat in the Study Area, but this species was not found during surveys. However, 2007 was a poor year for this species due to below-average precipitation, which could have resulted in false negative survey results
Small-flowered monkeyflower *Mimulus inconspicuus* (includes *M. acutidens* and *M. grayi*)	—	—	CRPR 4.3	Mesic sites in chaparral, cismontane woodland, lower montane coniferous forest above 1,300 feet elevation Flowering: May to June	Present • Twelve occurrences were documented in the Study Area during 2007 surveys • One occurrence documented in 2010 near the Temperance Flat RM 274 Dam site
San Joaquin Orcutt grass *Orcuttia inaequalis*	T	E	CRPR 1B.1	Known from northern basalt flow vernal pools on table tops in the region and northern hardpan vernal pools downstream from Friant Dam Flowering: April to September	Possible • Documented on top of tables above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in the Temperance Flat Reservoir Area, but potentially suitable habitat is present in the transmission line corridor • Neither the species nor its habitat was found during 2007 and 2010 surveys, but the survey area did not include the transmission line corridor
Michael's piperia *Piperia michaelii*	—	—	CRPR 4.2	Coastal bluff scrub, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub, lower montane coniferous forest between 10 and 3,000 feet in elevation Flowering: April to August	Present • Two occurrences of this species were documented in the Study Area during 2007 surveys
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E	E	CRPR 1B.1	Species is limited to grasslands and open woodlands on fine- to medium-textured sandy loam soils; typically on north to northeast-facing mima mounds Flowering: March to April	Possible • Suitable soils do not occur in the Temperance Flat Reservoir Area, but potentially suitable habitat is present in the transmission line corridor • This species was not found during surveys conducted in 2007 and 2010, but the survey area did not include the transmission line corridor

Table 6-9. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Sanford's arrowhead *Sagittaria sanfordii*	—	—	CRPR 1B.2 BLM Sensitive	Shallow freshwater marshes habitats on margins of small lakes and ponds, sluggish waters of sloughs, creeks, rivers, canals, and ditches between 0 and 2,000 feet in elevation Flowering: May to October	Unlikely • Streams in the area support periodic high velocity flows making them unsuitable for this species. No suitable habitat was observed in stock ponds • This species was not found during surveys conducted in 2007 and 2010
Farnsworth's jewelflower *Streptanthus farnsworthianus*	—	—	CRPR 4.3	Cismontane woodland at elevations between 1,300 and 4,600 feet in elevation Flowering: May to June	Present • Three occurrences of this species were found in the Study Area during 2007 surveys
Oval-leaved viburnum *Viburnum ellipticum*	—	—	CRPR 2B.3	Chaparral, cismontane woodland, and lower montane coniferous forest Flowering: May to June	Possible • Known to occur in vicinity of the Study Area • Reported on Squaw Leap Trail uphill from the primary Study Area • Suitable habitat occurs in Study Area, but this species was not found during surveys
Hall's wyethia *Wyethia elata*	—	—	CRPR 4.3	Cismontane woodland and lower montane coniferous forest between 1,500 to 4,600 feet in elevation Flowering: May to August	Present • Four occurrences of this species were found in the Study Area during 2007 surveys at 800-1,500 feet in elevation, which is below the elevation range report in the literature for this species.

Key:
BLM = U.S. Bureau of Land Management
CRPR = California Rare Plant Rank

Status:
[1] Federal Status:
E = Endangered
T = Threatened

[2] State Status:
E = Endangered
T = Threatened
R = Rare

[3] Other Status:
CDFW California Rare Plant Ranks (CRPR):
CRPR 1B: Rare, threatened, or endangered in California and elsewhere
CRPR 2B: Rare, threatened, or endangered in California, but more common elsewhere
CRPR 4.: Limited distribution (Watch List)
CRPR Extensions:
.1: Seriously endangered in California (>80 percent of occurrences are threatened and/or high degree and immediacy of threat)
.2: Fairly endangered in California (20–80 percent of occurrences are threatened)
.3: Not very endangered in California (<20 percent of occurrences are threatened or no current threats are known)
BLM Sensitive = BLM Sensitive Species

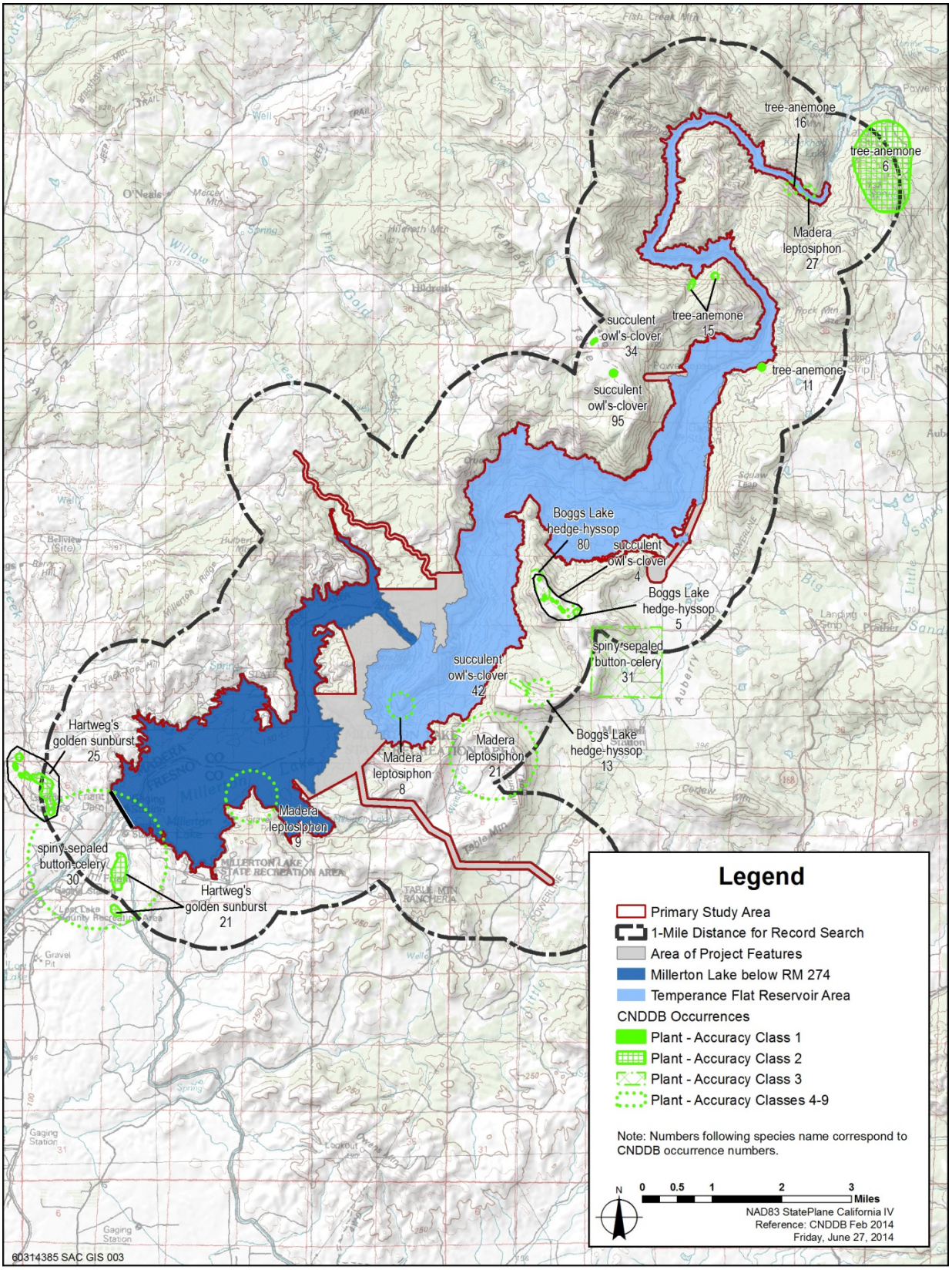


Figure 6-3. CNDDB Plant Occurrences in Vicinity of Primary Study Area

Results by Species

Tree Anemone (Carpenteria californica) One occurrence of tree anemone consisting of five mature shrubs and one young shrub was found in the primary study area within the BLM San Joaquin River Gorge during spring 2007 surveys. These six shrubs are contained within a 1,500-square-foot area on the left bank (Fresno County side) of the San Joaquin River, on a northeast-facing slope 1.14 miles northwest of Kerckhoff Dam at RM 291.25 (Figure 6-4). This occurrence corresponds to CNDDB occurrence number 16.

Two other tree anemone occurrences have been documented just outside the primary study area: one at the 1,148-foot elevation located approximately 0.3 mile east-southeast of RM 285 on the Fresno County side and another consisting of two polygons in close proximity at an elevation of 1,400 feet and located approximately 1.5 miles north of Kerckhoff Powerhouse on the Madera County side. A third occurrence has been documented within 1 mile of the primary study area upstream from Kerckhoff Reservoir and south of the river on both sides of Powerhouse Road.

Madera Leptosiphon (Leptosiphon serrulatus) Two occurrences of Madera leptosiphon were mapped in the primary study area during the 2007 surveys (Figure 6-4). One occurrence is approximately 0.5 mile upslope to the northwest of RM 277 at 990 feet and occupies an approximately 500-square-foot area. The other occurrence is approximately 1 mile northeast of the Kerckhoff Powerhouse upslope of RM 285 at an elevation of approximately 900 feet and occupies an approximately 3,000-square-foot area. These represent two separate occurrences because they are more than 0.25 mile apart. The two occurrences consisted of approximately 500 and 5,000 individuals, respectively.

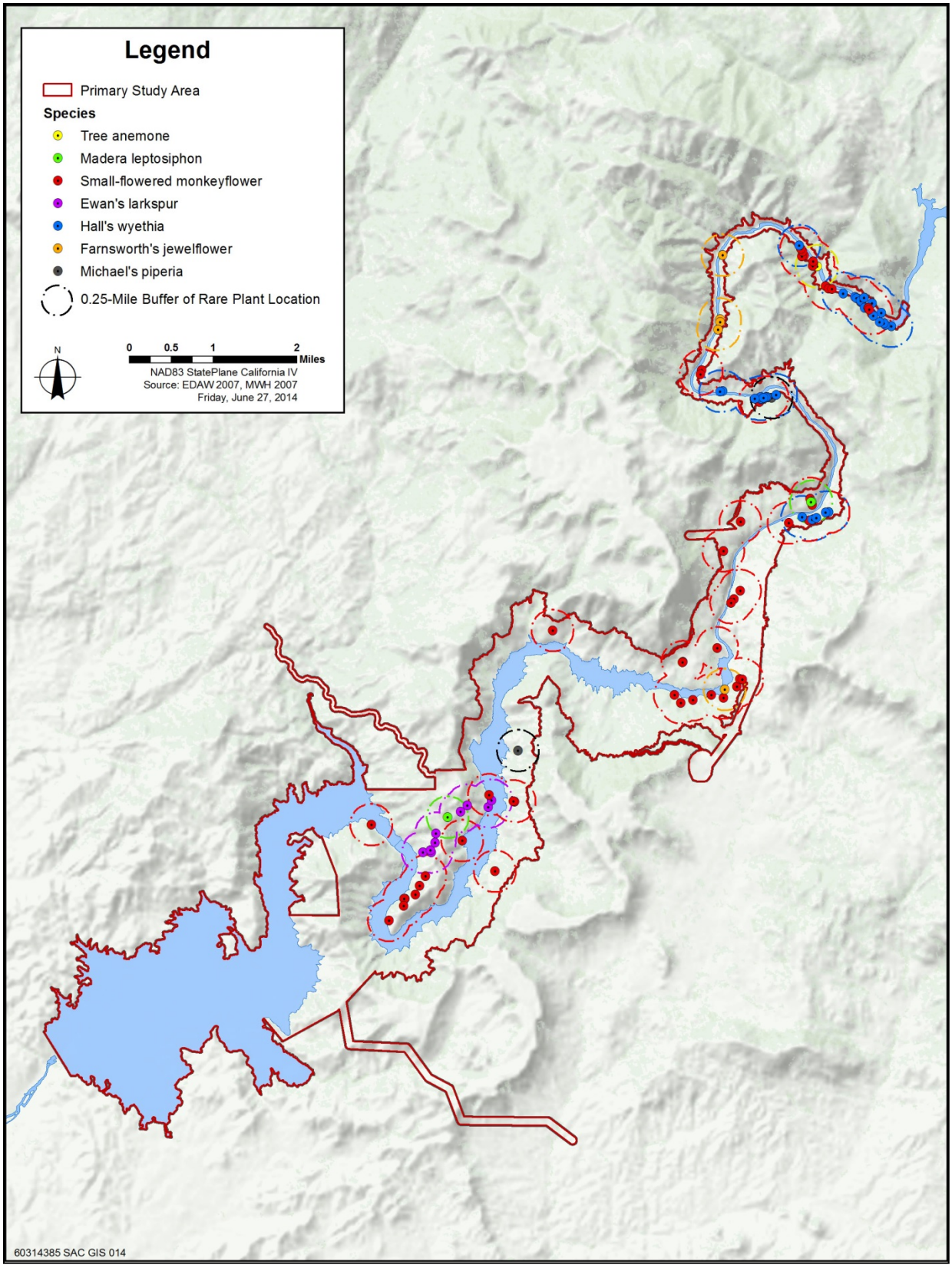


Figure 6-4. Special-Status Plant Occurrences in the Primary Study Area

It should be noted that population sizes of annual plant species are cyclical and fluctuate greatly from year to year because of environmental variation. Therefore, these occurrences could be much larger or much smaller in any given year depending on a variety of factors, including precipitation amount and timing, temperature, and grazing intensity and timing. Precipitation was below average for the winter preceding the spring 2007 surveys, making it a relatively poor year for annual wildflowers in general. Therefore, it is possible that Madera leptosiphon would be more abundant in the primary study area in a more favorable year. Reference populations of Madera leptosiphon were visited in 2007 before surveys and were observed to support similar population numbers as previously reported and were flowering vigorously.

The CNDDB contains a historical record of Madera leptosiphon that was reportedly found in the lower portion of Millerton Lake, upslope and north of RM 275.5 on the Madera County side of the lake. The area where this occurrence was reported was thoroughly searched during the 2007 surveys and Madera leptosiphon was not found. There are three additional records of Madera leptosiphon within 1 mile of the primary study area: one on big Table Mountain, which is isolated from the proposed Temperance Flat Reservoir Area and other project features; one on the south shore of Millerton Lake along an existing trail; and one record near Kerckhoff Dam on the Madera side of the San Joaquin River. The Kerckhoff Dam occurrence may fall partially within the Temperance Flat Reservoir Area, but the location information for this occurrence is not exact (accurate within one-tenth of a mile). The occurrence record is from a 2005 observation, but was not included in the CNDDB when the database was searched in 2007. This occurrence was also not observed within the Temperance Flat Reservoir Area during the 2007 surveys.

Ewan's Larkspur (Delphinium hansenii var. *ewanianum)*
Nine distinct locations of Ewan's larkspur, each containing between one and five individuals, were mapped on the Madera County side of the lower portion of Millerton Lake during the 2007 surveys. These locations are within 0.25 mile of each other, so they are considered a single occurrence. All of these plants were found growing in rocky outcrops in blue oak woodland or foothill pine oak woodland habitat.

Michael's Piperia (Piperia michaelii) Two occurrences of Michael's piperia, each consisting of a single individual, were found in the primary study area during the spring 2007 surveys.

One occurrence is located immediately south of RM 275 on the Madera County side of the river, along the Study Area boundary at approximately the 1,000-foot elevation level. The other occurrence was mapped east of RM 278.33 on the Fresno County side of the river, approximately 0.25 mile above the current high-water mark of Millerton Lake at the 700-foot elevation level. Both were found in foothill pine oak woodland habitat.

Farnsworth's Jewelflower Farnsworth's jewelflower was mapped at six locations classified as three distinct occurrences within the primary study area. All of the plants were found in open rocky sites along the San Joaquin River between Kerckhoff Dam and the Millerton Lake area, with the exception of a single plant that was found in the upper portion of Millerton Lake downstream from Kerckhoff No. 2 Powerhouse in a cocklebur-dominated community below the Millerton Lake high-water mark. The other five colonies contained between 100 and 1,000 individuals each. Below-average precipitation made 2007 a relatively poor year for annual wildflowers, but Farnsworth's jewelflower could be more abundant in the Study Area in a more favorable year.

Hall's Wyethia (*Wyethia elata*) Four occurrences of Hall's wyethia, containing a total of 31 clumps of plants, were identified in the primary study area along the San Joaquin River between Kerckhoff Dam and Millerton Lake. All of the occurrences were found in areas between 800 and 1,100 feet in elevation in somewhat open foothill pine oak woodland habitat.

Small-Flowered Monkeyflower (*Mimulus inconspicuus*) Small-flowered monkeyflower is widespread throughout the primary study area. Fifty-three clumps of small-flowered monkeyflower were mapped in 12 occurrences within the Study Area during the spring 2007 surveys (Figure 6-4). One additional population was identified during the spring 2010 surveys near the southwest side of the proposed Temperance Flat RM 274 Dam. This species could be even more abundant in the primary study area in years with normal precipitation. Small-flowered monkeyflower is endemic and rare in California, but it is locally abundant.

Extended Study Area

San Joaquin River from Friant Dam to Merced River

Sections describing the biological resources within the specific reaches of this portion of the extended study area are based on the prior analysis of biological resources in these reaches

prepared in McBain & Trush (2002), DWR (2002 and 2011), Reclamation (1998a and 1998b), and SJRRP (2012). In these analyses, study areas were used that encompassed 1,000 feet from the edge of levees (e.g., the upper portion of Reach 1 and most of Reaches 3 and 4) or extent of riparian vegetation (e.g., portions of Reaches 1 and 2) if those features were present. When no levee, escarpment, or clear, discrete outer boundary of riparian vegetation was present, but riparian vegetation extended more or less continuously from the mainstem to adjacent sloughs or side channels, the boundary was set at 2,000 feet from the centerline of the main channel of the San Joaquin River (e.g., portions of Reach 5) (McBain & Trush 2002; DWR 2002, 2011; and SJRRP2012).

Because the extended study area varies somewhat from this definition, land cover in some portions of the extended study area was not mapped in the previous studies. Descriptions of reach-specific physical conditions, plant communities, and sensitive resources by reach are based on the SJRRP PEIS/R (SJRRP 2012), and the CNDDB (2013c).

Reach 1A Special-status plant species have been documented high above the alluvial plain of the river corridor in Reach 1A, just outside the extended study area. No special-status plant species have previously been documented in Reach 1A (CNDDB 2013c).

Reach 1B No special-status plant species have previously been documented in Reach 1B (CNDDB 2013c). This is likely largely because of the minimal amount of remnant native habitats along this stretch of the river.

Reach 2A One occurrence of heartscale (*Atriplex cordulata*) has previously been documented in the grasslands on the terraces above the alluvial plain, which is outside the identified extended study area in this reach. Heartscale is associated with grassland habitats. Elderberry shrubs have been documented along the river within this reach of the extended study area (DWR 2002).

Reach 2B In the marshy backwater area of the Mendota Pool that extends into Reach 2B, there is a 1948 record of Sanford's arrowhead (*Sagittaria sanfordii*) (CNDDB 2013c). One other special-status plant species has been documented at Mendota Wildlife Area, outside the extended study area: Lost Hills crownscale (*Atriplex vallicola*) (CNDDB 2013c).

Reach 3 Lesser saltscale (*Atriplex minuscula*) and Munz' tidy-tips (*Layia munzii*), both associated with alkaline scrub and grassland habitats, have previously been documented on the higher terraces above the alluvial plain and just outside the extended study area along this reach (CNDDB 2013c). Palmate-bracted bird's beak (*Chloropyron palmatum*), a species that is Federally and State listed as endangered, is known to occur in the vicinity of the extended study area near Reach 3. This species grows in saline-alkaline soils in alkaline scrub and alkali meadow communities (USFWS 1998). This species primarily occurs along drainage channels (USFWS 1998).

Reach 4 The San Luis NWR and Grasslands Wildlife Management Area (WMA) in Reach 4B support marsh and emergent wetland, native grassland, alkali sink, riparian forest, and vernal pool vegetation communities; the Grasslands WMA supports the largest remaining block of contiguous wetlands in the Central Valley. Numerous documented occurrences of special-status plant species affiliated with these habitats have been documented throughout Reach 4B2; however, only one special-status plant, Delta button-celery (*Eryngium racemosum*), has previously been documented in Reach 4B1. Critical habitat for Hoover's spurge (*Chamaesyce hooveri*) and Colusa grass (*Neostapfia colusana*) has been designated within and adjacent to Reach 4B2 of the extended study area. No special-status plant species have been documented in the vicinity of the extended study area near Reach 4A.

Reach 5 Just north of its confluence with Bear Creek, Reach 5 of the San Joaquin River flows through Great Valley Grasslands State Park and then traverses the San Luis NWR. The State Park and San Luis NWR support the following vegetation communities: marsh and emergent wetlands, alkali sacaton (*Sporobolus airoides*) grasslands, alkali sinks, riparian forest, and vernal pools. Delta button-celery has previously been documented within Reach 5 (CNDDB 2013c). The State Park and NWR support occurrences of rare and endangered species, although these are not documented in this reach of the extended study area itself. These species include alkali milk-vetch (*Astragalus tener* var. *tener*), brittlescale (*Atriplex depressa*), heartscale, Hispid bird's-beak (*Cordylanthus mollis* ssp. *hispidus*), lesser saltscale, prostrate navarretia (*Navarretia prostrata*), vernal pool smallscale (*Atriplex persistens*), and Wright's trichocoronis (*Trichocoronis wrightii*).

Bypasses There are several documented occurrences of special-status species at the Eastside Bypass intersection with the Grasslands WMA, San Luis NWR, and Merced NWR. Marsh and perched wetlands, sand dunes, riparian forests, native grasslands, and vernal pools in these areas provide habitat for special-status plant species, including Delta button-celery, Wright's trichocoronis, and subtle orache (*Atriplex subtilis*). The Merced NWR also supports habitat for Colusa grass. Other special-status species, including brittlescale, heartscale, Sanford's arrowhead, and vernal pool smallscale, are documented in the vicinity but outside the extended study area. Critical habitat for Hoover's spurge and Colusa grass has been designated within and adjacent to the extended study area along the Eastside Bypass.

Palmate-bracted bird's beak is known to occur in the vicinity of the extended study area near Reach 3 and the Chowchilla Bypass.

The Mariposa Bypass supports several occurrences of Delta button-celery. Critical habitat for Hoover's spurge and Colusa grass has been designated within and adjacent to the extended study area along the Mariposa Bypass.

San Joaquin River from Merced River to the Delta
Special-status plant species in the San Joaquin River downstream from the confluence with the Merced River to the Delta include species that occur in the river floodplains, such as Delta button-celery, a State-listed endangered species, and marsh plants, such as Sanford's arrowhead, a CRPR List 1B species.

Delta Many special-status species are known or are likely to occur in the Delta because of the presence of unique wetland habitats. Tidal marshes, wet banks, and instream emergent wetlands support several special-status plant species, including rose mallow (*Hibiscus lasiocarpus*) (CRPR List 2), bristly sedge (*Carex comosa*) (CRPR List 2), slough thistle (*Cirsium crassicaule*) (CRPR List 1B), and Sanford's arrowhead (CRPR List1B). Riparian scrub provides habitat for Delta button-celery (State listed as endangered, CRPR List 1B), and riparian woodland provides habitat for fox sedge (*Carex vulpinoidea*) (CRPR List 2).

CVP and SWP Water Service Areas The CVP and SWP water service areas are subject to heavy anthropogenic influence and modification. As such, many native plant species

have been displaced by nonnative species or plants of horticultural or agricultural value. The potential for special-status plant species is generally considered low in areas subject to substantial human modification. However, Sanford's arrowhead, a CRPR List 1B species, is known to occur in drainages and canals and could be present within the water distribution systems within the CVP and SWP water service areas, particularly in areas that lack regular routine maintenance.

Waters of the United States, Including Wetlands, in Millerton Lake, the San Joaquin River, and Vicinity

Primary Study Area

A wetland delineation of the primary study area was performed in 2007 and supplemented in 2010 to determine the extent of waters of the United States within the primary study area.

Table 6-10 summarizes the findings of the respective wetland delineations. Also shown in Table 6-10 is the lacustrine habitat of Millerton Lake downstream from RM 274, which is part of the primary study area. Millerton Lake, which was formed by damming the San Joaquin River, a Traditional Navigable Water (TNW) of the United States, is subject to USACE jurisdiction under Section 404 of the CWA. A wetland delineation has not been conducted for the new or relocated transmission line corridors and therefore any wetlands present within these areas are not reflected in Table 6-10. Wetlands and waters of the United States within the primary study area are depicted in Figure 6-5.

Extended Study Area

A wetland delineation is under preparation for the San Joaquin River from Friant Dam to the Merced River portion of the extended study area; acreage of jurisdictional waters in this area is not yet available.

The San Joaquin River from Friant Dam to the confluence with the Merced River would be considered a navigable water and thus a jurisdictional feature subject to USACE regulation pursuant to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. The river channel likely contains other wetland habitats, including riparian habitats as described above.

Table 6-10. Acreages of Waters and Wetlands within the Primary Study Area

	Acres
Traditionally navigable waters	
Lacustrine (Millerton Lake)	4,607
Wetland habitats below OHWM of Millerton Lake	
Seasonal Wetlands[1]	71
Nonwetland habitats below OHWM of Millerton Lake	
Willow Riparian	3
Seasonal Wetlands (non-criteria)[2]	196
Riverine (San Joaquin River)	200
Riparian habitat below OHWM of San Joaquin River	
White Alder Riparian Woodland	25
Spanish Broom Scrub	<1
Relatively permanent waters (RPW)	
Perennial drainage	<1
Intermittent drainage	16
Wetlands abutting/adjacent to relatively permanent waters and nonrelatively permanent waters	
Swale	1
Freshwater seep	1
Nonrelatively permanent waters	
Ephemeral drainage	9
Total	5,129

Sources: Reclamation 2007, 2010

Notes:

California Wildlife Habitat Relationships (CWHR) nomenclature (Airola 1988; Mayer and Laudenslayer 1988) and the Cowardin classification system (Cowardin et al. 1979) were used for unvegetated cover types, such as lacustrine and riverine areas that could not be classified using Holland's terrestrial natural communities. Additional nomenclature, such as traditional navigable waters and relatively permanent waters, are from the *U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook* (USACE 2007).

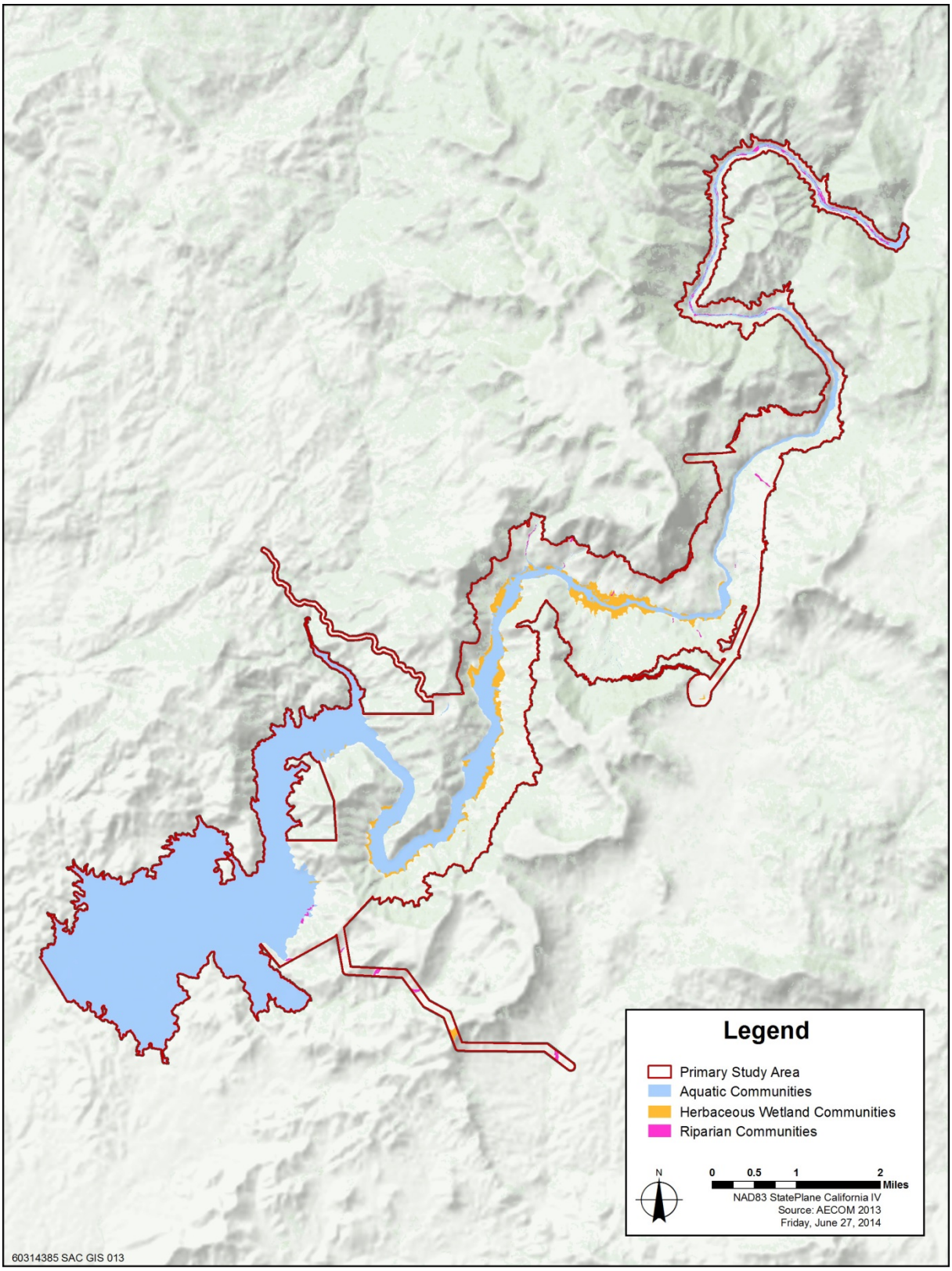
Acres are rounded to the nearest whole number.

[1] This acreage consists of 70 acres of bog yellowcress-cocklebur wetland and 1.4 acres of wet meadow. Both of these met the three criteria to qualify as wetlands under the CWA.

[2] This represents mixed herbaceous seasonal wetlands along the shoreline of Millerton Lake that did not meet the three criteria to qualify as wetlands under the CWA. These areas are considered waters of the United States, however, because they are within the OHWM of a Traditionally Navigable Water.

Key:

OHWM = ordinary high-water mark



Note: A wetland delineation has not been conducted for the transmission line corridors; wetlands identified in this portion of the primary study area are based on habitat types only.

Figure 6-5. Wetland Location Map for the Primary Study Area

The introduction of interim flows has resulted in surface water flows in several dry portions of the channel and has also contributed to near-river groundwater.

Sensitive aquatic habitats, including waters of the United States and wetland habitats present within the San Joaquin to Delta and the Delta portions of the extended study area, are present as shown in Table 6-7. Aquatic habitats found in the CVP and SWP water service areas, all of which are considered sensitive habitats and some of which may be waters of the United States, are listed in Table 6-8.

Invasive Plant Species

Invasive plants are species that are not native to the region, persist without human assistance, and have serious impacts on the native environment (Davis and Thompson 2000). The term "invasive plant" differs from the classification terms "nonnative," "exotic," or "introduced plant" because it is (when applied correctly) used only to describe those nonnative plant species that displace native species on a large enough scale to alter habitat functions and values. The Cal-IPC maintains a list of species that have been designated as invasive in California. The term "noxious weed" is used by government agencies for nonnative plants that have been defined as pests by law or regulation (CDFA 2009). Many invasive noxious trees and shrubs that have the ability to occupy channel and floodplain surfaces are a constant threat to river floodway capacity, and substantial cost and resources are required to remove and control large stands. Unlike the native riparian flora, many invasive riparian species do not attract populations of invertebrate life or produce edible seeds and fruit that support the food web for fish and aquatic and terrestrial wildlife.

Primary Study Area

Botanical surveys were conducted in the Temperance Flat Reservoir Area from February through July 2007. Within this area, stands of edible fig and Himalayan blackberry have been identified along intermittent and perennial drainages. Additionally, Spanish broom scrub habitat has been mapped in the primary study area. These vegetation communities are comprised of invasive species that typically occur in riparian habitats. Tocalote is an herbaceous invasive species typical of woodland and grassland vegetation communities, and localized infestations are present throughout the primary study area. Prevalent species and their associated Cal-IPC category and

California Department of Food and Agriculture (CDFA) rating are identified in Table 6-11.

Table 6-11. Prevalent Invasive Species in the Primary Study Area

Species	California Invasive Plant Council Inventory Category[1]	California Department of Food and Agriculture Rating[2]
Terrestrial Riparian Species		
Edible fig (*Ficus carica*)	Moderate	—
Scotch broom (*Cytisus scoparius*)	High	C
Spanish broom (*Sparticum junceum*)	High	C
Himalayan blackberry (*Rubus armeniacus*)	High	—
Terrestrial Woodland and Grassland Species		
Tocalote (*Centaurea melitensis*)	Moderate	—

Sources: California Invasive Plant Council 2006, CDFA 2009

Notes: Only plants with a Cal-IPC rating of Moderate, High, or Red Alert, or noxious weeds with a CDFA rating were included for consideration.

[1] California Invasive Plant Council Inventory Categories:

High – Have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Ecological amplitude and distribution is widespread.

Moderate – Have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal, but establishment generally depends on ecological disturbance. Ecological amplitude and distribution range from limited to widespread.

[2] California Department of Food and Agriculture Rating:

C – State-endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner.

Key:
— = Not applicable
Cal-IPC = California Invasive Plant Council.

Extended Study Area

San Joaquin River from Friant Dam to Merced River

Prevalent riparian and aquatic species and their associated Cal-IPC category and CDFA rating are identified in Table 6-12. Invasive species known to occur within this portion of the extended study area include salt cedar (*Tamarix* sp.), red sesbania, giant reed, pampas grass (*Cortaderia* sp.), and Himalayan blackberry (DWR 2002).

Table 6-12. Prevalent Invasive Species in the Extended Study Area

Species	California Invasive Plant Council Inventory Category[1]	California Department of Food and Agriculture Rating[2]
Terrestrial Riparian Species		
Pampas grass (*Cortaderia jubata*)	High	—
Red sesbania (*Sesbania punicea*)	High, Red Alert	B
Salt cedar (*Tamarix* spp.)	High	B
Giant reed (*Arundo donax*)	High	B
Chinese tallow (*Sapium sebiferum*)	Moderate	—
Tree-of-heaven (*Ailanthus altissima*)	Moderate	C
Blue gum (*Eucalyptus globulus*)	Moderate	—
Perennial pepperweed (*Lepidium latifolium*)	High	B
Aquatic Species		
Water hyacinth (*Eichornia crassipes*)	High	C
Water primrose (*Ludwigia hexapetala*)	High	—
Water milfoil (*Myriophyllum spicatum*)	High	C
Parrot's feather (*Myriophyllum aquaticum*)	High, Red Alert	—
Curly-leaf pondweed (*Potamogeton crispus*)	Moderate	—
Sponge plant (*Limnobium spongia*)	—	Q

Sources: California Invasive Plant Council 2006, CDFA 2009, SJRRP 2012

Notes: Only plants with a Cal-IPC rating of Moderate, High, or Red Alert, or noxious weeds with a CDFA rating, were included for consideration.

[1] California Invasive Plant Council Inventory Categories:

High – Have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – Have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal, but establishment generally depends on ecological disturbance. Ecological amplitude and distribution range from limited to widespread.

Limited – Invasive but ecological impacts are minor on a Statewide level, or not enough information was available to justify higher rating. Reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are limited, but these species may be locally persistent and problematic.

Red Alert – plants with the potential to spread explosively; infestations currently small and localized.

[2] California Department of Food and Agriculture Rating:

B – Eradication, containment, control or other holding action at the discretion of the commissioner.

Table 6-12. Prevalent Invasive Species in the Extended Study Area (contd.)

C – State-endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner.

Q – Temporary rating for eradication, containment, rejection, or other holding action at the State-county level, outside of nurseries pending determination of a permanent rating.

Key:
— = Not applicable
Cal-IPC = California Invasive Plant Council

Additional invasive plants that are potentially present include emergent and submergent aquatic plants, including sponge plant (*Limnobium spongia*), water hyacinth (*Eichornia crassipes*), curly leaf pond weed (*Potamogeton crispus*), parrot feather (*Myriophyllum aquaticum*), water milfoil (*Myriophyllum spicatum*), and water primrose (*Ludwigia hexapetala*).

Giant reed is widespread and mapped in all reaches except Reach 4 (SJRRP 2012). Himalayan blackberry is also frequently encountered, especially in riparian scrub communities, where it is observed over long channelized portions of the river. Red sesbania is a relatively recent introduction to the San Joaquin River, but it is spreading aggressively. It occurs extensively through Reaches 1A and upper Reach 1B, but as of 2008, it was more sparsely distributed in lower Reach 1B and Reach 2A (SJRRP 2012).

Invasive species information collected in 2008 was also included in the baseline description here because invasive species such as red sesbania can rapidly colonize a river corridor and substantially change vegetation composition identified during surveys conducted in 2000. The recent and rapid spread of red sesbania is of particular concern because it has successfully colonized both disturbed bar soil and substrate (banks of aggregate mining pits, sand and gravel bars, other exposed surfaces), as well as encroached into the occupied understory of existing dense riparian vegetation and formed monocultures along the low-flow shoreline.

Also, based on recent information from stakeholders, water hyacinth is present in Reaches 2, 3, and 4, and a small population of Chinese tallow (*Sapium sebiferum*) is present in Reach 1 (SJRRP 2012). In 2008, Chinese tallow was also observed in Reach 3 (SJRRP 2012). Perennial pepperweed (*Lepidium latifolium*), a herbaceous invasive not mapped by DWR in 2000, was documented in four occurrences in Fresno Slough and was widely distributed and abundant in patches in

Reach 5 and adjoining Salt and Mud Sloughs within the extended study area in 2008 (SJRRP 2012). Low-flow channels choked with a mix of floating and submerged aquatic weeds severely decrease flow capacity, lower dissolved oxygen (due to higher biochemical oxygen demand), and benefit habitat for nonnative fish species (e.g., centrarchids) that prey on native juvenile fish. Dense surface mats of aquatic weeds also cause greater adult mosquito production and diminish the effectiveness of biological mosquito control measures (e.g., bacterial toxin dispersal, mosquitofish).

Invasive species are likely to spread throughout this portion of the extended study area due to increased flows in the San Joaquin River and Bypass system resulting from implementation of the interim flow schedule. Seeds of native and invasive species are transported by the river and deposited at downstream locations, where germination occurs if conditions are favorable. As the water surface elevation of the San Joaquin River increases due to the interim flow schedule, seeds of invasive species growing along the active channel are transported downstream and onto the active floodplain, and are then reconnected to the San Joaquin River by the interim flows. Invasive species associated with riparian and riverine habitats, are adapted to aquatic transport and long distance seed dispersal.

San Joaquin River from Merced River to the Delta
Invasive plant species identified in Table 6-12 are anticipated to be present within the San Joaquin River from the Merced River to the Delta portion of the extended study area.

Delta Invasive plant species identified in Table 6-12 are anticipated to be present within the Delta portion of the extended study area.

CVP and SWP Water Service Areas Invasive plant species identified in Table 6-12 are anticipated to be present throughout the CVP and SWP water service areas.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on botanical resources and wetlands. It then discusses the impacts of the alternatives

and proposes mitigation where appropriate. The potential impacts on botanical resources and wetlands and associated mitigation measures are summarized in Table 6-13.

Methods and Assumptions

This analysis is based on information obtained from the CNDDB and California Native Plant Society databases; biological resource conditions as documented in biological resources studies conducted in 2007, 2008, and 2010, as discussed in the Affected Environment section; and additional documents describing historical and potential conditions for biological resources in the primary and extended study areas. A list of the main documents reviewed in support of preparing this analysis is presented in the Affected Environment section of this chapter (the complete list is provided in Chapter 30, “References”).

This analysis assumes that existing habitat and botanical resources located between 580 and 985 feet above msl within the Temperance Flat Reservoir Area would be eliminated either as a result of inundation or from vegetation removal before inundation. It is further assumed that existing habitat and botanical resources within the footprints of the project features located higher than the 985-foot full pool elevation would be removed or converted to other habitat types as a result of construction activities. The area encompassing all of the quarry, batch plant, and haul road options was included in the impact calculations for project features even though only one quarry site, supporting dam batch plant, and connecting haul road would ultimately be constructed under the action alternatives. This approach overestimates the area that would experience habitat removal or conversion, and provides a conservative analysis of the potential impacts of the action alternatives.

As discussed in Chapter 2, “Alternatives,” the environmental commitments for the project include revegetation of temporary construction areas. Because the action alternatives would have the same physical footprint and affected area, impacts on botanical and wetland resources would be the same for each of the action alternatives.

Table 6-13. Summary of Impacts and Mitigation Measures for Botanical and Wetland Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-1: Relocate Special-Status Plant Populations	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
BOT-2: Loss of Riparian Habitat and Other Sensitive Communities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-2: Compensate for Loss of Specific Habitats	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 6-13. Summary of Impacts and Mitigation Measures for Botanical and Wetland Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-3: Loss or Degradation of Waters of the United States, Including Wetlands, and Waters of the State	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-3: Ensure No Net Loss of Wetlands	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
BOT-4: Introduction and Spread of Invasive Plants	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	BOT-4: Implement a Weed Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 6-13. Summary of Impacts and Mitigation Measures for Botanical and Wetland Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-5: Elimination of a Plant Community or Substantial Reduction in the Number or Restriction of the Range of an Endangered, Rare, or Threatened Plant Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	BOT-6: Implement Mitigation Measures BOT-1, BOT-2, and BOT-3	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 6-13. Summary of Impacts and Mitigation Measures for Botanical and Wetland Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
BOT-7: Conflict with Provisions of an Adopted Habitat Conservation Plan Protecting Wetland or Botanical Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 4	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
PS = potentially significant
S = significant
SU = significant and unavoidable

Each action alternative would deliver some portion of the new water supply to the Friant Division via the Friant-Kern Canal and Madera Canals. Alternative Plans 2, 3, 4 and 5 would also deliver new supply to other CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. Alternative Plans 1, 2, and 4 would also deliver new supply to SWP SOD M&I contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. Alternative 3 would also deliver new supply to SWP SOD M&I contractors via existing cross-valley conveyance and the California Aqueduct.

The conveyance of water supplies via the San Joaquin River through exchange at Mendota Pool would not exceed channel capacity of the San Joaquin River, bypass systems, or Delta waterways. The delivery of this additional water, when combined with other existing CVP and SWP supplies, would not exceed the historical maximum CVP and SWP water deliveries, exceed existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment.

Construction of Temperance Flat RM 274 Reservoir would create incidental flood storage space, reducing the volume of winter and spring releases to the San Joaquin River that would be required to maintain the conservation space for rain flood and conditional space for forecasted snowmelt inflows by the Friant Dam and Millerton Lake Flood Control Manual. The largest reduction in releases is simulated to occur in February when releases from Friant Dam are reduced by a long-term average of 46 percent under the action alternatives. Under the action alternatives, some of the additional water supply captured in the Temperance Flat RM 274 Reservoir is released to the San Joaquin River. Because agricultural demand is highest in the summer months, this results in a long-term average increase in releases from Friant Dam during the month of August. For example, long-term average simulated flows in Reach 2B in August increase by 135 percent compared to the No Action Alternative.

Changes in stream flow volumes would remain within typical historical volumes and within the range of flows modeled for the No Action Alternative, as described in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations,” of this Draft EIS. Therefore, delivery of new water supplies to CVP and SWP water contractors and changes in stream flow within the extended study area would not have a

substantial impact on botanical and wetland resources in the extended study area.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," of this Draft EIS, before the release of Interim and Restoration flows began, Reach 2 of the San Joaquin River was typically dry and flows only reached Mendota Pool from Reach 2B or from the Fresno Slough during periods of flood management releases. Channel capacity limitations downstream from Mendota Pool have required recapture of most of the Interim and Restoration flows at Mendota Pool. As the capacity of the San Joaquin River downstream from Mendota Pool is gradually increased, Restoration Flows will increase downstream from Mendota Pool, and recapture at Mendota Pool would only occur as needed (e.g., during scheduled construction activities downstream from Mendota Dam, such as in Reach 4B). Flows in Reach 3 currently consist primarily of water conveyed from the Delta to Mendota Pool via the Delta-Mendota Canal. Flows in Reach 4 are predominantly agricultural return flows and current operations divert all flow from Reach 4B1 to the Eastside Bypass. Because Reaches 2B, 3, and 4 currently receive very little flow from Friant Dam as a result of channel limitations and water diversions, construction of the Temperance Flat RM 274 Reservoir has very little potential to substantially alter conditions, as a result of flow changes, in these reaches. San Joaquin River flows from Friant Dam reenter the river in Reach 5.

Although construction of the Temperance Flat RM 274 Reservoir could reduce the frequency of flood management releases from Friant Dam, it would not reduce flows reaching the lower San Joaquin River below the levels mandated by the Settlement, which would be an increase from the current condition in the lower San Joaquin River.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the

project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

The thresholds of significance for impacts used for this analysis are based on Appendix G of the State CEQA Guidelines, as amended, and Federal Executive Order (EO) 11312 regarding invasive species. These thresholds also encompass the factors taken into account to characterize the context and the intensity of an impact. Impacts on botanical resources would be significant if project implementation would do any of the following:

- Have a substantial adverse impact, either directly or through habitat modifications, on any plant species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by USFWS or CDFW.

- Have a substantial adverse impact on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by USFWS or CDFW.

- Have a substantial adverse impact on Federally protected wetlands, as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool), through direct removal, filling, hydrological interruption, or other means.

- Introduce or substantially spread a nonnative invasive plant species.

- Threaten to eliminate a plant community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened plant species.

- Conflict with local policies or ordinances protecting wetland or botanical resources, such as an oak tree or woodland preservation policy or ordinance.

- Conflict with the provisions of an adopted habitat conservation plan (HCP), natural community conservation plan, or other approved local, regional, or State HCP relating to the protection of plant resources.

Topics Eliminated from Further Consideration

No topics related to botanical resources and wetlands that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed in the following discussion.

Direct and Indirect Impacts

This section identifies how specific vegetation and wetland types could be affected by implementing any of the alternatives. Implementing any of the alternative plans could affect botanical resources and wetlands by doing any of the following:

- Grading land, removing vegetation, or otherwise disturbing ground for the construction of features including haul roads, transmission lines, and recreational facilities
- Clearing vegetation from the Temperance Flat Reservoir Area to facilitate safe operation of the Temperance Flat RM 274 Reservoir, ancillary facilities, and surrounding recreational areas; and the continued safe operation of Millerton Lake recreational areas
- Inundating habitats located between 580 and 985 feet above msl within the Temperance Flat Reservoir Area between the Temperance Flat RM 274 Dam site and Kerckhoff Dam
- Increasing water discharges from Millerton Lake into the San Joaquin River for conveyance to SOD CVP and SWP water contractors by 28 TAF to 37 TAF

Impact BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed and no change would occur to the operation of Friant Dam or the full pool elevation of Millerton Lake. Continuation of existing land uses would not result in changes to the quality or types of habitats present within the primary study area. No change in vegetation community composition or conversion of habitat types would occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives Creation of the Temperance Flat RM 274 Reservoir would result in inundation of several special-status plant occurrences that have been documented within the Temperance Flat Reservoir Area. Inundation of this area would result in mortality of known special-status plant populations and permanent loss of known occupied and potential habitat. Additional special-status plant species, including State-listed and Federally listed vernal pool plant species, could be adversely affected by development of project features outside of the Temperance Flat Reservoir Area that have not yet been surveyed.

Known plant occurrences that would be lost in the primary study area as a result of project implementation consist of one occurrence of tree anemone (State listed as threatened), two occurrences of Madera leptosiphon (CRPR 1B.2 and BLM Sensitive), and the following CRPR 4 (watch list) species: one occurrence of Ewan's larkspur, 12 occurrences of small-flowered monkeyflower, two occurrences of Michael's piperia, three occurrences of Farnsworth's jewelflower, and four occurrences of Hall's wyethia (Table 6-9). Each of these plant occurrences are located within the Temperance Flat Reservoir Area between the Temperance Flat RM 274 Dam site and Kerckhoff Dam and would be inundated as a result of dam construction and operation (Figure 6-4).

The known occurrence of tree anemone in the primary study area is small, consisting of only six plants observed at the time of the 2007 survey; however, there are only 11 known natural occurrences in existence so loss of this one occurrence would represent a substantial decrease in the number of occurrences. The overall wild population size for all known occurrences combined is close to 5,000 individuals (DFG 2005). Therefore, the 6 plants present in the primary study area represent 0.12 percent of the existing wild population. This occurrence is unique because it is the lowest elevation at which this species has been found, and if left undisturbed, it would likely increase in size over time. This population consisted of five mature shrubs and one young shrub in 2007 indicating that it is regenerating at this location.

Madera leptosiphon, designated as a CRPR 1B plant, is eligible for State listing because it is rare throughout its range and subject to a moderate degree and immediacy of threat. There are only three other documented occurrences of this plant species within the nine quadrangles surrounding the primary study area, so loss of two occurrences represents a loss of 40

percent of the known occurrences in the area. There are only 20 total records of this species covering Fresno and Madera counties so the two occurrences in the Temperance Flat Reservoir Area represent 10 percent of the known occurrences in these two counties. Many of the recorded occurrences have not been seen in more than 50 years and may no longer be extant. Loss of the two occurrences in the Temperance Flat Reservoir Area and loss and degradation of substantial acreage of suitable habitat within this species' limited range could further jeopardize it and warrant State or Federal listing of this species.

Watch-list species (designated CRPR 4) documented in the primary study area are all either widely distributed across the state (e.g., Michael's piperia) or are locally common (e.g., small-flowered monkeyflower, Hall's wyethia). None of these species are seriously threatened in the state at this time and they are found in common habitat types. Therefore, these species do not meet the definition of endangered, rare, or threatened pursuant to State CEQA Guidelines Section 15380. Loss of these watch list plant occurrences would not substantially reduce the number or restrict the range of any of these species or be likely to result in a trend toward State or Federal listing as threatened or endangered.

Additional special-status plant occurrences could be present in portions of the primary study area that have not yet been surveyed either because they are located on private property that could not be accessed or are associated with recent modifications in the location of project features, such as trails, campgrounds, and transmission lines. No Federally listed plant species are known or expected to occur in the Temperance Flat Reservoir Area because no suitable habitat is present.

The proposed new transmission line would traverse vernal pool habitat that has the potential to support vernal pool plant species such as succulent owl's clover and San Joaquin Orcutt grass, which are State listed as endangered and Federally listed as threatened, and Boggs Lake hedge-hyssop, which is State listed as endangered. The transmission line also traverses grasslands and open woodlands that may provide suitable habitat for Hartweg's golden sunburst, which is State and Federally listed as endangered. Construction of the transmission line could result in destruction of State-listed or Federally listed plant species or loss or degradation of their habitat. Dwarf downingia (CRPR 2B.2) and spiny-sepaled

button celery (CRPR 1B.2) could also be adversely affected by construction of the new transmission line if they are present.

Project implementation would result in loss and degradation of habitat that could support other special-status plant species or populations (refer to Table 6-9 for list of potentially occurring species) in areas that were not surveyed at a protocol level due to lack of access (Figure 6-2). Inundation, vegetation removal, grading, and other construction disturbances in suitable habitat for special-status plants could result in loss of special-status plants that may be present.

In addition to direct mortality of special-status plant populations and direct loss of habitat, project implementation could result in indirect impacts on populations adjacent to the Temperance Flat RM 274 Reservoir or other project features. Potential indirect impacts include changes in vegetation management around project features, introduction or spread of invasive species that compete with special-status plants, and degradation of habitat in adjacent areas due to increased access and use resulting from the new Temperance Flat RM 274 Reservoir, recreational trails and other recreation facilities, and new project roads. In particular, two populations of tree anemone and one population of Madera leptosiphon documented within 500 feet of the primary study area boundary may be subject to indirect impacts from increased access and recreational use in areas that currently receive very little human visitation. Indirect impacts on special-status plant occurrences that are near but outside the primary study area or that may be retained within project features that do not require complete removal of existing vegetation could result in eventual mortality of individuals or populations and loss of occupied habitat.

Loss and disturbance of known occurrences of tree anemone and Madera leptosiphon in the primary study area constitutes a substantial adverse impact on special-status plant species. Loss and degradation of habitat that could support other special-status plant species or populations could have a substantial adverse impact on special-status plant species if they are present.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam and Reservoir would not be constructed, and no change would occur to the operation of Friant Dam. No change in vegetation community composition or conversion of habitat types would take place.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementation of any of the action alternatives would increase water delivery reliability from Millerton Lake. On average for all but Wet years, 46 TAF to 110 TAF of the added water supply provided by the new Temperance Flat RM 274 Reservoir would be discharged to the San Joaquin River for conveyance to SOD CVP and/or SWP water contractors. In wet years with large runoff events, stream flow downstream from Friant Dam would be reduced from current conditions during the wettest part of the year, generally winter and spring, and increased during dry months or years. However, these additional water supplies would not exceed current channel capacity of the San Joaquin River or bypass systems and changes in stream flows during wet and dry years would be within typical historical volumes. Therefore, the additional water supply would not substantially alter special-status plant habitats.

The majority of special-status plant species that are known to occur in the vicinity of the extended study area between Friant Dam and the Merced River, as discussed in the Affected Environment section, are found in habitats that occur above the alluvial plain, such as grassland, vernal pool, and alkaline scrub habitats. Special-status plant species associated with these habitat types would not be affected by water releases within the current channel capacity of the San Joaquin River and other conveyance channels.

Delta button-celery, a species that is State listed as endangered, has been documented at 36 locations within Reaches 4B and 5 and the Eastside and Mariposa bypasses of the extended study area. These occurrences represent approximately three-quarters of all known extant occurrences of Delta button-celery. This species inhabits seasonally inundated floodplain depressions in riparian scrub habitat. The action alternatives would not increase flows in these reaches, therefore, Delta button-celery would not be substantially affected by the additional water supply.

Three special-status species that are not Federally or State listed, but have a CRPR of 1 or 2, are species that could occur in riverine, marsh, or riparian habitats in the extended study area: California satintail (*Imperata brevifolia*), Sanford's arrowhead, and Wright's trichocoronis. Marsh and riparian habitats potentially supporting these species within the current San Joaquin River and other conveyance channels could experience occasional flooding from additional water deliveries from Millerton Lake in dry months or dry years, but water deliveries would not substantially alter the current hydrologic regime and the overall flow patterns, water depth, and frequency and duration of flooding in these waterways would be within the current range of variation to which these species are adapted. Therefore, these species would not be substantially affected by the additional water supply.

The additional water storage in the Temperance Flat RM 274 Reservoir would provide a more reliable water supply making water available for delivery during periods when it might not otherwise be available. This means that in most years, more water would be released into the San Joaquin River and bypass channels than under current conditions. However, the overall maximum water deliveries, contracted water volumes, and existing water uses and adjacent land uses would not substantially change because water flows from Friant Dam would not deviate from the range of operating conditions that define existing conditions.

Additional water supply from the Temperance Flat RM 274 Reservoir could result in a minimal increase in flow duration in the existing San Joaquin River channel between Friant Dam and Mendota Pool in some years, but the increased water supply would not be enough to result in prolonged submergence of established vegetation that would lead to plant mortality or conversion of habitat.

Changes in delivery of the new water supply would have even less impact on San Joaquin River flows downstream from the Merced River as the contribution from Friant Dam becomes a smaller proportion of the total flow because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus rivers). The action alternatives would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta or in the Delta. Thus, any changes downstream from

the Merced River confluence or in the Delta would not be sufficient to affect special-status plant species.

Implementing any of the action alternatives is not expected to substantially alter potential habitat for special-status plant species or result in loss of any special-status plant occurrences in the extended study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-2: Loss of Riparian Habitat and Other Sensitive Communities

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam and Reservoir would not be constructed, and no change would occur to the operation of Friant Dam. No change in vegetation community composition or conversion of habitat types would take place.

There would be **no impact** under the No Action Alternative.

Action Alternatives Creation of the Temperance Flat RM 274 Dam and Reservoir would result in inundation of riparian habitat and oak woodland natural communities resulting in converting these terrestrial natural communities to lacustrine (open water) habitats. Constructing project features could also result in ground disturbance, stream or wetland alteration, and vegetation removal in riparian and oak woodland natural communities resulting in loss or degradation of these sensitive habitats.

Implementing any of the action alternatives would result in loss and degradation of substantial acreage of riparian and oak woodland natural communities considered sensitive by State and local resource agencies, protected under Section 1602 of the California Fish and Game Code, and/or requiring consideration under CEQA. Table 6-14 lists the acreage of each type of riparian and oak woodland community that would be inundated as a result of project implementation. Table 6-15 identifies the acreage that would be affected as a result of constructing other project features.

Aquatic habitats found in the primary study area qualify as wetlands or waters of the United States under Section 404 of

the CWA and waters of the State and are addressed in the discussion of Impact BOT-3.

Riparian and oak woodland communities would be directly affected as a result of constructing project features, vegetation removal within the Temperance Flat Reservoir Area, and from the Temperance Flat RM 274 Reservoir. All riparian and oak woodland habitats located between 580 and 985 feet above msl within the Temperance Flat Reservoir Area between the Temperance Flat RM 274 Dam site and Kerckhoff Dam would be converted to lacustrine habitat.

Table 6-14. Summary of Riparian and Oak Woodland Habitat Impacts in the Temperance Flat Reservoir Area under the Action Alternatives

Habitat	Acres Affected (Direct Impact)
Oak Woodland[1]	**4,238**
Foothill Pine Oak Woodland	3,289
Blue Oak Woodland	920
Live Oak Woodland	29
Riparian	**33**
White Alder Riparian	25
Mixed Riparian	2
Willow Riparian	2
Sycamore Woodland	<1
Buttonbush Scrub	<1
Fig Riparian	1
Fig - Willow Riparian	2
Total Oak Woodland and Riparian	4,271

Note:
[1] A total of 251.3 acres of oak woodland habitat would be directly affected on Sierra Foothill Conservancy lands and 82.8 acres of oak woodland would be impacted within the CDFW Big Table Reserve.

Table 6-15. Summary of Riparian and Oak Woodland Habitat Impacts in the Area of Project Features under the Action Alternatives

Habitat	Acres Affected (Direct Impact)
Oak Woodland	**1,519**
Foothill Pine Oak Woodland	1,215
Blue Oak Woodland	298
Live Oak Woodland	6
Riparian	**9**
Mixed Riparian	9
Total Oak Woodland and Riparian	1,528

Two ecological preserves, McKenzie Table Mountain Preserve and the Austin & Mary Ewell Memorial Preserve on Fine Gold

Creek, owned and managed by the Sierra Foothill Conservancy, would be directly affected as a result of inundation by the Temperance Flat RM 274 Dam or by construction of project features within the primary study area, such as haul routes or transmission corridors. Approximately 251 acres of oak woodland habitats within the McKenzie Table Mountain Preserve are located below the inundation line of the Temperance Flat Reservoir Area. In addition, a total of 74 acres of oak woodland and 3 acres of riparian habitat within the McKenzie Table Mountain Preserve are present within the new transmission line corridor. Approximately 8 acres of oak woodland habitat within the Austin & Mary Ewell Memorial Preserve would be directly affected as a result of the construction of the haul route to the aggregate quarry. In addition, approximately 83 acres of oak woodlands would be directly affected due to inundation on the Big Table Ecological Reserve, managed by CDFW.

Most of the riparian and oak woodland habitat within the footprint of other project features would be converted to developed or disturbed habitat types, although riparian habitat may be avoided during development of some of the project features. For example, the proposed Temperance Flat transmission line corridor intersects four intermittent streams supporting riparian habitat, but transmission towers could be located to avoid riparian features along these stream channels. In other instances, sensitive habitats may be more difficult to avoid during construction of project features. Some acreage of oak woodland vegetation within some project features, such as the new or relocated transmission line corridors, would likely be converted to annual grassland following project implementation.

Although not officially recognized as special-status natural communities by CDFW, the oak woodland communities within the primary study area are designated under the Oak Woodlands Conservation Act, California Public Resources Code 21083.4, and the Fresno County and Madera County general plans.

Oak woodlands provide important habitat to numerous common and special-status wildlife species. As such, oak woodland communities are considered sensitive habitats by wildlife resource agencies, including USFWS and CDFW. There is a great deal of concern about oak and other hardwood communities in California (Harris and Kocher 2002) because the rapid rate of urban and agricultural development in the

foothills is fragmenting and altering these communities. Studies suggest that oak and other hardwood habitats are at risk throughout California (California Oak Foundation 2006, Saving and Greenwood 2002, Giusti and Merenlender 2002, Light and Pedroni 2002). In the San Joaquin region, it is estimated that about 250,000 acres of oak woodland are at risk for loss by the year 2040 (California Oak Foundation 2006). The loss of approximately 5,757 acres of oak woodland habitat from project implementation is considered a substantial loss of this habitat.

Additional indirect impacts on sensitive natural communities could result from introduction of invasive species, vegetation management practices (e.g., clearing for fire control, maintaining recreational facilities), and intrusion by humans and domestic animals that could disturb sensitive natural communities and reduce habitat values.

The loss and degradation of riparian and oak woodland habitat that would occur in the primary study area with project implementation constitutes substantial adverse impact on sensitive natural communities regulated by CDFW under Section 1602 of the California Fish and Game Code and California Public Resources Code.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, and no change would occur to the regular operation of Friant Dam or water conveyance within the San Joaquin River and bypass systems. No new water supply would be discharged down the San Joaquin River to the Delta and no change in vegetation community composition or conversion of habitat types would occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under Alternative Plans 1 through 5, the construction of the Temperance Flat RM 274 Dam would increase water delivery reliability from Millerton Lake. During wet years, average stream flow would be reduced downstream from Friant Dam in winter and spring months when Temperance Flat RM 274 Reservoir would store large runoff

events that otherwise would be released from Millerton Lake as flood flows.

This stored water would be released during drier months and years thereby increasing average flows downstream from Friant Dam during these periods. Changes in stream flows during wet and dry years would be within typical historical volumes. Delivery of the new water supply would not exceed historical maximum CVP and SWP water deliveries, exceed existing contracted water volumes, result in placing new land into agricultural production, or change crop patterns.

All action alternatives described in this Draft EIS would enhance riparian habitat restoration along the San Joaquin River under the SJRRP, by providing the following effects:

- The reduced frequency, magnitude, and duration of Friant Dam releases greater than Restoration Flows would:
  - Reduce the risk of damage to SJRRP instream and floodplain investments
  - Increase flexibility for managing riparian recruitment flows and flexible flow periods
  - Reduce the potential for riparian zone/bank erosion
- Reduce frequency, magnitude, duration of floodplain habitat inundation
- Improve flexibility in management of Restoration Flows with no effect on water deliveries, including increased operational flexibility for providing buffer flows and pulse flows for gravel mobilization

The San Joaquin River downstream from Friant Dam would not experience a change in vegetation community composition or conversion of habitat types because water flows from Friant Dam would not deviate from the range of operating conditions that define existing conditions. Because the new water supply delivery would not exceed the current channel capacity of the San Joaquin River and would not substantially alter the overall hydrological regime, no substantial change in vegetation communities is anticipated. Therefore, the additional water supply would not substantially alter riparian habitats or other sensitive natural communities that occur within the San

Joaquin River channel or bypass systems within the extended study area downstream from Friant Dam to the confluence with the Merced River.

Changes in delivery of the new water supply would have even less influence on San Joaquin River flows downstream from the Merced River as the contribution from Friant Dam becomes a smaller proportion of the total flow because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus Rivers). The action alternatives would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta or in the Bay-Delta estuary.

The additional water storage in the Temperance Flat RM 274 Reservoir would provide a more reliable water supply, making water available for delivery during periods when it might not otherwise be available. This means that in most years, more water (about 46 TAF to 110 TAF) would be discharged into the San Joaquin River and bypass channels than under current conditions. However, the overall maximum water deliveries, contracted water volumes, and existing water uses and adjacent land uses would not change and flow would not exceed the current channel capacity.

Additional water supply from the Temperance Flat RM 274 Reservoir could result in a minimal increase in flow duration in existing channels in some years, but water deliveries would remain within the current range of variation and would not result in prolonged submergence of established vegetation that could lead to plant mortality or conversion of habitat. Therefore, project implementation is not expected to substantially alter riparian habitat or other sensitive natural communities.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-3: Loss or Degradation of Waters of the United States, Including Wetlands, and Waters of the State

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, and no change would occur to the regular

operation of Friant Dam. The primary study area would continue to be used for water storage, recreation, and cattle grazing. Continued operation of Friant Dam would not result in discharge of fill or dredged materials into waters of the United States or loss of wetlands. No change in vegetation community composition or conversion of habitat types would occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementation of any of the action alternatives would result in direct impacts from the loss of waters of the United States resulting from the placement of fill material into Federally jurisdictional waters of the United States within the primary study area, including wetlands, or the conversion of wetland types. This impact would be **significant**.

Waters of the United States and wetlands would be converted to a deeper water lacustrine habitat type as a direct result of constructing the dam at Temperance Flat RM 274 and inundation to the full-pool height of 985 msl. Waters of the United States that would be converted consist of riverine, ephemeral and intermittent drainages, swales, seasonal wetlands, vernal pools, and seeps. Table 6-16 lists the acreage of each type of wetland and other waters that would be inundated and converted to lacustrine habitat as a result of construction of the Temperance Flat RM 274 Dam, or filled as a result of project construction.

Table 6-16. Summary of Wetland Impacts in the Primary Study Area under the Action Alternatives

Habitat Type	Acreage within Area of Project Features	Acreage within Temperance Flat Inundation Area
Lacustrine	27[1]	5
Riverine	—	185
Perennial Drainage	—	0.02
Intermittent Drainage	1	13
Ephemeral Drainage	1	7
Freshwater Seep	—	1
Seasonal Wetland	4	6
Swale	1	—
Vernal Pool Grassland	6[2]	—
Total Area	**40**	**217**
Total for all Impacts within the Primary Study Area	**245**	

Notes:

[1] Area of habitat identified here for the area of project features consists of the 5.5-acre area below the Millerton Lake maximum inundation level that would be permanently filled by the Temperance Flat RM 274 dam structure and 21.5 acres of existing Millerton Lake Reservoir downstream from RM 274 that would be filled with waste disposal rock from the diversion tunnel. An additional 16.6 acres of lacustrine unconsolidated bottom and 4 acres of lacustrine unconsolidated shoreline within the existing Millerton Lake Reservoir would be temporarily filled by coffer dams.

[2] Acreage of vernal pool likely overestimated because detailed analysis for this area is scheduled after release of this report. Area mapped as vernal pool grassland within transmission route.

Implementing the action alternatives would result in converting all habitat types located between 580 and 985 feet above msl within the Temperance Flat Reservoir Area to lacustrine habitat. The conversion of riverine, ephemeral and intermittent drainages, swales, seasonal wetlands, vernal pools, and seeps to lacustrine habitat would be a significant impact because there would be some loss or change in ecological functions provided by these wetland resource types. However, the change of riverine habitat to a deeper water habitat would not represent an overall loss of waters of the United States and the functions currently provided by the riverine habitat (185 acres) in the upper San Joaquin River, would continue to be provided following construction of the Temperance Flat RM 274 Dam. Loss of waters of the United of the States would occur in the area of project features (Table 6-16), except where these waters could be avoided through project design. Dam construction would require the construction of temporary coffer dams and dewatering of approximately 64 acres of existing lacustrine habitat in Millerton Lake upstream and downstream from RM 274. The permanent dam footprint would occupy 15.3 acres within these 64 acres, and approximately 5.5 acres of that

would be within the existing maximum inundation level of Millerton Lake and therefore represents a permanent loss of lacustrine waters of the United States. In addition, wetland habitats (freshwater seep and seasonal wetland) within the inundation area would be lost because these habitats would become lacustrine habitats and would no longer function as wetlands.

In addition to direct impacts, lacustrine habitat created by the Temperance Flat RM 274 Dam would be indirectly affected as a result of increased recreation use upstream from the proposed Temperance Flat RM 274 Dam. A potential indirect impact on lacustrine habitat includes reduction in water quality caused by erosion and siltation; intrusion of humans and domestic animals; and introduction of aquatic invasive plant or fauna species that could result in habitat degradation.

Construction of the Temperance Flat RM 274 Dam would result in the need to dispose of waste rock from the diversion tunnel and powerhouse excavation. Waste rock disposal would require approximately 21.5 acres and would occur below the existing top-of-active-storage inundation level of Millerton Lake, located downstream from the Temperance Flat RM 274 Dam. Waste rock disposal below the top-of-active storage of Millerton Lake would constitute a direct impact on waters of the United States resulting from the placement of fill material into jurisdictional waters of the United States within the Millerton Lake downstream from the RM 274 portion of the primary study area, including wetlands. The bottom elevation of Millerton Lake would be altered as a result of waste rock disposal, and would change the substrate from unconsolidated lakeshore sediments to fragmented bedrock materials. The waste rock would occupy approximately 21.5 acres of existing lacustrine habitat in Millerton Lake.

In addition to the direct impact of altering the bottom elevation of Millerton Lake, waste rock disposal also has the potential to directly affect water quality within Millerton Lake. Sediment may cling to waste rock materials, and lubricants or other industrial chemicals may come into contact with rock as a result of the extraction process. These pollutants would wash these into the lake once the material is deposited below the top-of-active-storage level of Millerton Lake.

Potential indirect impacts on water quality also include erosion and siltation as a result of the new road required to access the waste rock disposal site, and intrusion of humans and heavy

construction equipment below the top-of-active-storage level of Millerton Lake. Construction equipment depositing the waste rock would cause soil disturbance that could result in the establishment of invasive plant species. The colonization of nonnative species in areas disturbed as a result of construction activities would result in decreased species richness and habitat degradation.

The placement of waste rock below the top-of-active-storage level of Millerton Lake would be considered fill material and would result in the change in the bottom elevation of waters of the United States. This action would result in the loss and degradation of USACE jurisdictional waters of the United States and constitutes a substantial adverse impact on jurisdictional waters of the United States, as defined by CWA Section 404. Loss of waters of the United States would also occur in the footprint of the Temperance Flat Dam where the dam itself would result in fill of water of the United States.

The loss and degradation of USACE jurisdictional waters of the United States and wetland habitats that would occur with project implementation constitutes a substantial adverse impact on jurisdictional waters of the United States, including wetlands, as defined by CWA Section 404. Construction of project features in upland habitats has the potential to directly and indirectly affect water quality and alter hydrology.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, no additional water supply would be created, and no changes would occur to the operation of Friant Dam. Continued operation of Friant Dam would not result in discharge of fill or dredged materials into waters of the United States or loss of wetlands within the San Joaquin River downstream from Friant Dam or Delta waterways. No filling or conversion of wetlands and waters of the United States from one type to another (e.g., seasonal stream or wetland to perennial stream or emergent marsh) would occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under any of the action alternatives, the proposed Temperance Flat RM 274 Dam would be constructed allowing large runoff events in wet years to be stored in the Temperance Flat RM 274 Reservoir, then released in dry months and years when water is scarce. These changes in stream flows would be within typical historical volumes.

Continued operations of Friant Dam would not result in discharge of fill or dredged materials into waters of the United States or loss of wetlands within the San Joaquin River downstream from Friant Dam. Additional water supply from the Temperance Flat RM 274 Reservoir would result in a minimal increase in flow duration in existing channels in drier months of some years, but water deliveries would remain within the current normal range of variation and would not result in a conversion of wetlands and waters of the United States from one type to another (e.g., seasonal stream or wetland to perennial stream or emergent marsh) in the San Joaquin River from Friant Dam to the Delta or in Delta waterways. There would be no loss of wetland acreage or function in the extended study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-4: Introduction and Spread of Invasive Plants

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, no vegetation removal would occur, and existing recreation trails would remain in use. Invasive species have been documented within the primary study area. Under the No Action Alternative, invasive species may continue to spread. However, the rate of spread would not be increased above the current rate because this alternative would not result in expansion of human recreation into currently inaccessible areas, and new dispersal corridors would not be created as part of constructing project features. The No Action Alternative would not cause any change in the rate of spread of invasive species.

There would be **no impact** under the No Action Alternative.

Action Alternatives Ground disturbance and vegetation removal associated with construction of the dam and other project features have the potential to introduce and spread

invasive plant species. Ground-disturbing construction activities can create gaps in native vegetation that provide optimal sites for establishment of invasive plants. Erosion-control materials, seed mixes, and unwashed construction equipment often transport propagules of invasive plants to construction sites where disturbed areas can provide ideal conditions for their establishment and aid their spread into adjacent native plant communities. Construction of project features would result in a temporary increase in weed vectors in the primary study area.

Establishment of new access roads, trails, and recreation areas would provide permanent new dispersal corridors and increase human use in areas that currently get little human visitation. Recreationists and their pets using new or relocated campgrounds, trails, and the Temperance Flat RM 274 Reservoir represent new or increased vectors for the introduction and spread of invasive plants. Rising water in the Temperance Flat 274 Reservoir would provide a new weed vector for invasion of habitats adjacent to the new inundation zone.

As shown in Table 6-11, five invasive plant species that have a moderate to high Cal-IPC rating have been documented in the primary study area. These species could be spread to new sites during project construction activities, and new invasive species could be introduced to the area via construction equipment and materials or by recreational users when construction and inundation are completed.

Establishment of invasive plant species results in general habitat degradation by eliminating native plants that provide habitat for native fish and wildlife species. Infestations by aggressive invaders can degrade sensitive habitats such as riparian and wetland habitats and eventually alter hydrological or other functions of these habitats. Competition from invasive plant species can exclude special-status plant species and generally lower species diversity.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, and no change would occur to the current

operation of Friant Dam, or water conveyance within the San Joaquin River and bypass systems. Existing infestations of invasive species may continue to spread within the San Joaquin River corridor and Delta waterways, but no new water supply would be discharged down the San Joaquin River to the Delta to facilitate spread of invasive species.

Continuation of existing land uses and current water delivery would not result in changes to the quality or types of habitats present within the extended study area or in the dispersal mechanisms for invasive plants. No change in vegetation community composition or conversion of habitat types would occur and no new weed vectors would be established.

Increased instream flow releases from the SJRRP could increase dispersal of invasive plants over time even though mitigation is included in the SJRRP to minimize expansion and establishment of invasive plants.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under any of the action alternatives, the proposed Temperance Flat RM 274 Dam would be constructed and water supply reliability would be increased, making additional water available during dry months and years when it might not otherwise be available. Invasive species have been documented downstream from Friant Dam down to and including the Delta. Under any of the action alternatives, invasive species may continue to spread within the San Joaquin River corridor and Delta waterways. However, the rate of spread would not be increased above the current rate because the rate of water released into the San Joaquin River would be within the range of flow releases from the SJRRP, except during flood events where some peak flood flows would be reduced under the action alternatives. All water released is anticipated to remain within the existing river channel, and new dispersal corridors would not be created as part of implementation of any of the action alternatives.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-5: Elimination of a Plant Community or Substantial Reduction in the Number or Restriction of the Range of an Endangered, Rare, or Threatened Plant Species

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam and project features would not be constructed in the primary study area, and project actions that would remove plant communities, special-status plants, and their habitats would not be carried out. Existing plant communities and special-status plant occurrences in the primary study area would remain comparable to existing conditions.

No habitat or special-status plants would be removed or taken as a result of project activities under the No Action Alternative. Implementing the No Action Alternative would not substantially reduce habitat for special-status plants or plant communities or reduce the number or restrict the range of an endangered, rare, or threatened plant species.

There would be **no impact** under the No Action Alternative.

Action Alternatives Plant communities within the primary study area are widely distributed across the Sierra Nevada foothills and would continue to be well represented within the region following project completion. Although project implementation would result in habitat loss and loss of special-status plant occurrences, these species would continue to exist at a number of locations outside of the Study Area (note that the project also includes Mitigation Measure BOT-1 to compensate for the loss of tree anemone and Madera leptosiphon occurrences by creating new occurrences and preserving existing occurrences outside of the Study Area in perpetuity; see the Mitigation Measures section). The project would not eliminate any habitat important to the long-term survival of any species or community.

The only plant species officially listed as threatened or endangered that is known to occur in the primary study area is tree anemone. This species is an extremely localized endemic found only in eastern Fresno and Madera counties, but elimination of one occurrence would not further restrict the range of this species. There are four additional occurrences of tree anemone within 10 miles of the primary study area and most of the known occurrences of this species are on USFS or

Sierra Foothill Conservancy lands and receive some level of protection that would enable them to persist into the future.

Therefore, project implementation would not eliminate a plant community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened plant species.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed, and no additional water supply would be discharged into the San Joaquin River, bypass systems, or Delta waterways. Existing plant communities and special-status plant occurrences in the extended study area would remain comparable to existing conditions. No habitat or special-status plants would be altered or taken as a result of project activities under the No Action Alternative. Implementing the No Action Alternative would not substantially reduce habitat for special-status plants or plant communities or reduce the number or restrict the range of an endangered, rare, or threatened plant species.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would not result in substantial changes in existing plant communities or potential habitat for special-status plants within the San Joaquin River from Friant Dam to the Delta or in Delta waterways, because water flows from Friant Dam would not deviate from the range of operating conditions that define existing conditions. Additional water supply from the Temperance Flat RM 274 Reservoir could result in a minimal increase in flow duration in existing channels in some years, but this additional flow duration would not result in prolonged submergence of established vegetation that could lead to plant mortality or conversion of habitat. No change in vegetation community composition or conversion of habitat types would occur. Therefore, implementing any of the action alternatives would not eliminate a plant community or reduce the number or restrict the range of any special-status plant species.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources

Primary Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam and project features would not be constructed in the primary study area, and project actions that could affect botanical and wetland resources protected under local or regional plans and policies would not occur. Therefore, there would be no conflict with these plans and policies.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would result in removal of special-status plants and sensitive habitats addressed in Madera County and Fresno County general plan policies and the BLM RMP. This would result in a conflict with the goals of these plans and policies.

Implementing any of the action alternatives would result in loss of wetland, riparian, and oak woodland habitats and special-status plant species as described under Impact BOT-1, Impact BOT-2, and Impact BOT-3. The Fresno County and Madera County general plan documents and BLM RMP include goals and policies aimed at conserving these resources to the extent feasible within their jurisdictions.

The majority of the primary study area is located on lands owned by the Federal government and not subject to county policies, but some portions of the Temperance Flat Reservoir Area and some of the project features, including most of the new transmission line, are on private property within either Fresno County or Madera County jurisdiction.

Much of the Temperance Flat Reservoir Area and some of the project features are situated within the SJRG SRMA and are therefore subject to the BLM RMP. Project implementation would result in direct conflicts with the goals and policies of these plans. Specifically, project implementation would result in the loss of Madera leptosiphon occurrences, a BLM sensitive plant species. Project implementation would also conflict with a number of Fresno County and Madera County policies requiring protection of endangered species and their habitat, wetlands, streams, riparian areas, and oak woodlands.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed and no additional water supply would be discharged into the San Joaquin River, bypass systems, or Delta waterways. Project actions that could affect botanical and wetland resources protected under local or regional plans and policies would not occur. Therefore, there would be no conflict with these plans and policies.

There would be **no impact** under the No Action Alternative.

Action Alternatives Within the extended study area, project impacts would be restricted to the current channel capacity of the San Joaquin River and bypass systems. No change in existing use of adjacent lands would occur, and no change in vegetation community composition or conversion of habitat types would occur that could substantially adversely affect botanical or wetland resources protected under local and regional policies and plans. Implementing any of the action alternatives therefore would not conflict with local land use policies such as county and city general plan policies.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact BOT-7: Conflict with Provisions of an Adopted Habitat Conservation Plan Protecting Wetland or Botanical Resources

Primary Study Area

No Action Alternative PG&E has an adopted HCP that covers routine operations and maintenance activities throughout 276,350 acres within the San Joaquin Valley. The primary study area is included within the PG&E HCP plan area. It is expected that all covered activities carried out by PG&E within the primary study area would be implemented in compliance with the adopted HCP, as it is mandatory for PG&E's operations. There are no other adopted conservation plans covering the primary study area, so implementing the No Action Alternative would not conflict with the provisions of an adopted conservation plan.

There would be **no impact** under the No Action Alternative.

Action Alternatives The PG&E HCP plan area is narrowly defined to include all gas and electrical transmission lines and distribution facilities, private access routes to infrastructure associated with operations and maintenance activities, minor facility expansion areas, and mitigation areas for impacts resulting from activities specifically covered by the HCP (PG&E 2006). This HCP provides coverage for routine operations and maintenance activities conducted by PG&E, which are not part of any of the action alternatives. Therefore, the PG&E HCP is not applicable to the action alternatives, nor are there other adopted conservation plans that cover the primary study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, the proposed Temperance Flat RM 274 Dam would not be constructed and no additional water supply would be discharged into the San Joaquin River, bypass systems, or Delta waterways. Project actions that could affect botanical and wetland resources protected under adopted HCPs would not occur. Therefore, there would be no conflict with the goals and policies of adopted HCPs.

There would be **no impact** under the No Action Alternative.

Action Alternatives The CALFED Bay-Delta Program sponsors the San Joaquin River Riparian Habitat Restoration Program Pilot Project to establish riparian habitat along the river where little or none existed before using releases from Friant Dam to disperse and germinate native tree seed. The National Wildlife Refuge comprehensive conservation plans (CCP) for Merced NWR and San Luis NWR include goals to restore and manage upland, riparian, and wetland habitats on refuge lands for the purpose of conserving natural diversity.

Implementing any of the action alternatives would provide a more reliable water supply, making water available for delivery during periods when it might not otherwise be available. The additional water supply would not result in changes to the overall maximum water deliveries, contracted water volumes, and existing land uses would not change. Therefore, implementing any of the action alternatives would not conflict with the goals of adopted conservation plans to establish or restore riparian habitat and maintain natural diversity.

Implementing action alternatives would not alter hydrology in the refuges and would not interfere with restoration or management of habitats in the refuges; therefore, there would be no conflict with the NWR conservation goals or strategies.

Implementing any of the action alternatives would not conflict with the CALFED Bay-Delta Program objectives for enhancing or conserving native biotic communities in the Bay-Delta estuary and its watersheds. Communities targeted for conservation and enhancement under the program include estuarine and freshwater marsh, riparian, seasonal wetland, vernal pool, and aquatic plant communities.

Operations under the action alternatives would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta or in the Bay-Delta estuary.

There would be no conflict with the goals of any adopted conservation plans covering any portion of the extended study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 6-13.

No mitigation is required for Impacts BOT-5 and BOT-7 within the primary study area or for Impacts BOT-1 through BOT-7 within the extended study area, because there would be no impact or the impact would be less than significant for all action alternatives.

Impacts BOT-1, BOT-3, BOT-4, and BOT-6 within the primary study area would be significant or potentially significant. Implementing Mitigation Measures BOT-1, BOT-3, BOT-4, and BOT-6 would reduce these impacts to a **less-than-significant** level.

Impact BOT-2 within the primary study area would be significant. Implementing Mitigation Measure BOT-2 would reduce this impact, but not to a less-than-significant level.

Therefore, Impact BOT-2 (within the primary study area) would be **significant and unavoidable**.

Mitigation Measure BOT-1: Relocate Special-Status Plant Populations

To mitigate direct and indirect impacts on tree anemone and Madera leptosiphon within the primary study area, outside the areas that would be directly affected by project implementation, Reclamation will implement the following measures:

- Preserve the other single known occurrence of tree anemone located on BLM lands at the 1,148-foot elevation located approximately 0.3 mile east-southeast of RM 285 on Fresno County side (CNDDB occurrence number 11) with a conservation easement (Figure 6-3).

- Acquire land, if possible, associated with the known occurrence of tree anemone consisting of two polygons in close proximity in the vicinity of the primary study area approximately 1.5 miles north of Kerckhoff Powerhouse on the Madera County side (CNDDB occurrence number 15). Place the acquired occupied habitat under a perpetual conservation easement (Figure 6-3).

- Preserve the known occurrence of Madera leptosiphon present within the Millerton Lake SRA portion of the primary study area (CNDDB occurrence number 9) with protective fencing to deter recreational users from trampling occupied habitat (Figure 6-3).

To compensate for the direct loss of tree anemone and Madera leptosiphon populations, new self-reproducing populations of tree anemone and Madera leptosiphon shall be established at a ratio of not less than 1:1 (one new population established for each population lost):

- Compensatory populations shall be preserved in perpetuity with a conservation easement and incompatible land uses shall be prohibited in habitat conservation areas.

- New populations shall be established from seed or cuttings, as appropriate for the individual species, of plants that would be lost as a result of project implementation. Seed and topsoil shall be salvaged

from the occupied habitat that would be removed by project implementation. Seed shall be collected from affected populations for at least three seasons before loss, but no more than 10 percent of the seed produced shall be removed from the overall population in a given growing season. Before the first seed collection, population density and extent of occupied habitat shall be determined. Collection seasons do not have to be consecutive. All of the seed from plants in occupied habitat to be removed shall be harvested in the final harvest season. Collected seeds shall be stored at two different seed repositories, including the National Center for Genetic Resources Preservation in Fort Collins, Colorado, and a repository certified by the Center for Plant Conservation, such as the Rancho Santa Ana Botanic Garden, until reestablishment habitat is ready for planting.

- Before planting, tree anemone shall be propagated at a qualified plant nursery and installed by a qualified firm with restoration expertise.

- The extent of occupied area and the flower density in compensatory reestablished populations shall be equal to or greater than the affected occupied habitat.

- Reestablished populations shall be monitored for a minimum of 5 years. Monitoring will continue beyond 5 years until reestablished populations are self-reproducing.

- Reestablished populations shall be considered self-reproducing when:

    - Plants reestablish annually for a minimum of 5 years with no human intervention such as supplemental seeding

    - Reestablished habitats contain an occupied area and flower density comparable to existing affected occupied habitat areas at the time of impact

- Reclamation will provide bonds or other financial assurances to ensure implementation of the mitigation measures.

Reclamation will develop and implement a mitigation and monitoring plan (MMP) for tree anemone and Madera leptosiphon in consultation with CDFW. The MMP shall include detailed plans to compensate for the direct loss of occupied habitat at a ratio agreeable to CDFW and Reclamation. At a minimum, the MMP shall include all of the measures listed above and shall include monitoring of preserved and compensatory reestablished populations annually for a minimum of 5 years to ensure plants are regenerating on a yearly basis without human intervention. If plants are not regenerating, reseeding and other measures (e.g., weed management), will be implemented as appropriate based on assessment by a qualified ecologist, and monitoring will continue until populations are self-sustaining.

Special-status plant surveys shall be conducted in areas that have not previously been surveyed during the time of year that target species are readily identifiable (i.e., in bloom or fruit). Surveys shall be floristic in nature and shall follow the protocol outlined by CDFW for special-status plant surveys (DFG 2009). If special-status species are not identified, no further action is required. However, if special-status species are identified, then the special-status plant populations shall be avoided to the maximum extent possible (i.e., trail realignment, relocating transmission towers to avoid direct impacts).

Federally listed and State-listed species, including Hartweg's sunburst, succulent owl's clover, and San Joaquin Orcutt grass, and the State-listed Boggs Lake hedge-hyssop, have the potential to occur within the new transmission corridor. Direct impacts on species afforded protection under Federal ESA and/or CESA would require an incidental take permit from USFWS and/or CDFW 2081 permit. Final mitigation for Federally protected or State-protected species would be determined through consultation; however, mitigation for impacts on Federally listed or State-listed species would be mitigated through a combination of preserving and enhancing existing populations, creation of off-site populations on project mitigation sites through seed or inoculum collection or transplantation, and/or purchase of preservation credits at a conservation or mitigation bank in sufficient quantities to achieve no net loss of occupied habitat.

Implementing Mitigation Measure BOT-1 would reduce potentially significant impacts from the loss of special-status plant populations to a **less-than-significant** level.

Mitigation Measure BOT-2: Compensate for Loss of Specific Habitats

To compensate for the loss of riparian habitat within the Temperance Flat Reservoir Area and avoid, minimize, or compensate for riparian habitat impacts within the area of project features, Reclamation will implement the following measures.

Project features including but not limited to haul roads, access roads, staging areas, powerhouse, transmission facilities, and hydroelectric facilities shall be located outside of riparian areas and shall avoid impacts on riparian habitat to the maximum extent possible. If avoidance is not possible, impacts on riparian habitats shall be compensated for by planting appropriate riparian trees within the primary study area at a ratio of not less than 1:1 and purchasing credits at a ratio of not less than 1:1 at a mitigation bank to compensate for temporal loss.

Reclamation will establish and/or restore riparian habitat along existing stream corridors located above the Temperance Flat inundation area. If suitable riparian habitat establishment and restoration areas are not available in sufficient quantities to satisfy the 1:1 compensation ratio on site, additional off-site riparian habitat restoration and/or establishment shall be implemented as needed to achieve a minimum compensation ratio of not less than 1:1 to offset the loss of riparian habitat functions and services at the project site. Reclamation will hire a qualified restoration ecologist to prepare a MMP describing specific method(s) to be implemented to compensate for impacts on the stream channels supporting riparian habitats within the Temperance Flat Reservoir Area that would be inundated as a result of constructing the Temperance Flat RM 274 Dam or would be removed during construction of project features.

The compensation habitat planted above the level of inundation shall be similar in composition and structure to the habitat to be removed and shall be at a ratio of not less than 1:1 to offset the loss of riparian habitat functions and services at the project site. To compensate for the temporal loss of riparian habitats and any additional acreage of riparian habitat loss that cannot be replaced on site, credits shall be purchased at a conservation bank at a ratio of not less than 1:1. The riparian habitat compensation section of the habitat MMP shall include the following:

- Compensatory mitigation sites and criteria for selecting these mitigation sites
- Complete assessment of the existing biological resources in both the on-site and off-site preservation and restoration areas
- Site-specific management procedures to benefit establishment and maintenance of native riparian plant species, including California sycamore, black willow, arroyo willow, white alder, and Fremont cottonwood
- A planting and irrigation program if needed for establishment of native riparian trees and shrubs at strategic locations within each mitigation site (planting and irrigation may not be necessary if preservation of functioning riparian habitat is chosen as mitigation or if restoration can be accomplished without irrigation or planting)
- In-kind reference habitats for comparison with compensatory riparian habitats (using performance and success criteria) to document success
- Monitoring protocol, including schedule and annual report requirements (compensatory riparian habitats shall be monitored for a minimum period of 5 years)
- Ecological performance standards, based on the best available science and including specifications for native riparian plant densities, species composition, amount of dead woody vegetation gaps and bare ground, and survivorship; at a minimum, compensatory mitigation planting sites must achieve 80 percent survival of planted riparian trees and shrubs by the end of the 5-year maintenance and monitoring period, or dead and dying trees shall be replaced and monitoring continued until 80 percent survivorship is achieved
- Corrective measures if performance standards are not met
- Responsible parties for monitoring and preparing reports

- Responsible parties for receiving and reviewing reports and for verifying success or prescribing implementation or corrective actions

Before the start of any ground-disturbing activities that would affect riparian habitats, streams, or alter Millerton Lake or any habitats subject to CDFW jurisdiction under Section 1602 of the California Fish and Game Code, a Lake and Streambed Alteration Agreement shall be obtained. The agreement shall be executed by Reclamation and CDFW before the approval of any grading or improvement plans or any construction activities in any project phase that could potentially affect the bed and bank of streams and associated riparian habitats present within the Study Area. Any conditions of issuance of the Streambed Alteration Agreement shall be implemented as part of project construction activities.

To compensate for the loss of oak woodland habitat within the Temperance Flat Reservoir Area and project features, Reclamation will preserve and protect existing oak woodland habitat in Madera and Fresno Counties in the vicinity of the primary study area. Lands with oak woodland habitat shall be acquired and placed under conservation easement to be protected in perpetuity. The mitigation lands shall be purchased within the upper San Joaquin watershed, to the maximum extent possible to mitigate for loss of oak woodland habitat within the watershed.

Woodland habitat selected for conservation shall be similar in species composition, age, and canopy cover, to the maximum extent possible, with the emphasis on the acquisition and protection of mitigation lands with opportunities to restore, establish, enhance, and preserve habitats with high conservation values and that connect and/or provide protection for wildlife migration corridors. Lands acquired to compensate for loss of oak woodland habitat shall be at a ratio of not less than 1:1 for each affected acre within the primary study area. If land acquisition cannot be completed at a 1:1 ratio within the watershed of impact, funds shall be contributed to CDFW's Oak Woodlands Conservation Fund at a ratio of not less than 1.5:1 for each acre of oak woodland impacted by project implementation and not compensated through acquisition of conservation lands within the affected watershed.

Implementing Mitigation Measure BOT-2 would reduce potentially significant impacts on riparian habitats to a less-than-significant level because a MMP ensuring adequate

compensation for the loss of riparian habitat would be developed and implemented establishing riparian areas along existing streams within the primary study area.

Implementing Mitigation Measure BOT-2 would reduce potentially significant impacts on oak woodland habitats, but not to a less-than-significant level, because the loss of oak woodland acreage and function would be substantial and would contribute substantially to the regional loss of this resource. It is unknown at this time if oak woodland habitat acreage having similar tree sizes and densities, species composition, site condition, and landscape context to the oak woodland to be removed would be available for purchase, and preservation in perpetuity of existing oak woodland habitat would still result in a net loss of oak woodland habitat. Therefore, impacts on oak woodland habitat would remain **significant and unavoidable**.

Mitigation Measure BOT-3: Ensure No Net Loss of Wetlands

A wetland delineation shall be conducted for any areas not previously surveyed for wetlands and waters of the United States. The wetland delineation shall be submitted to the Sacramento District USACE for review and verification before the preparation of permit applications required pursuant to Sections 404 and 401 of the CWA. To the maximum extent feasible, project features located above the Temperance Flat RM 274 Reservoir inundation line shall be located to avoid wetlands and other waters of the United States to the maximum extent possible.

Reclamation shall develop a draft wetland MMP for the project. Before any ground-disturbing activities that would adversely affect wetlands, Reclamation will submit the draft wetland MMP to USACE and the Central Valley Water Board for review and approval of those portions of the plan over which they have jurisdiction. The MMP would be required to be finalized before issuance of a Section 404 permit. Once the final MMP is approved and implemented, mitigation monitoring shall continue for a minimum of 5 years from completion of mitigation, or until the performance standards identified in the approved MMP have been met, whichever is longer.

As part of the MMP, Reclamation will prepare and submit plans for the creation of aquatic habitat to adequately offset and replace the aquatic functions and services that would be lost within the primary study area, account for the temporal loss of

habitat, and contain an adequate margin of safety to reflect anticipated success. Restoration of previously altered and degraded wetlands shall be a priority of the MMP for offsetting losses of aquatic functions on the project site because it is typically easier to achieve functional success in restored wetlands than in those created from uplands. The MMP must demonstrate how the aquatic functions and values that would be lost through project implementation will be replaced.

Mitigation for jurisdictional wetland features shall be consistent with USACE's and EPA's April 10, 2008 *Final Rule for Compensatory Mitigation for Losses of Aquatic Resources* (33 CFR Parts 325 and 332 and 40 CFR Part 230). According to the *Final Rule*, mitigation banks should be given preference over other types of mitigation because much of the risk and uncertainty regarding mitigation success is alleviated by the fact that mitigation bank wetlands must be established and demonstrating functionality before credits can be sold. This also alleviates temporal losses of wetland function while compensatory wetlands are being established.

The *Final Rule* also establishes a preference for compensating losses of aquatic resources within the same watershed as the impact site. The primary study area is located entirely within the upper San Joaquin watershed. Mitigation credits may be available within the watershed. To compensate for the conversion of terrestrial wetlands to a deeper water lacustrine habitat type, additional wetland habitat may need to be restored or created within the primary study area or on off-site lands within the affected watershed, to successfully replace lost functions.

Compensatory mitigation for losses of stream and intermittent drainage channels shall be achieved through in-kind preservation, restoration, or enhancement, as specified in the *Final Rule* guidelines. The wetland MMP shall address how to mitigate impacts on vernal pool, seasonal swale, seasonal wetland, seep, and ephemeral, intermittent, and perennial stream habitat, and shall describe specific method(s) to be implemented to avoid and/or mitigate any off-site project-related impacts.

An operations and management plan (OMP) for all on- and off-site wetland preservation and mitigation areas shall be prepared and submitted to USACE and USFWS for review and approval before the issuance of any permits under Section 404 of the CWA. The plan shall include detailed information on the

habitats present within the preservation and mitigation areas, the long-term management and monitoring of these habitats, legal protection for the preservation and mitigation areas (e.g., conservation easement, declaration of restrictions), and funding mechanism information (e.g., endowment).

Before the start of any ground-disturbing activity associated with the construction of any project feature that would affect waters of the United States, including wetlands, or waters of the State, Reclamation will obtain all necessary permits under Sections 404 and 401 of the CWA or the State's Porter-Cologne Act for the project.

All permits, regulatory approvals, and permit conditions for impacts on wetland habitats shall be secured before implementation of any grading activities within waters of the United States or wetland habitats, including waters of the State. Reclamation will commit to replace, restore, or enhance on a "no net loss" basis (in accordance with USACE and the Central Valley Water Board) the acreage of all wetlands and other waters of the United States that would be removed, lost, and/or degraded with implementation of project plans.

Wetland habitat shall be restored, enhanced, and/or replaced at an acreage and location and by methods agreeable to USACE and the Central Valley Water Board, as determined during the Section 404 and Section 401 permitting processes. Final mitigation ratios will be determined during the permitting process.

USACE has determined that the project will require an individual permit. In its final stage and once approved by USACE, the MMP for the project is expected to detail proposed wetland restoration, enhancement, and/or replacement activities that would ensure no net loss of aquatic functions in the project vicinity. Approval and implementation of the wetland MMP shall aim to fully mitigate all unavoidable impacts on jurisdictional waters of the United States, including jurisdictional wetlands.

All mitigation requirements determined through this process shall be implemented before grading plans are approved. The MMP shall be submitted to USACE and approved before the issuance of any permits under Section 404 of the CWA.

Water quality certification pursuant to Section 401 of the CWA will be required before issuance of the record of decision and

before issuance of a Section 404 permit. Before construction in any areas containing wetland features, Reclamation will obtain water quality certification for the project. Any measures required as part of the issuance of water quality certification shall be implemented.

Implementing Mitigation Measure BOT-3 would reduce potentially significant impacts from the loss of waters of the United States, and State to a **less-than-significant level**.

Mitigation Measure BOT-4: Implement a Weed Management Plan

A weed management plan shall be prepared in advance of any ground-disturbing activity. The weed management plan shall include annual weed monitoring of construction areas and shall extend for three seasons after construction is complete. The weed management plan shall include measures to monitor, control, and eradicate, where possible, invasive plant infestations within and adjacent to construction areas. Construction contractors shall use only weed-free fill, gravel, mulches, and seed sources.

Before commencement of ground-disturbing activities, a qualified botanist shall conduct comprehensive surveys to identify, map, and quantify invasive plant infestations at all construction areas within the primary study area. Mapping will be done using a Global Positioning System (GPS) unit. The resultant Geographic Information System (GIS) layer will be used to identify new and expanded infestations. This procedure will be repeated annually during construction and for 3 years following construction.

The weed management plan will establish and implement control and eradication methods specific to each invasive plant species. The plan will establish thresholds and specific management responses should those thresholds be exceeded. Management responses will be species-specific and will also depend on the size of the plants and of the infestation. Management responses may include mechanical and chemical treatment of infestations.

The weed management plan will include monitoring procedures, success criteria, and adaptive management measures for controlling invasive plant species.

Reclamation will implement the following measures at all construction sites within the primary study area to prevent the introduction and spread of invasive plant species:

- Use only certified weed-free straw or rice straw mulch
- Use native, noninvasive species or nonpersistent hybrids in erosion-control plantings to stabilize site conditions and prevent invasive species from colonizing
- Minimize surface disturbance to the greatest extent possible
- Clean construction equipment before transport to and from construction sites to remove debris that could contain invasive species or their seeds
- Limit washing of construction vehicles and equipment to approved maintenance facilities or staging areas

Implementing Mitigation Measure BOT-4 would reduce potentially significant impacts from the spread of invasive plants to a **less-than-significant** level.

Mitigation Measure BOT-6: Implement Mitigation Measures BOT-1, BOT-2, and BOT-3

Implementing Mitigation Measure BOT-6 would reduce the significant impact related to a conflict with local or regional policies and plans protecting wetland or botanical resources to a **less-than-significant** level because it would require the implementation of a combination of related mitigation measures (BOT-1, BOT-2, and BOT-3) to avoid, minimize, or compensate for impacts on special-status plants, riparian and oak woodland habitats, and wetlands and other waters of the United States consistent with Madera County and Fresno County general plan policies and the BLM RMP protecting these resources.

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Chapter 7
Biological Resources – Wildlife

This chapter describes the affected environment for wildlife species, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion focuses on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (the San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

This section describes the affected environment of the primary and extended study areas for the Investigation. Vegetation communities and their coverage in the Study Area is discussed in detail in Chapter 6, "Biological Resources – Botanical and Wetlands." The habitat types corresponding to the vegetation communities that occur in the primary study area are addressed in the Wildlife Habitats section below. The special-status and general wildlife species that could potentially inhabit these communities are described in the Special-Status Species section below.

Wildlife Habitats

Primary Study Area

The primary study area is located in Madera and Fresno counties in the eastern foothills of the Sierra Nevada, along the San Joaquin River from Friant Dam to Kerckhoff Dam. Elevation ranges from approximately 310 feet msl at Friant Dam to approximately 1,035 feet msl, which includes the buffer area surrounding the high-water surface elevation of the proposed Temperance Flat RM 274 Reservoir.

Area of Project Features Chapter 6, "Biological Resources – Botanical and Wetlands," presents the vegetation communities identified in the area of project features. The project features impact area has been defined to encompass all project features and their footprints.

Dam and Appurtenant Structures Construction of the proposed Temperance Flat RM 274 Dam and the upstream and downstream coffer dams would take place entirely within lacustrine unconsolidated bottom and lacustrine unconsolidated shoreline habitats. Dam embankments would be located in the foothill pine oak woodland atop the cliffs along both sides of the river channel.

Power-Generation Features Power-generation features include a new powerhouse, a Kerckhoff tunnel extension, a right-of-way/diversion tunnel, and an intake structure. Connecting these features and supporting construction is a network of access roads and haul routes. The primary habitat type in this area is foothill pine oak woodland, but annual grassland, blue oak woodland, and a small amount of bush lupine scrub are interspersed through the area where the features, access roads, and haul routes would be constructed. A ventilation shaft for the Kerckhoff tunnel extension would be constructed within an area that is a mix of foothill pine oak woodland, blue oak woodland, and annual grassland. Scattered through the area of project features are a few intermittent and ephemeral drainages. The features described above are all located south of Millerton Lake.

Transmission Line Corridors One new transmission line corridor and one relocated transmission line corridor would be constructed within the primary study area. The new transmission line would be located on the south bank of Millerton Lake and would follow a course that passes through foothill pine oak woodland and annual grassland habitats. Four small and disjunct patches of blue oak woodland are scattered through the general transmission line corridor, and one small patch of bush lupine scrub occurs in the northern portion of the corridor.

The second transmission line would replace an existing PG&E transmission line located near the existing Kerckhoff Powerhouse and cross over the Temperance Flat RM 274 Reservoir. The transmission line course would pass through foothill pine oak woodland and blue oak woodland.

Other Construction Areas Additional construction areas would include a soils waste area and a mobilization or staging area, and batch plants for making concrete and an aggregate quarry for excavating rock. The waste area would be used for waste rock and tunnel muck from various excavations and would be sited in a small embayment on Millerton Lake

composed entirely of lacustrine habitats. The area encompassing all of the quarry, batch plant, and haul road options was included in the impact calculations for project features even though only one quarry site, supporting dam batch plant, and connecting haul road would ultimately be constructed under the action alternatives. This approach overestimates the impacted area, and provides a conservative analysis of the potential impacts of the action alternatives.

A total of up to four potential boat-in campsites would be located within the primary study area. They would all be located on the edge of the new Temperance Flat RM 274 Reservoir, and the estimated impact on habitat associated with these features is included within the impact calculated for the area of inundation.

Existing hiking trails would also be relocated to areas along the edge of the Temperance Flat RM 274 Reservoir shoreline.

Temperance Flat Reservoir Area The Temperance Flat RM 274 Reservoir Area includes Millerton Lake above the proposed Temperance Flat RM 274 Dam, the San Joaquin River between the top of Millerton Lake and Kerckhoff Dam, the area that would be inundated by a 985-foot dam, and a buffer area outside of the inundation zone that is the lesser of 50 vertical feet or 0.25 mile. Nearly 78 percent of this area is composed of upland woodland habitats (see Chapter 6, “Biological Resources – Vegetation and Wetlands”), and most of those habitats consist of foothill pine oak woodland and blue oak woodland. Lacustrine and riverine habitats comprise the next largest component, covering 44 percent of the Temperance Flat Reservoir Area. Herbaceous wetland habitats in the form of seasonal wetland and freshwater seep make up 2 percent, annual grassland makes up 2 percent, and three cover types each make up less than 1 percent, including riparian communities covering approximately 33 acres.

Millerton Lake Below RM 274 Millerton Lake between Friant Dam and RM 274 consists solely of lacustrine unconsolidated bottom (open water [i.e., the lake]) and lacustrine unconsolidated shoreline (the shoreline exposed at lower lake levels) habitats. No other habitats were considered in this part of the primary study area.

Extended Study Area

San Joaquin River from Friant Dam to Merced River The portion of the extended study area encompassing the San

Joaquin River from Friant Dam to the Merced River was divided into eight reaches. Habitat types vary widely in each reach and are summarized below.

Reach 1A As a result of stabilized active-channel conditions below Friant Dam (due to reduced magnitude, frequency, and duration of flood flows), the extent of gravel bars and herbaceous riparian and marsh vegetation has declined from historical conditions. In addition, riparian forest has shifted from cottonwood dominance to mixed riparian forest, with dominance by willows and alders, which are particularly effective colonizers following upstream diversions (Reclamation 1998a). Reach 1A presently supports continuous riparian vegetation, except where the channel has been disrupted by instream aggregate removal or off-channel aggregate pits that have been captured by the river. This reach has the greatest diversity of vegetation types and has the highest overall diversity of plant species. Based on the 2000 vegetation surveys by DWR (DWR 2002), eight identified riparian communities (cottonwood, willow, mixed, and oak riparian forest; willow and riparian scrub and elderberry savanna; and emergent wetlands) are present in this reach.

Reach 1B Woody riparian vegetation is prevalent and occurs mainly in narrow strips immediately adjacent to the river channel. Mature vegetation on the back side of many point bars and on low floodplains is scarce. Remnant valley oaks are present on some of the higher terraces. Previously cleared terraces and the understory of the cottonwood and oak stands are dominated by nonnative annual grasses (McBain & Trush 2002).

Reach 2A Riparian vegetation in the upper 10 miles of this reach is sparse or absent because the river is usually dry and the shallow groundwater is overdrafted (McBain & Trush 2002). Grassland/pasture is relatively abundant in Reach 2A, contributing almost 50 percent to the total natural land cover (excluding urban and agricultural land cover types). The most abundant riparian communities present are riparian and willow scrub habitats. The only significant stand of elderberry savanna mapped in the extended study area occurs on the left bank of this reach.

Reach 2B The lower few miles of this reach support narrow, patchy, but nearly continuous vegetation, because this area is continuously watered by the backwater of the Mendota Pool affecting both surface and groundwater elevation. The riparian

zone is narrowly confined to a thin strip 10 to 30 feet wide bordering the channel. The herbaceous understory is rich in native species, and a high portion of the total vegetative cover is native plants. The margins of Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the waterline.

Reach 3 Nearly continuous riparian vegetation of various widths and cover types occurs on at least one side of the channel in this reach (McBain & Trush 2002); however, the narrow width of the riparian corridor results in a low ratio of native vegetation per river mile (DWR 2002). In this reach, cottonwood riparian forest is the most abundant native vegetation type, followed by willow scrub, willow riparian forest, and riparian scrub. The narrow riparian corridor is likely a result of development of the upper and middle floodplain elevations for agricultural and urban uses. A reduction in the frequency of flood events also likely resulted in less-frequent scouring events, decreasing the abundance of early successional riparian vegetation (i.e., scrub) and riverwash (Reclamation 1998b), while allowing the riparian forest to establish.

Reach 4A Reach 4A is sparsely vegetated, with a thin band of vegetation along the channel margin (or none at all). Willow scrub and willow riparian forest occur in small to large stands, and in-channel pools rimmed by small areas of marsh vegetation are present in the channel; however, this reach has the fewest habitat types and lowest ratio of natural vegetation per river mile in the extended study area.

Reach 4B Reach 4B is divided into Reaches 4B1 and 4B2. Reach 4B1 supports a nearly unbroken, dense, but narrow corridor of willow scrub or young mixed riparian vegetation on most of the reach, with occasional large gaps in the canopy. It no longer conveys flows because the Sand Slough Control Structure diverts all flows into the bypass system. As a result, the channel in Reach 4B1 is poorly defined and filled with dense vegetation, and, in some cases, it is plugged with fill material. Because of the wider floodplain and available groundwater, as well as management of the land as part of the San Luis NWR, Reach 4B2 contains vast areas of natural vegetation compared to the upstream reaches. Grasslands and pasture are the most common vegetation type, but willow riparian forest and emergent wetlands are also relatively abundant (DWR 2002).

Reach 5 In Reach 5, the San Joaquin River is surrounded by large expanses of upland grassland with numerous inclusions of woody riparian vegetation in the floodplain. Remnant riparian tree groves are concentrated on the margins of mostly dry secondary channels and depressions, or in old oxbows. Along the mainstem San Joaquin River, a relatively uniform pattern of patchy riparian canopy hugs the channel banks as large individual trees or clumps (primarily valley oaks or black willow) with a mostly grassland or brush understory (McBain & Trush 2002). The most abundant plant community is grassland and pasture, followed by willow riparian forest, emergent wetland, willow and riparian scrub, and willow, oak, and cottonwood riparian forests. Alkali scrub is also present in this reach (DWR 2002).

San Joaquin River from Merced River to the Delta From the confluence with the Merced River to the Delta, the San Joaquin River is bordered extensively by agricultural fields. Agricultural land use has also reduced much of the riparian habitat. In most areas, only a narrow ribbon of riparian habitat is supported. However, riparian habitat is more extensive locally, especially near the confluence with tributary rivers, within cutoff oxbows, and in the 6,500-acre San Joaquin River NWR between the confluences with the Tuolumne and Stanislaus Rivers (DWR 2012).

Delta The Delta is divided into numerous islands and hundreds of miles of waterways. Historically, the Delta had extensive areas of wetlands. Nearly all of the Delta's wetlands have been reclaimed for agriculture and other land uses. These islands include "flooded islands" that were once reclaimed land, but were abandoned after levee failures. The portion of the Delta under consideration for the extended study area is limited to open waterways because the impacts of the project in the Delta would be limited to the conveyance of water that would be contained within the bed, bank, and channels of the existing waterways. Chapter 6, "Biological Resources – Vegetation and Wetlands," provides a list of land cover types in this portion of the extended study area.

CVP and SWP Water Service Areas The CVP and SWP water service areas contain a large diversity of both lowland and upland habitats and associated species, although agricultural and urban development has reduced the area and connectivity of important habitats that are critical to sustaining a wide variety of unique plants and animals (DFG 2007). The agricultural land and urban development that dominate the

CVP and SWP water service areas, respectively, are dominated by nonnative and ornamental plant species. Examples of habitat features within these areas include shelter belts characterized by disked agricultural fields and urban parks with landscaped vegetation.

Special-Status Species

Primary Study Area

As defined in this document, special-status taxa are species or subspecies that fall into one or more of the following categories, regardless of their legal or protection status:

- Officially listed or proposed for listing by California or the Federal government as endangered, threatened, or rare
- Taxa that meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the State CEQA Guidelines
- Taxa designated as a special-status, sensitive, or declining species by other State or Federal agencies or nongovernmental organizations, including species classified as sensitive by BLM
- Species identified by the CDFW as California Species of Special Concern
- Animals fully protected in California under the California Fish and Game Code

Each special-status species known to be present or potentially present in the primary study area is presented in Table 7-1.

Temperance Flat Reservoir Area Based on the results of database searches and review of existing environmental documentation, 39 special-status animal species were identified as either known to occur or having potential to occur in the primary study area (Table 7-1). See Figures 7-1 and 7-2 for special-status wildlife species that have been documented in the vicinity of the primary study area. The same species are either known to occur or have potential to occur in the Temperance Flat Reservoir Area. Species descriptions are derived primarily from information in the CNDDB records (CDFW 2013); existing species accounts available from CDFW, the USFWS, and others; recovery plans for

special-status species with potential to occur in the extended study area; and relevant scientific literature.

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Invertebrates					
Dutchman's pipe / Pipevine swallowtail *Battus philenor*	—	—	BLM	Plants from the pipevine family are hosts (e.g., Dutchman's pipe, California pipevine); found in mesic habitat in forest understory or with shrubs	Present • Multiple pipevine swallowtails were observed in the primary study area during surveys (Figure 3-2 of wildlife technical report-Bureau of Reclamation 2007). Eleven populations of host-plant locations were also detected throughout the primary study area (U.S. Department of the Interior, Bureau of Reclamation 2007). • Suitable habitat occurs in riparian habitat throughout primary study area
Vernal pool fairy shrimp *Branchinecta lynchi*	T	—	—	Inhabits primarily vernal pools, but also occurs in other seasonal wetlands such as alkaline rain pools, ephemeral drainages, rock outcrop pools, ditches, stream oxbows, stock ponds, and vernal swales	Possible • A number of CNDDB records northeast, north, west, south, southwest, and southeast of Friant Dam • May use vernal pools on tops of tables
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	—	—	Elderberry shrubs are host; generally found in riparian areas and floodplains, also open hillsides and rocky outcrops	Possible • Species not documented in primary study area but known to occur in region • Many elderberry shrubs present; some older live and dead shrubs with potential exit holes
Vernal pool tadpole shrimp *Lepidurus packardi*	E	—	—	Occurs in a variety of seasonal habitats: vernal pools, ponded clay flats, alkaline pools, ephemeral stock tanks, and roadside ditches	Possible • A number of CNDDB records northeast of Friant Dam at Big Table Mountain • May use vernal pools on tops of tables

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Amphibians					
California tiger salamander *Ambystoma californiense*	T	T	—	Breeds in vernal pools or other temporary pools; spends most of life cycle in upland burrows	Possible • One undocumented report near Indian Village site within primary study area • A number of CNDDB records northeast, north, west, south, and southeast of Friant Dam; also documented in Auberry • May use vernal pools on tops of tables • Potential movement corridors exist from tops of tables to Millerton Lake, but movements into and out of the San Joaquin River Gorge are unlikely • No California tiger salamander detected during aquatic larval surveys in 2008 and 2011
California red-legged frog *Rana draytonii*	T	CSC	—	Aquatic habitat such as ponds, backwaters, sloughs, stock ponds, especially with emergent and submersed aquatic vegetation	Unlikely • Primary study area in current known range, and suitable habitat is present; however, nearest known occurrence 65 miles away
Foothill yellow-legged frog *Rana boylii*	—	CSC	BLM-S	Partly shaded shallow streams and riffles with rocky substrate that is at least cobble sized, in various habitats; may breed near confluence of smaller tributaries with larger rivers	Possible • Potential habitat is present in primary study area • None found during 2007 focused surveys in the San Joaquin River Gorge or tributaries
Western spadefoot *Spea hammondii*	—	CSC	BLM-S	Preferred habitat is grasslands with temporary water pools, but will breed in permanent pools	Possible • Known occurrences near primary study area • Suitable habitat available
Birds					
Cooper's hawk *Accipiter cooperii* (nesting)	—	WL	—	Inhabits oak savanna, woodlands, and open grassland habitats, especially near water	Present • Present throughout primary study area
Sharp-shinned hawk *Accipiter striatus* (nesting)	—	WL	—	Nests in woodlands, but may occur in the more open savanna type habitats, especially near water	Present • Present in portions of primary study area with relatively higher-quality nesting habitat

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Birds (contd.)					
Grasshopper sparrow *Ammodramus savannarum* (nesting)	—	CSC	—	Inhabits moderately open grasslands, grassland-shrub areas, and ruderal areas with patchy bare ground	Possible • No recent records of occurrence near primary study area • Limited suitable nesting habitat is present in the table top grasslands to the southeast of the Temperance Flat RM 274 Dam site.
Golden eagle *Aquila chrysaetos*	—	FP, WL	BGEPA	Forages over open shrub and grasslands; nests in large trees and on cliffs or large rock outcrops	Present • Known to occur in primary study area; nests in cliffs above Millerton Lake
Long-eared owl *Asio otus* (nesting)	—	CSC	—	Wide distribution but uncommon; found in riparian and areas of dense trees and shrubs near water	Unlikely • Habitat in primary study area is marginal
Western burrowing owl *Athene cunicularia* (burrow sites and some wintering sites)	—	CSC	BLM-S	Open dry grasslands and desert habitat; nests and dens in underground burrows, especially those of ground squirrels	Unlikely • Habitat in primary study area is marginal
Northern harrier Circus cyaneus (nesting)	—	CSC	—	Prefers annual and perennial grasslands, open meadows	Unlikely • Predominantly forested habitats in the primary study area are not optimal
White-tailed kite Elanus leucurus	—	FP	—	Prefers coastal and lowland valleys; often associated with farmlands, meadows with emergent vegetation, grasslands	Unlikely • Not commonly known in the primary study area; may be occasional migrant • Preferred habitat not present
Little willow flycatcher *Empidonax trailii brewsteri*	—	E	—	Requires contiguous patches of multilayered dense willows or riparian habitat with moist soils and/or standing water for nesting; riparian habitats and large wet meadows with abundant willows during migration	Unlikely • No confirmed recent sightings in primary study area but incidental occurrence as migrant is possible • Riparian habitat too limited in size, distribution, and structure for nesting
California horned lark *Eremophila alpestris actia*	—	WL	—	Open grasslands and pasture with short vegetation	Possible • Limited suitable nesting habitat is present in the table top grasslands to the southeast of the proposed Temperance Flat RM 274 Dam site

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Merlin *Falco columbarius* (wintering)	—	WL	—	Prefers open grasslands, savannas and woodlands below elevation 4,000 feet	Possible • Uncommon winter migrant • Suitable habitat is limited in primary study area
Prairie falcon *Falco mexicanus* (nesting)	—	WL	—	Forages over large areas of open habitats; nests in cliffs	Present • Known to nest in San Joaquin River Gorge and in cliffs above Millerton Lake
American peregrine falcon *Falco peregrinus anatum* (nesting)	—	FP	—	Forages in open fields, especially near water and over forest and woodland habitats; nests on cliffs, tall buildings, or bridges	Present • Reported as occasional over the San Joaquin River east of Friant Dam • Suitable nesting and foraging habitat is available but nesting has not been documented
Bald eagle *Haliaeetus leucocephalus*	—	E, FP	BGEPA	Forages over open water, roosts in adjacent trees, nests in tall, sturdy trees	Present • Pair nesting at southwestern edge of primary study area near Millerton Lake and known to use other parts of primary study area
Yellow-breasted chat *Icteria virens* (nesting)	—	CSC	—	Dense riparian thickets of willows, vine tangles, and dense brush associated with streams, swampy ground, and the borders of small ponds	Unlikely • Suitable riparian habitat is limited in primary study area
Loggerhead shrike *Lanius ludovicianus* (nesting)	—	CSC	—	Common resident in open habitats with scattered trees and shrubs; prefers habitats with abundant perches	Possible • Known to occur in primary study area as winter migrant • Suitable habitat is available for nesting
Osprey *Pandion haliaetus* (nesting)	—	WL	—	Forages over large bodies of water and rivers that have abundant fish with large trees or other platforms for nesting	Present • Observed around Millerton Lake; nests north of primary study area • Nesting within primary study area possible
Yellow warbler *Setophaga petechia* (nesting)	—	CSC	—	Breeds in mesic, deciduous thickets, especially riparian; preferred habitat includes moist areas with dense insect prey populations	Present • Detected in primary study area at Big Sandy Creek but nesting not documented • Habitat is limited in size and has marginal structure for nesting

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
California spotted owl *Strix occidentalis occidentalis*	—	CSC	BLM-S	In the Sierra Nevada foothills, nests in oak woodlands located in or near riparian areas in steep-sided canyons	Possible • Detected immediately southeast of Kerckhoff Dam • Suitable habitat is available in primary study area
Least Bell's vireo *Vireo bellii pusillus* (nesting)	E	E	—	Cottonwood-willow forest, oak woodland, shrubby thickets, and dry washes with willow thickets	Unlikely • Riparian habitat too limited in size, distribution, and structure • Not known to nest in or near primary study area
Mammals					
Pallid bat *Antrozous pallidus*	—	CSC	BLM-S	Forages over wide range of habitats, including grasslands, scrub, woodlands, and forests; most common in open, dry habitat with rocky areas for roosting; also roosts in large oaks and buildings	Present • Known to breed in cliffs above Millerton Lake
Ringtail *Bassariscus astutus*	—	FP	—	Prefers riparian, brush habitats and most forest habitats, areas with talus or rocky elements or snags for cover; occurs at low elevations to middle elevations	Possible • Species is known to occur near primary study area and likely to occur within it • Suitable habitat available
Townsend's big-eared bat *Corynorhinus townsendii*	—	CSC	BLM-S	Found throughout California in many habitats; roosts in colonies in caves, mines, or buildings; extremely sensitive to human disturbance	Present • Detected in rock outcrop near Millerton Bottoms • Suitable roosting and foraging habitat is available in primary study area
Spotted bat *Euderma maculatum*	—	CSC	BLM-S	Species biology not well known; distribution limited to approximately 40 small areas in California; may forage in foothills, desert; breeds and roosts in rock crevices	Possible • Not known to occur in primary study area • Suitable habitat occurs in primary study area
Western mastiff bat Eumops perotis californicus	—	CSC	BLM-S	Found throughout California in many habitats; nests in cliffs; intolerant of human activity	Possible • Known to nest in cliffs above Millerton Lake. Likely uses portions of primary study area for foraging.
Western small-footed myotis *Myotis ciliolabrum*	—	—	BLM-S	Occurs in wide range of dry upland habitats in the Sierra Nevada; prefers scrub and woodlands near open water where it feeds; ranges from sea level to elevation 9,000 feet	Possible • Occurrence in primary study area unknown • Suitable habitat exists

Table 7-1. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Long-eared myotis *Myotis evotis*	—	—	BLM-S	Widespread but uncommon; prefers brushy, woodland, and forest habitats; roosts in buildings, caves, under tree bark, snags and rock crevices	Possible • Occurrence in primary study area unknown • Suitable habitat present
Fringed myotis *Myotis thysanodes*	—	—	BLM-S	Distribution is widespread, but abundance is irregular; optimal habitat is pinyon–juniper, valley foothill hardwood and hardwood-conifer between elevation 4,000 and 7,000 feet	Possible • Occurrence in primary study area unknown • Suitable habitat is limited in the primary study area; elevation is below general distribution
Yuma myotis *Myotis yumanensis*	—	—	BLM-S	Common and widespread in California; wide range of habitats used; roosts in caves, mines, buildings; optimal habitat is open woodlands and forests near open water	Present • Known to occur in region • Suitable habitat occurs in primary study area
San Joaquin pocket mouse *Perognathus inornatus inornatus*	—	—	BLM-S	Occurs in dry, open grasslands with fine-textured soils in the Central and Salinas Valleys from elevation 1,000 to 2,000 feet	Possible • Presence in primary study area unknown • Suitable habitat is limited
American badger *Taxidea taxus*	—	CSC	—	Drier open grassland, shrub, and forest habitats with friable soils	Possible • Known to occur near primary study area • Suitable habitat present and species is likely to occur

Key:
CNDDB = California Natural Diversity Database

[1] Federal Status:
E: Endangered
T: Threatened

[2] State Status:
CSC: California Species of Special Concern
E: Endangered
FP: Fully Protected
T: Threatened
WL: Watch list

[3] Other Status:
BGEPA: Federal Bald and Golden Eagle Protection Act
BLM-S: BLM Sensitive Species
BLM: Species of management concern to BLM

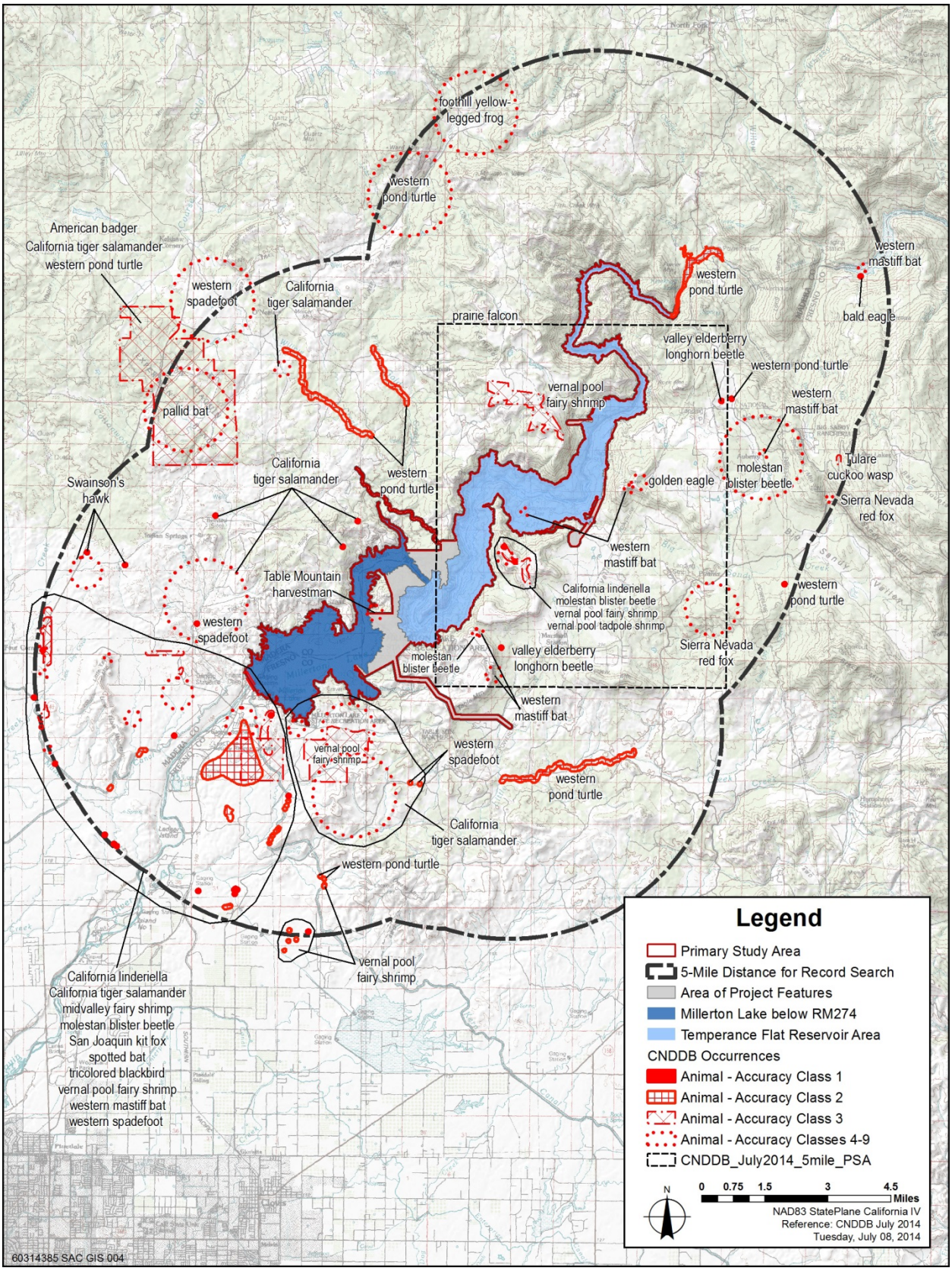


Figure 7-1. Wildlife Occurrences in Vicinity of Primary Study Area

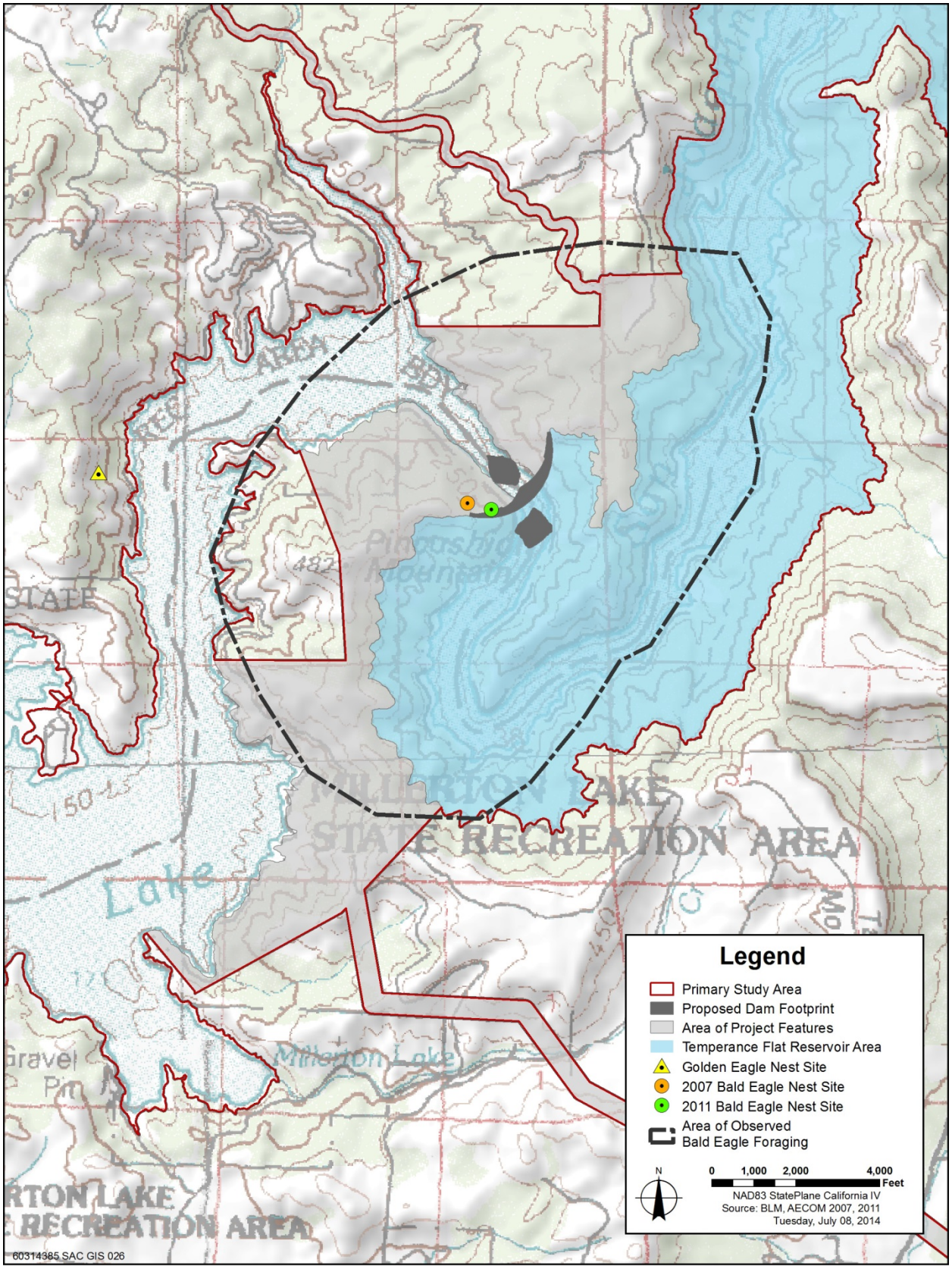


Figure 7-2. Eagle Nest Location Map

Invertebrates

Pipevine Swallowtail (*Battus philenor*) Eleven California pipevine (*Aristolochia californica*) plant populations were identified in the Temperance Flat Reservoir Area. All were located on streambanks or in mesic woodland sites between Big Sandy Creek and just upstream from Kerckhoff Powerhouse. Pipevine swallowtail butterflies were observed in the Temperance Flat Reservoir Area, primarily in the vicinity of the BLM facilities and Kerckhoff Powerhouse. Each of the five of the largest pipevine populations observed in the primary study area supported hundreds of pipevine swallowtail caterpillars during surveys conducted in April and May. The pipevine swallowtail is of management concern to BLM because it is reportedly one of only two known resident populations (Reclamation 2007); however, it has not been designated as a sensitive species by BLM.

Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) The entire primary study area is located within the known range of the vernal pool fairy shrimp. Suitable habitat for this species within the primary study area is generally limited to possible vernal pool grassland in the new transmission line corridor. No vernal pool fairy shrimp have been detected within the primary study area, but there are various CNDDB occurrences within 3 to 5 miles of the primary study area, with the closest occurrences at Big Table Mountain approximately 0.4 miles to the southeast of the primary study area (CNDDB 2014). Two critical habitat units have been designated in the vicinity of the primary study area: Units 25 and 24b (USFWS 2006a). These critical habitat units are located outside of the primary study area, one in Madera County at Kennedy Table (Unit 25), and one in Fresno County southwest of Friant Dam (Unit 24b). Upland habitats used by vernal pool fairy shrimp are grassland uplands interspersed with vernal pools. No vernal pool branchiopod surveys have been performed within the primary study area.

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) Elderberry shrubs, host plant for the valley elderberry longhorn beetle, were found throughout the Temperance Flat Reservoir Area, primarily in foothill pine oak woodland, often near intermittent or ephemeral drainages or in rock outcrops. A total of 375 elderberry shrubs were mapped within the Temperance Flat Reservoir Area, and all were of appropriate size for this beetle. Exit holes were frequently observed in dead wood but were observed in the live wood of only five shrubs. There are six documented valley elderberry

longhorn beetle occurrences in the CNDDB within 10 miles of the primary study area (CDFW 2013). The nearest CNDDB occurrence is located just east of Big Table Mountain, approximately 1 mile from the primary study area. Another occurrence is reported for Little Sandy Creek, approximately 3 miles from the primary study area. Other occurrences are reported in the San Joaquin River Gorge by Stebbins (2003).

Vernal Pool Tadpole Shrimp (*Lepidurus packardi*) The primary study area is located partially within the known range of the vernal pool tadpole shrimp. Suitable habitat for this species within the primary study area is generally limited to possible vernal pool grassland in the new transmission line corridor. No vernal pool tadpole shrimp have been detected within the primary study area, but there are three CNDDB occurrences within 1 mile of the primary study area, all at Big Table Mountain approximately 0.4 miles to the southeast of the primary study area (CNDDB 2014). One critical habitat unit has been designated in the vicinity of the primary study area: Unit 17 (USFWS 2006a). This critical habitat unit is located outside of the primary study area at Big Mountain Table approximately 0.4 miles to the southeast of the Temperance Flat Reservoir Area. Upland habitats used by vernal pool tadpole shrimp are grassland uplands interspersed with vernal pools. No vernal pool branchiopod surveys have been performed within the primary study area.

Amphibians and Reptiles

California Red-Legged Frog (*Rana draytonii*) The primary study area is located within the historic range of the California red-legged frog, but not the current known range (USFWS 1999a, 2002; CDFW 2013). The nearest known occurrence is approximately 65 miles west of the primary study area (CDFW 2013). Five stream segments and four pools in the Temperance Flat Reservoir Area provide habitat with suitable physical characteristics, but they are located a substantial distance from known occupied habitats. This species is considered unlikely to occur in the primary study area.

California Tiger Salamander (*Ambystoma californiense*) The entire primary study area is located within the known range of the California tiger salamander. There are two reported California tiger salamander occurrences within 3 miles of the primary study area and one reported sighting of California tiger salamander within the primary study area (CDFW 2013). Three California tiger salamander critical habitat units have been designated in the vicinity of the primary

study area: Units 1a, 1b, and 2 (USFWS 2005). These critical habitat units are located outside of the primary study area, two in Madera County north (Unit 1a) and west (Unit 1b) of Friant Dam, and one in Fresno County south of Friant Dam and mostly south of Auberry Road (Unit 2). Upland habitats used by California tiger salamander are grasslands and woodlands with active small-mammal burrows. Larval surveys were conducted in 2008 and 2011 within the primary study area, at which time no California tiger salamanders were found.

Foothill Yellow-Legged Frog (*Rana boylii*) Habitat for foothill yellow-legged frog is limited within the primary study area by lack of perennial water and by management of water releases from Kerckhoff Dam. Based on general habitat requirements, three locations were identified as potentially suitable, and five, including the San Joaquin River, as marginal. The entire primary study area is located within the known range of the foothill yellow-legged frog, and there are three known occurrences of foothill yellow-legged frog located within 10 miles of the primary study area; however, there are no known occurrences located within 3 miles (CDFW 2013). These frogs were not detected during visual-encounter surveys in 2007.

Western Spadefoot (*Spea hammondii*) Western spadefoot occurs in grassland with temporary pools and is likely to occur in the primary study area based on habitat presence and known occurrence in the vicinity. The species was not observed during field surveys in 2007, 2010, and 2011. There are more than 30 recorded spadefoot occurrences located within 10 miles.

Western Pond Turtle (*Emys marmorata*) Western pond turtle is known to occur in the primary study area and in the general vicinity in stock ponds, streams, and reservoirs. There are a number of western pond turtle occurrences identified in the vicinity of the primary study area, including Kerckhoff Lake (CDFW 2013). During surveys, three adult western pond turtles were observed in Big Sandy Creek, and one adult western pond turtle was observed in the San Joaquin River. Sixteen CNDDB records of western pond turtle are reported within 10 miles of the primary study area.

Coast Horned Lizard (*Phrynosoma blainvillii*) Coast horned lizard is found on gravelly, sandy soils in a variety of habitats. Suitable habitat occurs at a number of locations in the

primary study area. This species was not observed during field surveys but has the potential to be present.

Birds

Cooper's Hawk (*Accipiter cooperi*) Cooper's hawk breeds in deciduous, mixed, and evergreen forests with forest-edge habitat for hunting (Curtis et al. 2006). Occurrences of Cooper's hawks within and surrounding the primary study area include the San Joaquin River Gorge (Stebbins 2003), the San Joaquin Experimental Range as uncommon permanent residents (Purcell et al. 2005), and observations during point-count surveys between 1999 and 2004 along transects in Big Sandy Creek, on Wellbarn Road, and in Sky Harbor Channel (Millerton Lake, downstream from Fine Gold Creek) (Smith, pers. comm., 2007). Suitable habitat is present, and a Cooper's hawk was detected in the primary study area during the May 2007 survey.

Sharp-Shinned Hawk (*Accipiter striatus*) Sharp-shinned hawk breeds in dense woodlands that contain conifers and are cool, moist, well shaded, and near water (Bildstein and Meyer 2000). Occurrences of sharp-shinned hawks within and surrounding the primary study area are from the San Joaquin Experimental Range as a rare fall migrant and winter resident and as an occasional spring migrant (Purcell et al. 2005); they have typically been recorded from September to April. This species has also been detected during point-count surveys between 1999 and 2004 along Winchell Cove and Sky Harbor Channel transects (Smith, pers. comm., 2007). Suitable nesting habitat is present in the primary study area and a sharp-shinned hawk was detected during a May 2007 survey near Kerckhoff Dam.

Grasshopper Sparrow (*Ammodramus savannarum*) Grasshopper sparrow generally prefers moderately open grasslands and prairies with patchy bare ground (Vickery 1996). There are no records of grasshopper sparrow occurrence in the San Joaquin River Gorge or San Joaquin Experimental Range. It is unlikely to occur in the primary study area because grassland habitats are small and patchy.

Golden Eagle (*Aquila chrysaetos*) Golden eagle occurs in open and forested habitats, nesting in large trees or on ledges, cliffs, or rock outcrops (Kochert et al. 2002) and foraging primarily for small mammals in open areas. It has been detected in the vicinity of the primary study area in the San Joaquin River Gorge (Stebbins 2003) and in the San

Joaquin Experimental Range as an occasional permanent resident (Purcell et al. 2005), has been observed on or above cliffs along the Sky Harbor Channel and during point-count surveys between 1999 and 2006 (Smith, pers. comm., 2007), and was seen flying over in the primary study area during 2010 surveys. Suitable breeding habitat and foraging habitat is found throughout the primary study area. Therefore, it is assumed to be present within the primary study area.

Long-Eared Owl (*Asio otus*) Long-eared owl prefers riparian habitats or other areas with dense trees and shrubs near water. There are no CNDDB or other local records for this species; however, it is a secretive owl that is difficult to detect. Available habitat is considered only marginal for this species, but occurrence is possible. There are no CNDDB records indicating the presence of this species within 10 miles of the primary study area.

Western Burrowing Owl (*Athene cunicularia*) Western burrowing owl inhabits dry, open, short-grass, mostly treeless plains, usually associated with burrowing mammals (Haug et al. 1993). There are no CNNDB records (CDFW 2013) or other recorded observations in San Joaquin River Gorge or San Joaquin Experimental Range. With the exception of the transmission line area, suitable habitat was not found within the primary study area, and this species is not expected to nest or winter there. There are three CNDDB records of occurrence for this species within 10 miles, but no records of occurrence within 1 mile of the primary study area.

Northern Harrier (*Circus cyaneus*) Northern harrier breeds in open wetlands, including meadows, lightly grazed pastures, fallow croplands, upland prairies, and marshes (MacWhirter and Bildstein 1996). Harriers were observed adjacent to the primary study area during spring point-count surveys in 2000 near Sky Harbor Channel (Smith, pers. comm., 2007) and as a casual species from fall through spring. Harriers were not detected within the primary study area during 2007 surveys and are unlikely to be present based on existing habitat conditions. Grassland and open-marsh habitats in the primary study area are marginal, and this species is unlikely to nest there.

White-Tailed Kite (*Elanus leucurus*) White-tailed kite prefers low-elevation grassland, agricultural, wetland, oak-woodland, or savanna habitats (Dunk 1995). Although it may be an occasional migrant in the primary study area,

suitable nesting habitat is not present and foraging habitat is marginal. Occurrences near the primary study area include observations in the San Joaquin Experimental Range, located northwest of the primary study area (Purcell et al. 2005), and infrequent observations of individuals at other times. This species is considered unlikely to occur.

Little Willow Flycatcher (*Empidonax trailii brewsteri*) Little willow flycatcher inhabits moist, shrubby areas, often with standing or running water (Sedgwick 2000). It is typically restricted to thickets of willows, whether along streams, in canyon bottoms, in seepages, or at the margins of ponds and lakes (Grinnell and Miller 1944). There are eight records of occurrence from the San Joaquin Experimental Range (upstream from the Temperance Flat Reservoir Area) of accidental migrants in spring/summer and fall (Purcell et al. 2005). Suitable habitat for breeding little willow flycatchers was not detected in the Temperance Flat Reservoir Area, and flycatchers were not observed during surveys in May and June 2007 in the highest-quality habitats available. It is unlikely to occur within the primary study area and there are no CNDDB records of occurrence within 10 miles.

California Horned Lark (*Eremophila alpestris actia*) California horned lark prefers open grasslands and grazed fields with short and often sparse vegetation (Beason 1995). There are no known occurrences of California horned lark within the primary study area but they are known to occur nearby. Suitable habitat is limited, so this species is unlikely to be present.

Merlin (*Falco columbarius*) Merlin occurs in open grassland, savanna and woodland habitats. Merlin could occur in the primary study area during winter; however, it does not nest in California. There are no recorded occurrences of this species within the primary study area.

Prairie Falcon (*Falco mexicanus*) Prairie falcon nests on ledges, crevices, or potholes on volcanic buttes, sandstone canyons, bluffs, and isolated rock outcrops. Vertical cracks and horizontal shelves provide the most typical nest sites, and open grass and shrub land provide foraging habitat (Steenhof 1998). Prairie falcons have been detected in the San Joaquin River Gorge (Stebbins 2003) and in the San Joaquin Experimental Range (Purcell et al. 2005) where they have been rare in fall and winter and occasional in spring. Prairie falcons were detected during spring point-count surveys in 2004 and 2006

along Wellbarn Road and Sky Harbor Channel (Smith, pers. comm., 2007). No prairie falcons were detected during spring surveys in 2007, but this species is expected to nest in the area based on presence in the area and abundance of high-quality nesting habitat.

American Peregrine Falcon (*Falco peregrinus anatum*) American peregrine falcon nests on cliff ledges, buildings, and bridges, usually adjacent to rivers, lakes, and marshes supporting abundant waterfowl and other water birds for prey (White et al. 2002). This species has not been recorded in the San Joaquin River Gorge or San Joaquin Experimental Range (Purcell et al. 2005), but occurrence is considered likely. Although it was not observed during the spring surveys in 2007, high-quality breeding habitat, such as table-top mountain cliffs within the San Joaquin River Gorge, is present, as is suitable foraging habitat. Therefore, the species is assumed to be present in the primary study because of existing high-quality nesting habitat and suitable foraging habitat.

Bald Eagle (*Haliaeetus leucocephalus*) Bald eagle forages in rivers and lakes and nests in many parts of California and is known to occur in the primary study area. Nesting habitat typically includes large trees with open branches, usually within 1 mile of large bodies of open water (Buehler 2000). There are several documented occurrences of bald eagles in the San Joaquin River Gorge (Stebbins 2003). They are common winter residents, and some remain to nest at Millerton Lake, the Fine Gold Creek area, and Bass Lake (Smith, pers. comm., 2007). They have also been detected during spring point-count surveys along Sky Harbor Channel in 2000, 2003, and 2007 (Smith, pers. comm., 2007). Nests were found in 2010 and 2011 within the proposed Temperance Flat Reservoir Area.

Yellow-Breasted Chat (*Icteria virens*) Yellow-breasted chat inhabits riparian and shrubby habitat and is a relative generalist in its use of available habitat (Eckerle and Thompson 2001). In California, chats use dense riparian thickets of willows, vine tangles, and dense brush associated with streams and the borders of small ponds (Small 1994). There are no CNDDB or other local records of occurrence for this species in the primary study area or in the region, it was not detected on 2007 surveys, and little suitable habitat is found in the primary study area. It is considered unlikely to occur.

Loggerhead Shrike (*Lanius ludovicianus*) Loggerhead shrike is typically found in open country with short vegetation, such as pastures, mowed roadsides, and open woodlands with isolated trees or shrubs for nesting (Yosef 1996). There are no CNDDB records of occurrence (CDFW 2013), reports in local accounts, or point-count data for this bird in the region during the breeding season. Habitat is considered marginal for nesting, but nesting in the primary study area is possible.

Osprey (*Pandion haliaetus*) Osprey forages and nests in a variety of habitats where an adequate supply of accessible fish and shallow waters exists within 12 miles of elevated and open nest sites (Poole et al. 2002). Occurrences include an individual observed in 2006 at Millerton Lake and multiple observations during early spring point-count surveys in 1999 and 2000 near Sky Harbor Road, Wellbarn Road, and Winchell Cove (Smith, pers. comm., 2007). Suitable nesting habitat is sparse but nesting cannot be precluded. Ospreys are likely to forage in the primary study area whether they nest there or not.

Yellow Warbler (*Setophaga petechia*) Yellow warbler breeds most commonly in wet, deciduous thickets, especially those dominated by willows, and in disturbed and early successional riparian habitats (Lowther et al. 1999). It has been observed in the San Joaquin Experimental Range as an occasional spring and fall migrant and as an incidental visitor in late summer (Purcell et al. 2005). Yellow warbler was also detected multiple times during spring point-count surveys between 2000 and 2004 along transects in Big Sandy Creek and Sky Harbor Channel (Smith, pers. comm., 2007). Nesting habitat within the primary study area is considered marginal, but yellow warblers have been detected in the primary study area and may nest there.

California Spotted Owl (*Strix occidentalis occidentalis*) Known nest sites for California spotted owl range in elevation from approximately 1,000 to 7,700 feet; approximately 86 percent occur between 3,000 and 7,000 feet (Verner et al. 1992). In the Sierra Nevada, approximately 3 percent of spotted owls occur in foothill riparian/hardwood forest and eastside pine (USFS 2001). Nesting habitat is generally characterized by dense canopy closure with medium to large trees in stands with multiple canopy levels. The primary study area itself contains limited suitable nesting and foraging habitat for this species. However, a single individual spotted owl responded to calls on each of two separate nocturnal surveys

near Kerckhoff Dam; therefore, it is possible that this species occurs in the primary study area.

Least Bell's Vireo (*Vireo bellii pusillus*) Least Bell's vireo inhabits dense, low, shrubby vegetation in riparian areas or near water in arid regions (Brown 1993). In California, it is found in dense shrub layers 2 to 10 feet above ground (Kus 2002, Franzreb 1989), usually in early- to mid-successional stages of riparian habitat with structurally diverse canopies for foraging (Kus 2002). There are no CNDDB or other local records of occurrence for least Bell's vireo in the primary study area. Suitable habitat for breeding Bell's vireos was not found in the primary study area, and it was not detected during surveys in May and June 2007. This species is unlikely to occur in the primary study area.

Mammals

Pallid Bat (*Antrozous pallidus*) Pallid bat is known to roost in a number of habitats found in the primary study area, including abandoned buildings, adits, crevices, caves, mines, and cliff overhangs. It forages over oak savanna, grassland, and woodlands. The nearest CNDDB pallid bat roosts are 6 and 9 miles away, at Millerton Lake and Musick Mountain respectively (CNDDB 2014). This species is expected to occur in the primary study area.

Ringtail (*Bassariscus astutus*) Ringtail inhabits riparian, brush, and most forest habitats; it is particularly associated with talus or rocky elements (Whitaker 1996). Rodney Olsen (Reclamation 2007) reports that ringtails are likely to be found within the primary study area, especially near Big Sandy Creek (Stebbins 2003, Reclamation 2007). They were not detected during 2007 surveys, but they are shy and nocturnal and difficult to detect.

Townsend's Big-Eared Bat (*Corynorhinus townsendii*) Townsend's big-eared bat is primarily a cave-dwelling species, with most known roost sites located in caves and mines (Fellers and Pierson 2002). In California, more than 40 percent of known roosts are located in abandoned mines and buildings (Pierson pers. comm. as cited in Sherwin et al. 2000), with recent studies showing that caves are more frequently inhabited than mines and have larger and more spatially stable populations (Sherwin et al. 2000, 2003). Both caves and mines are found in the primary study area as is suitable foraging habitat. A single big-eared bat was detected in April 2007 in the primary study area; four Townsend's big-eared bats were

found within the Millerton Lake Cave System in 2012 (Graening 2013).

Spotted Bat (*Euderma maculatum*) Spotted bat has a wide geographic range but a patchy distribution (Pierson and Rainey 1998a). It appears to specialize on butterflies and moths as prey items, and distribution may be limited by availability of suitable roost sites. It is considered a nearly obligate cliff-roosting species (Pierson and Rainey 1998b). The nearest known roost was found in 1970 approximately 4 miles southwest of the primary study area. In 2002, spotted bats were documented at two locations approximately 11 and 12 miles away. No spotted bats were detected during 2007 surveys, although focused surveys for bats were not conducted. Suitable roosting habitat is found within the primary study area and presence of this bat is possible. There is one CNDDB record of occurrence for this bat within 10 miles of the primary study area.

Western Mastiff Bat (*Eumops perotis californicus*) Western mastiff bat was recorded in the primary study area in 1994 and 1995 at the San Joaquin River and adjacent to the primary study area at McKenzie Table Mountain Preserve (Pierson and Rainey 1998a; CDFW 2013). They have also been reported at Kennedy Table Mountain (Stebbins 2003). Although no western mastiff bats were detected during 2007 surveys, the basaltic tables, cliff margins, crevices, and abandoned structures of the primary study area offer potential roosting habitat (Pierson and Rainey 1998a, Reclamation 2007), and its presence is possible. There are three CNDDB records of occurrence for this bat within 1 mile of the primary study area.

Other Bat Species Several BLM-sensitive bat species are known or likely to occur in the primary study area: the Yuma myotis (*Myotis yumanensis*) is known to occur, western small-footed myotis (*Myotis ciliolabrum*) could occur, and long-eared myotis (*Myotis evotis*) could occur. It is also possible that the fringed myotis (*Myotis thysanodes*) occurs in the primary study area, although it is generally found at higher elevations. There are several CNDDB-recorded locations for these species within 10 miles of the primary study area. Western red bat (*Lasiurus blossevillii*) is a species of special concern that may occur within the primary study area, although no CNDDB-recorded locations for this species are within 10 miles of the primary study area.

San Joaquin Pocket Mouse (*Perognathus inornatus inornatus*) San Joaquin pocket mouse prefers weedy or grassy areas with fine soils (Whitaker 1996). The nearest recorded location of a pocket mouse is 13 miles away from 1933 (CNDDB 2014). Suitable habitat is limited and patchily distributed in the primary study area, but presence of this species is possible.

American Badger (*Taxidea taxus*) American badger occurs in drier grasslands, shrublands, and forests with friable soils. It has been documented in the San Joaquin Experimental Range (DFG 1986) and reported at the McKenzie Preserve (Big Table Mountain) and Kennedy Table southwest of the primary study area (Reclamation 2007). Olsen (Reclamation 2007) suggested that badgers are highly likely to occur in the primary study area. No badgers were seen during surveys although night surveys were not conducted as part of the survey of the primary study area. This species would be expected to be most active at night.

Area of Project Features The Temperance Flat Reservoir Area section above provides detail on all the special-status wildlife species that could occur in the Temperance Flat Reservoir Area. This list of species also applies to the area of project features. Of the 29 habitat types found in the primary study area, 12 are present in the area of project features: foothill pine oak woodland, blue oak woodland, bush lupine scrub, annual grassland, mixed riparian, willow riparian, seasonal wetland, lacustrine (unconsolidated bottom and unconsolidated shoreline), ephemeral drainage, intermittent drainage, in-channel pools, and developed. Foothill pine oak woodland is the most prevalent habitat type and comprises approximately 71 percent of the total area of project features. Blue oak woodland comprises 17 percent of the total area of project features. Grassland habitats comprise 10 percent of the total area of project features. Each of the others makes up less than 1 percent of the remaining area. Special-status wildlife species that could use this area are listed briefly below:

- Pipevine swallowtail was observed in this area during 2010 surveys.

- Blue elderberry was observed in the area of project features; valley elderberry longhorn beetle is potentially present where there are elderberry plants.

- California tiger salamander is not known or likely to occur but could potentially use pools found along intermittent or ephemeral drainages. Larval surveys were conducted in 2011 in the area of project features. No California tiger salamander larvae were found.
- Western spadefoot could breed in ponds.
- Coast horned lizard could occur in more open habitats with sandy soils.
- Bald eagle is known to nest near the Temperance Flat RM 274 Dam site and to winter in the general area.
- American peregrine falcon, golden eagle, and prairie falcon could nest on cliffs or ledges.
- Cooper's hawk could nest in woodlands in the area, especially near riparian areas.
- Sharp-shinned hawk could nest in woodlands in the area, especially near riparian areas.
- Loggerhead shrike could nest in woodland areas that are relatively open.
- Osprey could nest in large trees or snags in the woodlands.
- Merlin, a winter visitor, could forage in open woodlands or over open waters in or near the area.
- Ringtail is likely to occur in the woodlands.
- American badger is likely to occur in most of the area.
- Pallid bat, spotted bat, western mastiff bat, and other bat species could roost and/or breed in the cliffs and rock crevices.
- Townsend's big-eared bat could roost in rock outcrops in this area and forage over woodlands and riparian habitats.

Millerton Lake Below RM 274 Millerton Lake between Friant Dam and the proposed Temperance Flat RM 274 Dam provides open-water, or lacustrine, habitat surrounded

primarily by relatively open foothill pine oak woodland. Millerton Lake is known to support basking and foraging western pond turtle and foraging bald eagles and osprey. Lacustrine habitats also provide foraging habitat for at least four of the special-status bats known to occur nearby: western mastiff bat, pallid bat, spotted bat, and Townsend's big-eared bat. These species are all discussed above. These and other bat species, as well as a number of special-status raptors such as golden eagles and falcons, could nest in the cliffs around Millerton Lake and forage on waterfowl and other birds using the lake and its adjacent habitats.

Extended Study Area

San Joaquin River from Friant Dam to Merced River

Based on the results of database searches and review of existing environmental documentation, 23 special-status animal species were identified as having potential to occur in habitats associated with the active channel of the extended study area or the Mariposa and Eastside bypasses. They are presented in Table 7-2 below. Species descriptions are derived primarily from information in CNDDB records (CDFW 2013); existing species accounts available from CDFW, USFWS, and others; recovery plans for special-status species with potential to occur in the extended study area; relevant scientific literature; other environmental assessments for the San Joaquin River Restoration Program (SJRRP 2009, 2011); and information contained in the San Joaquin River Restoration Study Background Report (McBain & Trush 2002).

Invertebrates

Valley Elderberry Longhorn Beetle Valley elderberry longhorn beetle is known to occur in elderberry shrubs present within the riparian woodland in Reach 1A. The species is also expected to occur in suitable habitat in other locations in the extended study area.

Amphibians and Reptiles

California Red-Legged Frog California red-legged frog is unlikely to occur within the extended study area because it is not generally known to occur on the valley floor. However, there is one 1993 CNDDB record of occurrence within 10 miles of the extended study area in a farm pond 4.5 miles southwest of Newman (CDFW 2013).

Table 7-2. Special-Status Wildlife Species Known or with Potential to Occur in the Extended Study Area

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Invertebrates					
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	—	—	Elderberry shrubs are host; generally found in riparian areas and floodplains, also open hillsides and rocky outcrops	Present • Known to occur in elderberry shrubs present in the riparian woodland in Reach 1A • Expected to occur in suitable habitat in other locations in the extended study area
Amphibians					
California red-legged frog *Rana draytonii*	T	CSC	—	Aquatic habitat such as ponds, backwaters, sloughs, and stock ponds, especially with emergent and submersed aquatic vegetation	Unlikely • Not generally known to occur on the floor of the Central Valley
California tiger salamander *Ambystoma californiense*	T	T	—	Breeds in seasonal wetlands, such as vernal pools and other ephemeral features. Adults spend most of life in upland burrows up to 1.5 miles from suitable breeding habitat.	Present • Widespread in suitable habitat within the extended study area. • Would not be expected to be found within the channel of the San Joaquin River because this is not suitable habitat.
Reptiles					
Western pond turtle *Emys marmorata*	—	CSC	—	Ponds, lakes, streams, rivers, and backwaters with abundant basking habitat and escape cover (e.g., deep or turbid water, submerged root wads, or shoreline vegetation)	Present • Known to occur in suitable habitat on the San Luis NWR complex, in the Mendota Wildlife Area, and at Mendota Pool in Reach 2B • Expected to occur in suitable habitat in other locations in the extended study area
Blunt-nosed leopard lizard *Gambelia sila*	—	FP	—	Alkali scrub habitat, sparsely vegetated habitat with sandy soil; uses burrows for shelter, predator avoidance, and thermoregulation	Possible • Known to occur on the Merced NWR, adjacent to the Eastside Bypass • Upland habitat adjacent to the Eastside and Mariposa bypasses could provide suitable habitat • Surveys adjacent to these bypasses in 2009 and 2010 did not locate any individuals

Table 7-2. Special-Status Wildlife Species Known or with Potential to Occur in the Extended Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Giant garter snake *Thamnophis gigas*	T	T	—	Streams, sloughs, ponds, and irrigation/drainage ditches; requires upland refugia not subject to flooding during inactive season (winter)	Present • Known to occur in suitable habitat on the San Luis NWR complex and in the Mendota Wildlife Area; reported from Mendota Pool in Reach 2B; expected to occur in suitable habitat in other locations in the extended study area
Birds					
Tricolored blackbird *Agelaius tricolor* (nesting colony)	—	CSC	—	Nests in large colonies near open water in dense emergent, riparian scrub, and herbaceous vegetation with open grassland/agricultural foraging habitat nearby	Present • Known to occur in suitable habitat on the San Luis NWR complex and other sites in the extended study area
Long-eared owl *Asio otus* (nesting)	—	CSC	—	Wide distribution, but uncommon; found in riparian and areas of dense trees and shrubs near water	Possible • Suitable habitat present in extended study area; nesting possible
Redhead *Aythya americana* (nesting)	—	CSC	—	Nests in freshwater emergent wetlands with dense patches of tules or cattails interspersed with areas of deep, open water	Present • Uncommon but regular breeder in Central Valley; known to nest at Mendota Pool in Reach 2B and also occurs at the San Luis NWR and Mendota Wildlife Area; expected in the extended study area
Black tern *Chlidonias niger* (nesting colony)	—	CSC	—	Nests semi-colonially in protected marshes and rice fields; forages on fish and insects	Present • Uncommon visitor in extended study area, including San Luis NWR • Suitable habitat present; nesting possible
Western yellow-billed cuckoo *Coccyzus americanus occidentalis* (nesting)	C	E	—	Inhabits wide, dense riparian forests with thick understory of willows for nesting; prefers sites with a dominant cottonwood overstory for foraging	Possible (nesting) • No recent nesting records, but potential nesting habitat present

Table 7-2. Special-Status Wildlife Species Known or with Potential to Occur in the Extended Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Little willow flycatcher *Empidonax trailii*	E (*E.t. extimus*)	E	—	Riparian habitats and large wet meadows with abundant willows during migration	Present • Known as rare spring and uncommon fall migrants in riparian habitats of the San Luis and West Bear Creek units of the San Luis NWR • Nesting unlikely in extended study area
Lesser sandhill crane *Grus canadensis canadensis* (wintering)	—	CSC	—	Forages in winter in grasslands, pastures, and agricultural fields; roosts in a variety of wetlands with shallow water depths	Present • Known to winter at the Merced NWR; expected to occur in suitable habitat in extended study area
Greater sandhill crane *Grus canadensis tabida* (nesting and wintering)	—	T	FP	Nests near shallow lakes and freshwater marshes in northeastern California; foraging habitat in winter similar to lesser sandhill crane above	Present • Known to occur during winter on San Luis NWR complex and along the San Joaquin River • extended study area not within nesting range
Yellow-breasted chat *Icteria virens* (nesting)	—	CSC	—	Dense riparian thickets of willows, vine tangles, and dense brush associated with streams, swampy ground and the borders of small ponds	Present • Known to occur during migration in the San Joaquin Valley • Suitable nesting habitat present in extended study area; nesting possible
Double-crested cormorant *Phalacrocorax auritus* (rookery)	—	WL	—	Forages in inland ponds and lakes; nests on rock ledges, rugged slopes, and in live or dead trees	Present • Known to occur in suitable habitat on the San Luis NWR complex • Known along Reach 1A at CDFW's Milburn Ecological Reserve • Nesting unlikely; not generally known to nest in Central Valley
White-faced ibis *Plegadis chihi* (nesting colony)	—	WL	—	Nests in dense, fresh emergent wetlands; forages in wetlands, meadows, flooded pastures, and croplands	Present • Known to occur on the San Luis NWR complex and other sites in the extended study area • Not currently known as a regular breeder anywhere in California

Table 7-2. Special-Status Wildlife Species Known or with Potential to Occur in the Extended Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Least bittern *Ixobrychus exilis* (nesting)	—	CSC	—	Nests in dense emergent vegetation in fresh and brackish marsh	Possible • Uncommon but regular breeder in suitable habitat in the San Joaquin Valley • Expected in the extended study area
Bank swallow *Riparia riparia* (nesting)	—	T	—	Forages in various habitats; nests in banks or bluffs, typically adjacent to water	Possible • No recent nesting records, but potential nesting habitat present
Yellow warbler *Setophaga petechia* (nesting)	—	CSC	—	Breeds in mesic, deciduous thickets, especially riparian; preferred habitat includes moist areas with dense insect prey populations	Present • No recent nesting records, but potential nesting habitat present • Known to occur during migration on the San Luis NWR complex and other sites in the extended study area
Least Bell's vireo *Vireo bellii pusillus*	E	E	—	Cottonwood-willow forest, oak woodland, shrubby thickets, and dry washes with willow thickets	Present • Known to nest in suitable habitat on the San Joaquin River NWR and in the San Luis NWR complex
Yellow-headed blackbird *Xanthocephalus xanthocephalus* (nesting)	—	CSC	—	Nests in freshwater emergent wetlands with dense vegetation and deep water, often along borders of lakes or ponds	Present • Known to occur throughout San Joaquin Valley, including the San Luis NWR complex • Potential nesting habitat present in extended study area
Swainson's hawk *Buteo swainsonii*	—	T	—	Nests in riparian woodlands or suitable large trees. Forages in grasslands, row crops, and other open habitat types.	Present • Known to occur throughout San Joaquin Valley • Potential nesting habitat present in extended study area

Table 7-2. Special-Status Wildlife Species Known or with Potential to Occur in the Extended Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Mammals					
San Joaquin (riparian) woodrat *Neotoma fuscipes riparia*	E	CSC	—	Riparian forests	Unlikely • No recorded locations known from the extended study area in the immediate vicinity of the channel • Unlikely, but could occur in suitable habitat
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	E	—	Dense thickets of brush associated with riparian or chaparral habitats	Unlikely • No records known from the extended study area in the immediate vicinity of the channel • Reintroduced on private land adjacent to San Joaquin River NWR • Unlikely, but could occur in suitable habitat

Key:
NWR = National Wildlife Refuge
[1] Federal Status:
E: Endangered
C: Candidate
T: Threatened
[2] State Status:
CSC: California Species of Special Concern
E: Endangered
FP: Fully Protected
T: Threatened
WL: Watch list
[3] Other Status:
BGEPA::Federal Bald and Golden Eagle Protection Act

Western Pond Turtle Western pond turtle is known to occur in suitable habitat in the San Luis NWR complex, in the Mendota Wildlife Area, and at Mendota Pool in Reach 2B. It is expected to occur in suitable habitat in other locations in the extended study area. The CNDDB provides many records for western pond turtle occurrences within 10 miles of the extended study area (CDFW 2013).

Blunt-Nosed Leopard Lizard (*Gambelia sila*) The blunt-nosed leopard lizard has been observed at the Merced NWR, and habitats adjacent to the Mariposa and Eastside bypasses could provide potentially suitable habitat for this species. Recent surveys in 2009 and 2010 did not locate any individuals in accessible areas near the bypasses (SJRRP 2011). The inundation of potentially suitable habitat in the bypass reaches by either flood releases or interim flow releases would decrease the suitability of this habitat and make it less likely to be occupied.

Giant Garter Snake (*Thamnophis gigas*) The giant garter snake (GGS) has been observed at the San Luis, Kesterson, and West Bear Creek units of the San Luis NWR and documented in the Mendota Wildlife Area (Dickert 2005) and south of the San Joaquin River in Fresno Slough (USFWS 2006b). The southernmost populations at the Mendota Wildlife Area (Fresno County) and the Grassland Wetlands (Merced County) are small, fragmented, unstable, and probably decreasing (USFWS 2006b). There are eight CNDDB records of occurrence within 1 mile of the extended study area, including one at the San Luis NWR and one in the Mendota Pool area (Reach 2B) of the San Joaquin River (CDFW 2013).

Birds

Tricolored Blackbird (*Agelaius tricolor*) Tricolored blackbird is known to nest in suitable habitat in the San Luis NWR complex and other sites in the extended study area. There are no CNDDB records of occurrence within 1 mile, but approximately 40 records of occurrence within 10 miles of the extended study area (CDFW 2013).

Long-Eared Owl Long-eared owl prefers riparian habitats or other areas with dense trees and shrubs near water. There are no CNDDB or other local records for this species; however, it is a secretive owl that is difficult to detect. There are no CNDDB records of occurrence for this species within 10 miles of the extended study area.

Redhead (*Aythya americana*) Redhead is known to nest in the extended study area at Mendota Pool, and nesting also occurs at the San Luis NWR and Mendota Wildlife Area (Beedy and Deuel 2008). There are no CNDDB records of occurrence for this species within 10 miles of the extended study area (CDFW 2013).

Black Tern (*Chlidonias niger*) Although there are no CNDDB records of black tern occurrence within 10 miles of the extended study area (CDFW 2013), it has been documented as an occasional visitor at the San Luis NWR complex (USFWS 1996a, 2006a). It is likely to use wetland habitats in the extended study area for foraging during the nonbreeding season and may also nest there.

Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*) In the late 1960s, a few western yellow-billed cuckoos were observed regularly near the confluence of the Tuolumne and San Joaquin rivers, but this area was subsequently intensively logged and no cuckoos have been observed in recent years (McBain & Trush 2002). The yellow-billed cuckoo has been considered a rare migratory species during spring in Stanislaus County (McBain & Trush 2002). The CNDDB contains one July 1977 record in the extended study area at Mendota Pool on the San Joaquin River (CDFW 2013). Suitable nesting habitat for this species is present in the extended study area.

Little willow Flycatcher Within the San Joaquin River floodplain, little willow flycatchers are rare spring and uncommon fall migrants in riparian habitats of the San Luis and West Bear Creek units of the San Luis NWR. There are no CNDDB records of this species, and no recent breeding has been documented in the San Joaquin Valley (RHJV 2004, McBain & Trush 2002, CDFW 2013).

Lesser Sandhill Crane (*Grus canadensis canadensis*) The lesser sandhill crane is known to winter at Merced NWR (Littlefield 2008); most lesser sandhill cranes wintering in California concentrate near the Merced NWR in autumn, and later disperse to the northwest and southwest. Sandhill crane records are not normally provided in the CNDDB.

Greater Sandhill Crane (*Grus canadensis tabida*) The greater sandhill crane nests in Siskiyou, Modoc, and Lassen counties, and in Sierra Valley in Plumas County (Remsen 1978; Zeiner et al. 1990), but is only a winter visitor in the

extended study area. It occurs along the San Joaquin River and at the San Luis NWR complex during winter (McBain & Trush 2002). Sandhill crane records are not normally provided in the CNDDB.

Yellow-Breasted Chat Historically, the yellow-breasted chat bred in areas throughout California below 5,000 feet and in almost all areas of the Central Valley (Comrack 2008). Currently, it breeds in only a small portion of the Sacramento Valley and is not known to nest in the San Joaquin Valley. Potential nesting habitat is present in the extended study area, and this bird is known to occur during migration in the San Joaquin Valley. There are no CNDDB records of occurrence within 10 miles of the extended study area.

Double-Crested Cormorant (*Phalacrocorax auritus*) Nesting habitat for the double-crested cormorant includes steep slopes, cliff faces, tall trees (such as those found in riparian forests), and tall human-made structures such as transmission towers beside water, but it is not generally known to nest in the Central Valley (DFG 2005b). It is known to occur in the San Luis NWR complex and along Reach 1A at the CDFW Milburn Ecological Reserve, but is not recorded as nesting at these locations.

White-Faced Ibis (*Plegadis chihi*) White-faced ibis is known to occur in the San Luis NWR complex and at other sites in the extended study area. Nesting colonies have been documented in the past at the Mendota Wildlife Area south of the extended study area; however, it is not currently known to be a regular breeder anywhere in California (DFG 2005b).

Least Bittern (*Ixobrychus exilis*) The historic distribution of least bittern included most of the Central Valley (Sterling 2008). The present distribution includes isolated marsh areas in the Central Valley and other parts of the state. Although there are no CNDDB records of occurrence within 10 miles of the extended study area (CDFW 2013), it is a regular, though uncommon, breeder in San Joaquin Valley marshes, including the Mendota area (Sterling 2008). Recent breeding records from the San Luis NWR are lacking. The species is likely to nest in suitable marsh habitat in the extended study area.

Bank Swallow (*Riparia riparia*) Bank swallow historically occurred along the larger lowland rivers throughout

California (Garrison 1998). The current breeding range (about 50 percent of the historical range) is primarily confined to parts of the Sacramento Valley and northeastern California, including the banks of the Sacramento and Feather Rivers (DFG 2005a). There is one 1980 record of a colony at Mendota Pool in Reach 2B on San Joaquin River, and it could occur elsewhere in the extended study area.

Yellow Warbler The historical breeding range of the yellow warbler included the entire Central Valley, but it has been largely extirpated from the Central Valley as a breeder. It nests and forages in dense riparian woodlands. There are no nesting records for this species within 10 miles of the extended study area (CDFW 2013), but potential nesting habitat is present. It is known to occur during migration in the San Luis NWR complex and other sites in the extended study area.

Least Bell's Vireo Least Bell's vireo historically nested in riparian areas throughout the Central Valley (RHJV 2004). The species was characterized as abundant at one time, but by 1980 it was extirpated from the entire Central Valley, and it is now absent from most of its historical range (RHJV 2004). Recent observations indicate that the species' range is expanding northward and individuals are currently recolonizing areas that have been unoccupied for decades (RHJV 2004). Least Bell's vireos successfully nested at the San Joaquin River NWR in 2005 and 2006 (USFWS 2006c).

Yellow-Headed Blackbird (*Xanthocephalus xanthocephalus*) The yellow-headed blackbird is recorded in the CNDDB at Dos Palos, in the vicinity of the extended study area. Potential nesting habitat is present in emergent wetland habitats.

Mammals

San Joaquin Valley (Riparian) Woodrat (*Neotoma fuscipes riparia*) Historically found along the San Joaquin, Stanislaus, and Tuolumne Rivers, this species likely occurred throughout the riparian forests of the northern San Joaquin Valley (USFWS 1998). Its range has become much more restricted, and the only verified extant population is confined to about 250 acres of riparian forest in Caswell Memorial State Park on the Stanislaus River at its confluence with the San Joaquin River, and within the San Joaquin NWR (USFWS 1998). There are no documented CNDDB occurrences of San Joaquin Valley woodrat within or near the river channel within

the extended study area, although it could occur in suitable habitat.

Riparian Brush Rabbit (*Sylvilagus bachmani riparius*) Because the riparian brush rabbit subspecies was not described until after it is believed to have been extirpated from most of its historical range, definitive information on its former distribution is lacking, but it has been extirpated from most of the lower San Joaquin River and its tributaries (Williams 1986). It is currently restricted to several populations at Caswell Memorial State Park: along the Stanislaus River, along Paradise Cut, a channel of the San Joaquin River in the southern part of the Delta, and a reintroduction on the San Joaquin River NWR (Williams 1993; Williams and Basey 1986).

San Joaquin River from Merced River to the Delta
Special-status animals that may occur in this section of the San Joaquin River include valley elderberry longhorn beetle; Swainson's hawk; and a number of riparian-dependent songbirds, such as least Bell's vireo and yellow warbler. The riparian brush rabbit and riparian woodrat are known to occur in specific locations along the lower San Joaquin River including the San Joaquin NWR (DWR 2012).

Delta Several special-status wildlife species are known or are likely to occur in the Delta because of the presence of unique wetland habitats. Tidal marshes, wet banks, and instream emergent wetlands support several special-status wildlife species, including salt marsh harvest mouse (*Reithrodontomys raviventris*) (Federally and State listed as endangered), Suisun song sparrow (*Melospiza melodia maxillarus*) (California Species of Special Concern), and salt marsh common yellowthroat (*Geothylpis trichas sinuosa*) (California Species of Special Concern). Riparian scrub and woodland provides habitat for western yellow-billed cuckoo (State listed as endangered).

CVP and SWP Water Service Areas The CVP and SWP water service areas are subject to substantial human influence and modification. For this reason, much of the native wildlife has been displaced by nonnative species that have adapted well to human-influenced land cover, including urban and agricultural land uses. Although a variety of special-status species could occur in habitats within and adjacent to the CVP and SWP water service areas, special-status species under consideration in this document are limited to those that could

occur in the ditches and canals that constitute the CVP and SWP delivery systems, because other habitats are not expected to be influenced. The potential for special-status wildlife species to occur within these water delivery systems is generally considered low because of the developed nature of the canals and frequency of maintenance. However, western pond turtle (California Species of Special Concern) is known to forage in drainages and canals and could be present within the water distribution systems within the CVP and SWP water service areas, particularly in areas that lack regular routine maintenance.

Other Wildlife Resources

Primary Study Area

Temperance Flat Reservoir Area Approximately 50 percent of the new Temperance Flat Reservoir Area supports upland woodland, dominated by foothill pine oak woodland, blue oak woodland, and live oak woodland. These habitat types, which are described in detail in Chapter 6, "Biological Resources – Botanical and Wetlands," support a diversity of upland wildlife species. In contrast, less than 1 percent of the primary study area supports riparian habitat, mostly in small fragmented patches. For that reason, wildlife species that depend on riparian habitats are not common. Wetland and aquatic habitats above the inundation zone of Millerton Lake are also uncommon in the primary study area. Only 1 acre of freshwater seep was mapped. These habitats are frequently invaded by bullfrogs, compromising their suitability for native amphibians. Millerton Lake supports seasonal wetlands; however, the habitat value of this area is compromised by erratic changes in water level. Numerous rock faces, crevices, caves, and abandoned mines in the primary study area provide extensive habitat for bats and other cave-dwelling species.

Foothill pine oak woodland, which supports a moderately diverse wildlife community, is the dominant terrestrial habitat in the primary study area. It provides foraging habitat and cover for such species as white-breasted nuthatch (*Sitta carolinensis*), turkey vulture (*Cathartes aura*), lesser goldfinch (*Spinus psaltria*), common gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), and western gray squirrel (*Sciurus griseus*). California voles (*Microtus californicus*), Botta's pocket gopher (*Thomomys bottae*), and mule deer (*Odocoileus hemionus*) all forage on the leaves, twigs, and acorns of many oak species, especially young seedlings (Griffin 1971). This habitat provides nesting features,

such as large limbs of pines and oaks, and snags and cavities for species such as American kestrel (*Falco sparverius*), acorn woodpecker (*Melanerpes formicivorus*), red-tailed hawk (*Buteo jamaicensis*), and oak titmouse (*Baeolophus inornatus*). Raccoons (*Procyon lotor*) may use hollow oaks and snags as den sites or escape cover. Deer mice (*Peromyscus maniculatus*) (Quinn and Baldwin 2012) and striped skunks (*Mephitis mephitis*) (Salmon et al. 2004) will seek cover under fallen oaks and bark (Ingles 1965). Wildlife such as pacific slender salamander (*Batrachoseps pacificus*), California quail (*Callipepla californica*), Gilbert's skink (*Eumeces gilberti*), and western rattlesnake (*Crotalus viridis*) may use undersides of logs or the interior of brush piles for shelter. Bats likely forage at the edges of foothill pine oak woodlands, and several bat species, such as long-eared myotis, may roost under tree bark or in big snags and large oaks.

Blue oak, live oak, and foothill pine woodland types are the most common habitat types after foothill pine oak woodland. These habitats generally support an assemblage of wildlife similar to that found in foothill pine oak woodland. Some blue oak woodland is more open and savanna-like and may provide habitat for grassland-associated species. Blue oak woodland has a less complex structure than other woodland types, and its overstory cover is generally more open. Thus, its groundcover is more exposed, making it more xeric than communities with a closed canopy. These factors affect the wildlife species associated with this habitat type resulting in a generally less-diverse wildlife community. It is nevertheless an important habitat type, being similar to the other woodland types and providing important food and structure for local wildlife.

Annual grassland is the next most common vegetation community in the primary study area. Annual grassland is dominated by nonnative plant species. These grasslands may provide habitat for species such as western rattlesnake, western fence lizard (*Sceloporus occidentalis*), California ground squirrel (*Spermophilus beecheyi*), black-tailed hare (*Lepus californicus*), and grassland birds such as meadowlark (*Sturnella neglecta*), as well as foraging habitat for red-tailed hawk, turkey vulture, and coyote (*Canis latrans*). Grasslands provide prey and forage, and dens and cover. For many species dependent on extensive grassland habitat, the annual grasslands within the Temperance Flat Reservoir Area are of generally poor quality because they are relatively small and patchily distributed, and have steep topography.

Riparian communities mapped in the Temperance Flat Reservoir Area include white alder riparian, willow woodland, sycamore alluvial woodland, mixed riparian woodland, fig-willow riparian, Spanish broom scrub, sycamore woodland, and button bush scrub. Along the San Joaquin River, there are also a number of ephemeral and intermittent drainages running through foothill pine oak woodland habitat, many with riparian vegetation.

No flowing water and few pools were observed in any of the tributaries to the San Joaquin River, including larger ones such as Big Sandy Creek. Riparian areas provide foraging, nesting, and roosting habitat for bats such as small-footed myotis and Yuma myotis and for riparian-associated birds such as black phoebe (*Sayornis nigricans*), Bewick's wren (*Thryomanes bewickii*), and lazuli bunting (*Passerina amoena*). Moist soils covered with loose leaf litter offer hiding places for amphibians and reptiles, including California newt (*Taricha torosa*), Sierran treefrog (*Pseudacris sierra*), and common kingsnake (*Lampropeltis getulus*).

Dampness creates good habitat for insect larvae that are prey for vertebrate species, such as raccoon and striped skunk. Riparian habitats also provide travel corridors for larger mammals, including mule deer, coyote, bobcat, and mountain lion (*Felis concolor*). For species with more restricted riparian habitat requirements, such as warbling vireo (*Vireo gilvus*) and special-status passerines (discussed previously), riparian habitat in the primary study area is generally of poor quality, primarily because the existing habitat is fairly limited in size, has a patchy, fragmented configuration and distribution, and has little structural diversity.

Seasonal wetlands are located at the upper extent of Millerton Lake and interface with areas of unconsolidated shoreline. Most of this area is fairly dry and on a steep incline and is therefore of limited value for most species. Seasonal wetland in the upper part of the seasonally inundated zone has a more dense vegetation cover (mostly nonnative plants) than unconsolidated shoreline and provides foraging habitat for some wildlife species. There are a few sparsely distributed areas of seasonal wetland habitat that would potentially be suitable for amphibian and reptile species, including American bullfrog (*Rana catesbeiana*), Sierran tree frog, western pond turtle, and western toad (*Bufo boreas*). These areas include small in-channel pools and riffle areas in drainages surrounded by annual grassland or foothill pine oak woodland. The

combination of lack of perennial streams, erratic hydrology, and steep topography within San Joaquin River Gorge results in only marginally suitable habitat for most amphibians and the western pond turtle.

Riverine habitat within the new Temperance Flat Reservoir Area includes the San Joaquin River upstream from Millerton Lake which is located near the PG&E Powerhouse to Kerckhoff Dam. Riverine habitat differs from lacustrine habitat in the rate of water circulation. Aside from fish species described in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," riverine habitats in the Temperance Flat Reservoir Area could support western pond turtle, river otter (*Lontra canadensis*), and aquatic garter snake (*Thamnophis couchii*), and birds such as American dipper (*Cinclus mexicanus*), belted kingfisher (*Ceryle alcyon*), and common merganser (*Mergus merganser*).

Millerton Lake upstream from RM 274 is composed of lacustrine habitat in the forms of lacustrine unconsolidated bottom (e.g., open water, or the lake) and lacustrine unconsolidated shoreline (or the shoreline exposed at lower lake levels). The lacustrine unconsolidated bottom open-water habitat supports fish species that are prey for such special-status wildlife as bald eagle and osprey and for other birds such as common merganser and belted kingfisher. In winter, open water often supports rafts of waterfowl such as mallards (*Anas platyrhynchos*), Canada goose (*Branta canadensis*), America coot (*Fulica americana*), and western grebe (*Aechmophorus occidentalis*). Lacustrine unconsolidated shoreline could support basking western pond turtles, and wading birds and shorebirds such as great blue heron (*Ardea herodias*), great egret (*Ardea alba*), and killdeer (*Charadrius vociferus*). Waterfowl often come ashore to rest in the sun on exposed shorelines.

There are 31 acres of natural barren areas such as rock outcrops, cliffs, caves, and crevices in the Temperance Flat Reservoir Area, which are suitable and in some cases essential for bat roosting (Whitaker 1996). The tall cliffs of the table-top mountains bordering much of the primary study area are also of value as perches for foraging raptors and for nesting red-tailed hawk, turkey vulture, and common raven (*Corvus corax*). Several reptile species, such as western rattlesnake and western fence lizard, also use barren habitats for basking and foraging.

The primary study area, once the site of historic towns and gold-mining districts (Springer 2005), contains a number of abandoned mines, prospects, and adits that are frequently the sites of bat roosts. Sullivan Mine is reported to have multiple adits and mill sites; limited surveys in this area found a deep (approximately 145 feet), abandoned mine shaft that contains a number of wall crevices suitable for bat roosting. San Joaquin and Diana (Patterson) mines, along with more southern prospects, have numerous tunnels. Most of the prospects and mine tunnels have suitable features for bats such as crevices, proximity to water, and little apparent human disturbance, and were found in foothill pine oak woodland habitat with rock outcrops.

Abandoned homesteads near mining operations appeared to have been disturbed by humans following abandonment but showed signs of wildlife use such as woodrat nests, presence of juvenile owls, and bird droppings. Mourning doves (*Zenaida macroura*) and barn owls (*Tyto alba*) will nest in abandoned buildings. The San Joaquin Mine site was more disturbed than the other mine sites; an abandoned structure on the property had recently been occupied by humans; however, the home near Sullivan Mine had an attic and a basement that were considered suitable bat-roosting locations.

The primary study area has a mixture of resident and migratory mule deer (black-tailed deer subpopulation) herds. CDFW reported the presence of at least three herds in the primary study area (Reclamation 2007). The Piedra herd is a resident herd in the area, inhabiting the Sierra Nevada foothills year-round at an elevation of 50 to 3,000 feet. It is unknown how many deer are in this herd. The deer population increases in winter when two migratory herds come down to the foothills and join the resident population. It is believed that the San Joaquin migratory deer herd winters in Madera County and then migrates up into the Sierra Nevada in summer. This herd's range is more southern than the North King's herd, a second migratory herd using the area. The North King's deer herd is reported to migrate to the Auberry and Squaw Leap areas in winter.

Because most deer studies have been conducted outside the primary study area, little is known about the migratory routes and specific herd locations within the primary study area. Cotter indicated that the San Joaquin River can act as a dividing line between the two migratory deer herds. Bart Toppings (Reclamation 2007) reported that the majority of deer

are observed during the summer, but they are also seen year-round on Kennedy Table. Toppings does not believe that Kennedy Table is located within a migratory route for deer; rather, he suggests that the migratory route lies on the North Fork of the San Joaquin River, approximately 20 miles northeast of Kerckhoff Lake, at an elevation of approximately 3,000 feet.

Although the precise location is unknown, it has been reported that critical deer winter range is located near the primary study area (Reclamation 2007). Important deer winter ranges exist in the vicinity of the new Temperance Flat Reservoir Area. San Joaquin mule deer are year-round residents of the area and mix with migratory herds from higher elevations (USFS 2004). Some critical features of deer habitat include oaks, acorn masts, a shrub layer composed of Ceanothus, and open grassland for fawn use (e.g., foraging on forbs).

Deer, and more frequently deer sign, were detected during 2007 surveys. Patterson Bend Reach was reported by a local resident to be a fawning ground; however, no fawns were detected during any surveys. Four major river crossings used by mule deer during migration in the Mammoth reach of the San Joaquin River include near Chawanakee at Dam 6, below the confluence of Rock Creek and the San Joaquin River, the confluence of Shake Flat Creek and the San Joaquin River, and the Mammoth Pool area. Additionally, mule deer cross the San Joaquin River at its confluence with Jackass Creek (SCE 2003).

Area of Project Features The wildlife habitats observed in the area of project features are upland woodland, scrub, riparian, seasonal wetland, in-channel pools, and lacustrine habitats, similar to those identified in the new Temperance Flat Reservoir Area and addressed in the previous section. The multilayered woodlands and grasslands provide excellent habitat for a number of mammal, bird, and other wildlife species such as those described in the previous section.

Pools in the otherwise dry grasslands and woodlands of the primary study area would support aquatic species such as crayfish (*Pacifastacus* spp.), bullfrog, and Sierran treefrog, and an array of local animals that would both drink from the pool and forage there, such as raccoon, bobcat, mountain lion, great blue heron, gopher snake, and aquatic and terrestrial garter snakes.

Millerton Lake below RM 274 Millerton Lake below the proposed Temperance Flat RM 274 Dam is entirely composed of lacustrine unconsolidated bottom and lacustrine unconsolidated shoreline habitat. General wildlife species using these habitats are described in the Temperance Flat Reservoir Area section above, and include mallard, Canada goose, common merganser, great blue heron, and western pond turtle.

Extended Study Area

San Joaquin River from Friant Dam to Merced River

Vegetation communities found in the extended study area are described in detail in Chapter 6, "Biological Resources – Botanical and Wetlands." Below, this section describes the general wildlife species commonly associated with these communities that are present within the extended study area. The San Joaquin River from Friant Dam to Merced River section above identifies which of these habitats is found in each of the reaches.

Riparian forest has been classified into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest. Large, mature riparian forest stands support the most dense and diverse breeding bird communities in California (Gaines 1974). Tall riparian trees provide high-quality nesting habitat for raptors, such as red-tailed hawk and red-shouldered hawk (*Buteo lineatus*). They also provide nesting habitat for cavity-nesting species such as downy woodpecker (*Picoides pubescens*), wood duck (*Aix sponsa*), northern flicker (*Colaptes auratus*), ash-throated flycatcher (*Myiarchus cinerascens*), and tree swallow (*Tachycineta bicolor*).

Riparian forests and associated wetlands produce populations of insects that feed on foliage and stems during the growing season and are in turn prey for migratory and resident birds, including Pacific-slope flycatcher (*Empidonax difficilis*), western wood-pewee (*Contopus sordidulus*), olive-sided flycatcher (*Contopus cooperi*), warbling vireo, orange-crowned warbler (*Vermivora celata*), and Bullock's oriole (*Icterus bullockii*). Mammal species using riparian forests include coyote, beaver (*Castor canadensis*), river otter, raccoon, desert cottontail (*Sylvilagus audubonii*), and striped skunk.

Three types of scrub habitat—willow scrub, riparian scrub, and elderberry savanna—are found in the extended study area.

Typical bird species found in scrub habitats include western wood-pewee, black phoebe, yellow-billed magpie (*Pica nuttalli*), bushtit (*Psaltriparus minimus*), Bewick's wren, and blue grosbeak (*Passerina caerulea*). Mammals using scrub habitats are similar to those described for riparian forest habitats above.

Emergent wetlands typically occur in the river bottom immediately adjacent to the low-flow channel. Sites such as backwaters and sloughs where water is present through much of the year support emergent marsh vegetation. Many wildlife species are known to use emergent wetlands, including song sparrow (*Melospiza melodia*), common yellowthroat (*Geothlypis trichas*), marsh wren (*Cistothorus palustris*), and red-winged blackbird (*Agelaius phoeniceus*). Mammal species that use this habitat include California vole, common muskrat (*Ondatra zibethicus*), and the nonnative Norway rat (*Rattus norvegicus*). Sierran treefrog and western terrestrial garter snake (*Thamnophis elegans*) are commonly present in this habitat.

The nonnative giant reed plant community is characterized by dense stands of the invasive grass species giant reed—nonnative plants are discussed further in Chapter 6, "Biological Resources – Botanical and Wetlands," and are mentioned in more detail below. These stands are up to 13 feet tall and consist solely of giant reed with no other plant species present. Giant reed stands provide very little habitat value for wildlife.

Grassland and pasture habitats are forb- and grass-dominated plant communities. Typical bird species associated with grasslands include northern harrier, mourning dove, savannah sparrow (*Passerculus sandwichensis*), and the nonnative ring-necked pheasant (*Phasianus colchicus*). Mammal species that use grasslands include deer mouse, California vole, California ground squirrel, Botta's pocket gopher, and coyote. Common amphibians and reptiles associated with grasslands in the San Joaquin Valley include western toad, western fence lizard, western racer (*Coluber constrictor mormon*), and gopher snake (*Pituophis catenifer*).

Alkali sinks are shallow, seasonally flooded areas or playas that are dominated by salt-tolerant plants. Wildlife species typically associated with alkali sink habitats include species of common kangaroo rats (*Dipodomys* spp.), coyote, and side-blotched lizard (*Uta stansiburiana*).

Agricultural lands in the extended study area consist primarily of annual crops, orchards, and vineyards. Cropland agricultural habitats can provide food and cover for wildlife, but the value of the habitat varies greatly among crop type and agricultural practice. Grain crops provide forage for songbirds, small rodents, and waterfowl at certain times of year. Pastures, alfalfa, and row crops, such as beets and tomatoes, provide foraging opportunities for raptors because of the frequent flooding, mowing, or harvesting of fields, which make prey readily available. Orchards and vineyards have relatively low value for wildlife because understory vegetation growth that would provide food and cover typically are removed. Species that use orchards and vineyards, such as ground squirrel, American crow (*Corvus brachyrhynchos*), Brewer's blackbird (*Euphagus cyanocephalus*), and the nonnative European starling (*Sturnus vulgaris*), often are considered agricultural pests.

Open water is characterized by permanent or semi-permanent ponded or flowing water. Open-water areas provide habitat for waterfowl, western pond turtle, Sierran treefrog, and the nonnative American bullfrog. Both submerged and floating aquatic vegetation are used as basking or foraging habitat and provide cover for aquatic wildlife. Deeper open-water areas without vegetation provide habitat for species that forage for fish, crayfish, or other aquatic organisms, such as river otter and waterfowl.

Riverwash consists of alluvial sands and gravel associated with the active channel of the San Joaquin River. Generally, riverwash areas exist as sand and gravel point bars within the floodplain of the river. Riverwash provides nesting habitat for shorebirds, such as killdeer. Other species, such as mallard and western pond turtle, may use riverwash habitats for roosting or resting.

Disturbed areas include roads, canals, levees, and aggregate pits. Also included are areas used by off-highway vehicles and sites where rubble or fill has been deposited. Active and former aggregate mines are included if they are dry or unvegetated. As with agricultural habitats, low vegetation cover and species diversity in disturbed habitats limit their value to wildlife. However, these habitats are expected to support some common mammals, such as California ground squirrel, deer mouse, and desert cottontail.

Within each of the habitat types above, a variety of invasive plants is found. Plant communities within the extended study

area that are dominated by invasive plant species are often less suitable for native wildlife, and often support a higher number and higher densities of nonnative wildlife species. Nonnative eucalyptus trees within the extended study area may provide roosting and nesting habitat for native birds (e.g., hawks and waterbirds) and insects (i.e., monarch butterflies); however, studies have found the diversity and abundance of wildlife to be lower in eucalyptus groves than in native scrub and oak woodland habitats (Hanson et al. 1979). While native habitats often support nonnative wildlife species such as American bullfrog, crayfish, and red-eared slider (*Trachemys scripta elegans*), habitats with nonnative vegetation often support higher densities than native habitats of nonnative wildlife species such as Norway rat, house mouse (*Mus musculus*), house sparrow (*Passer domesticus*), European starling, and rock pigeon (*Columba livia*).

San Joaquin River from Merced River to the Delta The San Joaquin River between the Merced River and the Delta supports a variety of nonnative species, including American bullfrog, crayfish, Norway rat, and house sparrow. Common wildlife species such as raccoon, striped skunk, opossum (*Didelphimorphia* spp.), and other wildlife generalists that are adaptable to a variety of habitat types likely occur along this section of the San Joaquin River (DWR 2012).

Delta The Delta supports a variety of wildlife as a result of the mixture of various types of wetland and marsh habitats along with riparian and upland habitats. For example, riparian trees are an important feature of the Delta landscape, providing nesting opportunities for numerous wading birds, raptors, and cavity-nesting birds, and roosting habitat for some bat species, including the Mexican free-tailed bat (*Tadarida brasiliensis*) and California myotis (*Myotis californicus*). Tidal marshes and associated mudflats are exposed at low tides and support a variety of foraging shorebirds and dabbling ducks, such as least sandpiper (*Calidris minutilla*) and mallard. Adjacent upland habitats are also required for seasonal hibernation and reproduction in some species; they serve as important resting, cover, and nesting sites for many birds and mammals that move into uplands during high tide, including northern-rough winged swallow (*Stelgidopteryx serripennis*). Canals, side channels, and backflow pools of the Delta that contain emergent vegetation provide forage and cover habitat for species such as beaver, American mink (*Mustela vison*), and green heron (*Butorides striatus*). They also are dispersal

corridors that link habitat areas for terrestrial and semiaquatic species, including river otter, as well as many bird species.

CVP and SWP Water Service Areas The service areas cover a vast area spread across portions of 10 biogeographic regions: the northern, central, and southern coast; the central Coast Ranges; the southern mountains and valleys; the Central Valley; the Sierra Nevada and foothills; and the Mojave and Sonoran Deserts. Therefore, this portion of the extended study area has a great diversity of habitat types (see Chapter 6, "Biological Resources – Vegetation and Wetlands"), and structure and species composition vary widely. Because of intense human-induced habitat loss and change of land cover, much of the common wildlife consists of introduced species, including European starlings that nest in cavities in wooden telephone poles, house sparrows that nest in eaves in suburban homes, and Norway rats that forage in urban areas including parking lots or landfills.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria used to determine the significance of impacts on wildlife resources. It then discusses the impacts of the Investigation and proposes mitigation where appropriate. The potential impacts on wildlife resources and associated mitigation measures are summarized in Table 7-3.

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-1: Substantial Impact on Special-Status Invertebrates	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-1a: Mitigate Impacts on VELB, WLD-1b: Mitigate Impacts on Pipevine Swallowtail, WLD-1c: Mitigate Impacts on Listed Vernal Pool Branchiopods	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-2a: Mitigate Impacts on California Tiger Salamander and Western Spadefoot, WLD-2b: Mitigate Impacts on Foothill Yellow-Legged Frog and California Red-Legged Frog, WLD-2c: Mitigate Impacts on Western Pond Turtle, WLD-2d: Mitigate Impacts on Coast Horned Lizard	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-3: Substantial Impact on Special-Status Raptors	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-3a: Mitigate Impacts on Bald Eagle and Golden Eagle, WLD-3b: Mitigate Impacts on California Spotted Owl, WLD-3c: Mitigate Impacts on Burrowing Owl WLD-3d: Mitigate Impacts on American Peregrine Falcon and Prairie Falcon, WLD-3e: Mitigate Impacts on Cooper's Hawk and Sharp-Shinned Hawk, WLD-3f Mitigate Impacts on Osprey, WLD-3g: Mitigate Impacts on Northern Harrier	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-4a: Mitigate Impacts on Yellow Warbler, WLD-4b: Mitigate Impacts on Grasshopper Sparrow and California Horned Lark, WLD-4c: Mitigate Impacts on Loggerhead Shrike, WLD-4d: Mitigate Impacts on Bird Species Protected by the Migratory Bird Treaty Act	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-5: Substantial Impact on Ringtail	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-5: Mitigate Impacts on Ringtail	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-6: Substantial Impact on American Badger	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-6: Mitigate Impacts on American Badger	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-7: Substantial Impact on San Joaquin Pocket Mouse	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-7: Mitigate Impacts on San Joaquin Pocket Mouse	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-8: Substantial Impact on Special-Status Bat Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-8: Mitigate Impacts on Special-Status Bat Species	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-9: Substantial Impact on Migratory and Wintering Deer Herds	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	WLD-9: Mitigate Impacts on Migratory and Wintering Deer Herds	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	NI
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-11: Potential Reduction in Habitat or Populations of Special-Status Invertebrates	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-12: Potential Reduction in Habitat or Populations of Special-Status Amphibians and Reptiles	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-13: Potential Reduction in Habitat or Populations of Special-Status Bird Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-14: Potential Reduction in Habitat or Populations of Special-Status Mammal Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-15: Potential Interference with Migratory Corridors or Nursery Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
WLD-16: Potential Impact on Riparian Habitat for Special-Status Bird Species	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	WLD-16: Monitor and Manage Riparian Vegetation Structure Within Extended Study Area	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS

Table 7-3. Summary of Impacts and Mitigation Measures for Wildlife Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
WLD-17: Conflict with Local or Regional Policies Protecting Wildlife Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
WLD-18: Potential Conflict with Adopted Conservation Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

Methods and Assumptions

This analysis of impacts on wildlife resources resulting from implementing any of the alternatives under consideration is based on review of existing documentation that addresses biological resources in or near the primary and extended study areas and on GIS analysis. Where specific suitable habitat data for individual species with the potential to occur within the primary study area were not available, suitable habitat data as defined by California Wildlife Habitat Relationships (CWHR) was used to determine impacts.

The following assumptions about activity within the primary study area and vicinity have been made for the purposes of the impact analysis:

- Proposed facilities sites (dam construction areas, transmission lines, power houses, valve houses, access/haul roads, recreation facilities) would be completely cleared of all vegetation and would have marginal habitat value for wildlife after project construction.

- Complete or overstory vegetation removal would occur in vegetated areas below the Temperance Flat RM 274 Reservoir maximum surface water elevation during construction, except in special habitat areas.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A “[s]ignificant effect on the environment” means “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project” (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

Significance criteria used to analyze the potential impacts of the project on wildlife resources include factual and scientific

information and regulatory standards of county, State, and Federal agencies, including the State CEQA Guidelines. These criteria have been developed to establish thresholds to determine the significance of impacts pursuant to CEQA (Section 15064.7) and should not be confused with a "take" or adverse impact under the ESA. Impacts on wildlife resources would be significant if project implementation would do any of the following:

- Result in mortality of State-listed or Federally listed wildlife species, or species that are candidates for listing or proposed for listing
- Have the potential to substantially reduce the habitat of any wildlife species, including those that are listed as endangered or threatened or are candidates or proposed for endangered or threatened status
- Have the potential to cause a wildlife population to drop below self-sustaining levels
- Have a substantial adverse impact, either directly or through habitat modifications, on any non-special-status wildlife species
- Substantially adversely affect, either directly or through habitat modifications, any wildlife species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by CDFW or USFWS
- Interfere substantially with the movement of any native resident or migratory wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites
- Conflict with or violate the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved Federal, State, regional, or local habitat conservation plan relating to the protection of wildlife species
- Conflict with any State or local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance

Significance statements are relative to both existing conditions and future conditions unless stated otherwise. Impact conclusions are made using the significance criteria described above and include consideration of the "context" of the action and the "intensity" (severity) of its impacts in accordance with NEPA guidance (40 CFR 1508.27).

Topics Eliminated from Further Consideration

No topics related to wildlife resources that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

Implementing any of the action alternatives would increase the amount of water available for delivery from Millerton Lake. Portions of this water would be conveyed directly to Friant Division water contractors or down the San Joaquin River and rediverted or exchanged for delivery to SOD CVP and SWP water contractors. The conveyance of these water supplies would not exceed channel capacity of the San Joaquin River or Delta waterways. No change in existing use of adjacent lands would occur.

The direct and indirect impact assessment in the extended study area is limited to riverine, riparian, and wetland habitats within the existing channel of the San Joaquin River. Because implementing any of the action alternatives would not result in San Joaquin River or Delta instream flows that would exceed channel capacity or result in changes to land uses or habitats outside of the river channel, their implementation would not result in an impact on associated wildlife resources. Therefore, none of the five action alternatives would have an impact on biological resources in the San Joaquin River or Delta located outside of the river channel. Therefore, these portions of the extended study area are not discussed further in this analysis.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," of this Draft EIS, implementing any of the action alternatives would increase water reliability for the Friant Division and SOD CVP and SWP water contractors during most water-year types. The delivery of this additional water would not exceed historic maximum deliveries or existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment.

Because implementing any of the action alternatives would not result in land use changes or other physical consequences in the CVP and SWP water service areas that would affect existing habitat for biological resources, their implementation would not create an impact on biological resources within these service areas. This portion of the extended study area is not discussed further in this analysis.

Impacts on biological resources within the primary study area are addressed in the discussions for Impact WLD-1 through Impact WLD-10. These discussions address impacts on biological resources that are expected to be restricted to the primary study area. The discussions for Impact WLD-11 through Impact WLD-18 address impacts on biological resources that could occur within the extended study area only. These impact discussions address potential impacts associated with changes in water delivery volumes and flooding frequency that could occur within the San Joaquin River and Delta channels within the extended study area.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any of the alternatives. It describes how various wildlife species could be affected by the following types of impacts:

- Direct impacts from construction-related activities at the Temperance Flat RM 274 Dam and project facilities, including a new powerhouse, a water intake structure, campsites, and temporary construction facilities, including staging areas, and quarry, batch plant, and haul road options

- Direct impacts associated with habitat loss from construction and operation of the Temperance Flat RM 274 Dam and associated project facilities

- Direct impacts from habitat loss associated with inundation upstream from the Temperance Flat RM 274 Dam related to the Temperance Flat RM 274 Reservoir

- Indirect impacts from an increase in the level of human disturbance associated with increased recreation activities or recreation activities in a new location

- Indirect impacts from an increase in erosion and decrease in water quality in aquatic habitat

Impact WLD-1: Substantial Impact on Special-Status Invertebrates

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses. No impact of future development would occur in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Ground-disturbing activities and vegetation removal associated with the construction of the new Temperance Flat RM 274 Dam, as well as activities associated with construction of project facilities sites, could result in direct take of pipevine swallowtail, a BLM species of management concern, and valley elderberry longhorn beetle, a species Federally listed as threatened and CALFED Multi-Species Conservation Strategy Recovery species. The goal for species with a recover status is to "Recover species populations within the MSCS focus area to levels that ensure the species long-term survival in nature." The potential for direct take of these species through vegetation removal and inundation associated with construction of the project would be substantial.

In addition, the construction of the new Temperance Flat RM 274 Dam and Reservoir would result in inundation of suitable habitat, and the ground-disturbing activities would also remove suitable valley elderberry longhorn beetle habitat throughout the primary study area, and in the Temperance Flat Reservoir Area up to the Kerckhoff Powerhouse for the pipevine swallowtail. The permanent loss of habitat through vegetation removal and inundation for these special-status species associated with construction of the project would be substantial.

Vernal pool branchiopods, vernal pool fairy shrimp, and vernal pool tadpole shrimp are Federally listed under the ESA. These species are not expected to occur within the zone of inundation associated with Temperance Flat RM 274 Reservoir because of the absence of vernal pool or seasonal wetland habitat. However, suitable vernal pool habitat exists on table top grasslands found along the proposed transmission line to the south of the Temperance Flat RM 274 Dam, as described above in the Special-Status Species section under Invertebrates.

Direct mortality of listed vernal pool branchiopods or loss of dormant cysts could occur where vegetation clearing implemented for the construction of the transmission lines intersects potential habitat for listed vernal pool branchiopods. The potential for direct take of listed vernal pool branchiopods associated with construction of the transmission lines would be substantial.

The construction of the transmission lines would also potentially result in loss of suitable habitat in the primary study area for vernal pool branchiopods (Table 7-4). The permanent loss of habitat through vegetation removal for these special-status species associated with construction of the project would be substantial.

This impact would be **significant**. Mitigation for this impact is proposed below in the Mitigation Measures section.

Table 7-4. Impacts on Suitable Habitat for Vernal Pool Branchiopods in the Primary Study Area

Suitable Habitat	Area (acres)
Vernal Pool and Swale	6.37
Total	**6.37**

Impact WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles

Primary Study Area

No-Action Alternative Implementing the No-Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur,

resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses. No impact of future development would occur in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives California tiger salamander is Federally and State listed as threatened. Western spadefoot is a California Species of Special Concern. These species have not been observed within the primary study area. However, suitable seasonal wetland habitat could exist within seasonal ponds along ephemeral drainages within the primary study area, as described above in the Special-Status Species section under Amphibians and Reptiles. If California tiger salamander or western spadefoot were present in seasonal wetland habitats in the primary study area, construction of the Temperance Flat RM 274 Dam and resulting inundation could lead to direct take of individuals and loss of breeding habitat.

Direct mortality of California tiger salamander and western spadefoot could occur in areas of suitable upland habitat where vegetation clearing is implemented if these activities occur during the breeding (i.e., wet) season when these species are on the surface. The potential for direct take of these special-status species with construction of the project would be substantial.

California tiger salamander and western spadefoot may use grasslands for dispersal and aestivation habitat. Construction activities in suitable upland habitat would result in a loss of upland dispersal and aestivation habitat for these species. Impacts on suitable California tiger salamander and western spadefoot habitat by CWHR type in the primary study area is summarized in Table 7-5. The permanent loss of suitable aestivation and movement habitat for these special-status species associated with construction of the project would be substantial.

Regularly or permanently inundating these habitats could make remaining suitable seasonal pools unsuitable for California tiger salamander and western spadefoot by altering their hydrology or by increasing predation from nonnative fish or bullfrogs, which require more permanent water. The potential change in hydrology for these special-status species associated with construction of the project would be substantial.

Table 7-5. Impacts on Suitable Habitat for Special-Status Amphibians and Reptiles in the Primary Study Area

Suitable Habitat	Area (acres)
California Tiger Salamander and Western Spadefoot	
Annual Grassland	317
Vernal Pool and Swales	6
Total	**323**
Foothill Yellow-Legged Frog	
Riverine	200
Willow Riparian Forest	4
White Alder Riparian Forest	25
Mixed Riparian Forest	12
Sycamore Riparian Forest	0.4
Buttonbush Scrub	0.3
Fig Riparian/Fig-Willow Riparian	3
Total	**245**
Western Pond Turtle	
Riverine	200
Seasonal Wetlands	269
Willow Riparian Forest	4
White Alder Riparian Forest	25
Mixed Riparian Forest	12
Sycamore Riparian Forest	0.4
Buttonbush Scrub	0.3
Fig Riparian/Fig-Willow Riparian	3
Total	**512**
Coast Horned Lizard	
Annual Grassland	317
Foothill Pine Chaparral Woodland	5
Total	**322**

Implementing any of the action alternatives could also result in the degradation of suitable aquatic habitat because of increased erosion, increased sedimentation, or accidental fuel leaks and spills. The potential decrease in water quality for California tiger salamander and western spadefoot habitat associated with construction of the Project would be substantial.

California red-legged frog is Federally listed as threatened, a California Species of Special Concern, and a CALFED Multi-Species Conservation Strategy Goal – Maintain species. The goal for species with a “maintain” status is to “Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species.” Although suitable breeding and upland habitat is present and the primary study area falls within its range, the nearest known occurrence of California red-legged frog is more than 65 miles away, and the species has not been observed during surveys of

the primary study area. Given this information, it is unlikely for construction and operation of the project to result in direct take of California red-legged frog or indirect take through changes in hydrology or water quality. However, until such time as its absence in the primary study area is confirmed, there is some potential for the project to affect this species. Loss of suitable habitat within the primary study area as a result of implementing the action alternatives may result in a potentially significant impact on the future recovery of the species. If California red-legged frog were present in the primary study area, the impact on California red-legged frog within the primary study area would be substantial.

Foothill yellow-legged frog is a California Species of Special Concern and a BLM-sensitive species. No foothill yellow-legged frogs have been observed within the primary study area. However, limited potentially suitable breeding habitat occurs within the primary study area at the confluence of small tributaries with the San Joaquin River (see the Special-Status Species section under Amphibians and Reptiles). Ground-disturbing activities and vegetation removal associated with Temperance Flat RM 274 Dam construction activities could result in direct take of foothill yellow-legged frog. Although frogs could move away from disturbance, impacts on foothill yellow-legged frog could also occur as a result of ground-disturbing construction activities in or near suitable aquatic habitat. The potential for direct or indirect take of foothill yellow-legged frog associated with construction of the action alternatives would be substantial.

In addition, inundation caused by the construction of the new Temperance Flat RM 274 Dam would result in converting suitable riverine and riparian habitat to unsuitable lacustrine habitat. Impacts on suitable foothill yellow-legged frog habitat by CWHR type in the primary study area is summarized in Table 7-5. Loss of suitable habitat for foothill yellow-legged frog would be substantial.

Project implementation could also result in the degradation of remaining suitable aquatic habitat because of increased erosion, sedimentation, or accidental fuel leaks and spills. The potential decrease in water quality in aquatic habitat for foothill yellow-legged frog associated with construction of the project would be substantial.

Western pond turtle is a California Species of Special Concern and a BLM-sensitive species that is known to occur within the

primary study area. Ground-disturbing activities and vegetation removal associated with Temperance Flat RM 274 Dam and project facilities construction could lead to direct take of western pond turtle as a result of project-associated construction activities in or near suitable aquatic and upland habitat. Potential construction impacts include direct mortality of western pond turtle individuals from strikes by construction equipment and through increased vehicle traffic. The potential for direct take of western pond turtle associated with construction of the project would be substantial.

Although lacustrine habitat that would be created by implementing the action alternatives is suitable habitat for western pond turtle, annual fluctuations in water levels may result in an adverse impact on western pond turtle individuals in the primary study area. In addition to using aquatic habitats, western pond turtle uses upland habitats for nesting and overwintering. Nests are generally located on south-facing slopes of less than 60 degrees averaging about 660 feet from an aquatic site (DFG 1994). Thus, loss of existing upland habitat adjacent to suitable aquatic habitat (within approximately 660 feet) could adversely affect western pond turtle. Direct take of western pond turtle eggs or juveniles could occur during initial inundation of habitat. Western pond turtles could lay eggs in suitable habitat that subsequently becomes inundated, resulting in the death of the eggs or overwintering juveniles. In addition, inundation would convert suitable upland habitat to lacustrine habitat that is not suitable for nesting and overwintering.

Construction of the new Temperance Flat RM 274 Dam and Reservoir would also result in conversion of riverine habitat to lacustrine habitat. Impacts on suitable western pond turtle habitat by CWHR type in the primary study area is summarized in Table 7-5. Western pond turtles use both riverine and lacustrine habitat. However, lacustrine habitat would occur only during times of high water levels in the Temperance Flat RM 274 Reservoir. Thus, the conversion of suitable riverine habitats to suitable lacustrine habitat would result in a net loss of suitable western pond turtle habitat. These impacts would be moderate in intensity.

An increase in human activity in suitable habitat for hibernating and nesting western pond turtle could occur in association with Temperance Flat RM 274 Dam construction. The creation and future use of the Temperance Flat boat-in campground upstream from Millerton Lake would result in more human activity close to potential upland burrows. The

increase in noise and human disturbance could lead to abandonment and the incidental loss of fertile eggs or young.

In addition, project implementation could result in the degradation of suitable aquatic habitat from increased erosion, sedimentation, or accidental fuel leaks and spills associated with human activity. The potential decrease in water quality and increased human activity associated with construction of the project would be a substantial risk of indirect impacts on western pond turtle.

The coast horned lizard is a California Species of Special Concern and BLM-sensitive species. Although this species has not been observed within the primary study area, potentially suitable grassland and scrub habitat occurs within the primary study area (see the Special-Status Species section under Amphibians and Reptiles). Ground-disturbing activities and vegetation removal associated with Temperance Flat RM 274 Dam construction activities could result in direct take of coast horned lizard. Potential construction impacts include mortality of individuals through crushing by construction equipment or vehicle traffic within suitable breeding and hibernation habitat.

Inundation of suitable habitat could also lead to direct take of coast horned lizard eggs or juveniles during the initial Temperance Flat RM 274 Reservoir inundation. The lizards use small-mammal burrows for refuge and for hibernating during winter and could lay eggs in suitable habitat that subsequently becomes inundated, resulting in the death of the eggs or overwintering juveniles. The potential for direct take resulting from ground-disturbing construction and inundation associated with construction of the project would be substantial.

In addition, ground-disturbing activities and vegetation removal associated with the construction of the Temperance Flat RM 274 Dam, as well as construction activities in the project facilities sites, could result in loss of suitable habitat for the coast horned lizard. Impacts on suitable coast horned lizard habitat by CWHR type in the primary study area is summarized in Table 7-5.

In addition, the construction of the new Temperance Flat RM 274 Dam would result in the inundation of additional suitable grassland and scrub habitat within the primary study area. The permanent loss of habitat through vegetation removal and

inundation for coast horned lizard associated with construction of the project would be substantial.

Human activity in suitable habitat for hibernating and nesting coast horned lizards could increase. The creation and future use of the boat-in campground upstream from Millerton Lake would result in more human activity close to potential upland burrows for coast horned lizard. The increase in noise and human disturbance could lead to abandonment or incidental loss of fertile eggs or young. The increase in human activity associated with construction of the project would substantially increase the risk of indirect take of coast horned lizard.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-3: Substantial Impact on Special-Status Raptors

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives Special-status raptors, including bald eagle, golden eagle, California spotted owl, burrowing owl, American peregrine falcon, prairie falcon, merlin, osprey, northern harrier, Cooper's hawk, and sharp-shinned hawk, are known to occur or have the potential to occur within the primary study area.

Bald eagle (State listed as endangered, State fully protected species, covered by Federal Bald and Golden Eagle Protection Act), golden eagle (covered by Federal Bald and Golden Eagle Protection Act), osprey (watch list), Cooper's hawk (watch list), sharp-shinned hawk (watch list), merlin (watch list), and California spotted owl (California Species of Special Concern,

BLM-Sensitive) are known to occur in woodland habitats within the primary study area.

Suitable habitat features that serve as nesting sites such as snags and large trees would be removed with construction of the new Temperance Flat RM 274 Dam, construction of the project facilities, and inundation associated with the new Temperance Flat RM 274 Reservoir. Inundation could also increase erosion and decrease bank stability, which could affect nest trees that are close to the inundation zone.

A known bald eagle nest tree in the vicinity of the proposed Temperance Flat RM 274 Dam site would be lost by vegetation removal associated with the action alternatives. Because bald eagles generally use the same nest for multiple years, construction of the dam would likely result in the loss of a bald eagle nest site. This impact would be substantial.

Inundation from the Temperance Flat RM 274 Dam in the primary study area within suitable foraging habitat could also affect cliff-nesting raptors such as golden eagle (fully protected species, covered by the Bald and Golden Eagle Protection Act, watch list species), American peregrine falcon (fully protected species), and prairie falcon (watch list species) by inundating suitable cliff nesting sites or resulting in a loss of suitable foraging habitat for these species, potentially resulting in a loss of an existing territory.

Western burrowing owl (California Species of Special Concern, BLM-Sensitive) and northern harrier (California Species of Special Concern) nest in open grasslands. Vegetation removal and construction activities along the transmission line in these habitats would result in loss of potential nesting habitat for these species.

Ground-disturbing activities associated with project construction and resulting inundation from the Temperance Flat RM 274 Dam would also result in significant loss of foraging habitat for woodland-foraging species such as Cooper’s hawk, sharp-shinned hawk, California spotted owl, and merlin. The permanent loss of nesting and foraging habitat for these special-status raptors associated with construction of the project and inundation would be substantial.

White-tailed kite and long-eared owl are not expected to nest in the primary study area, but could use grasslands and meadows, and dense shrubs in riparian woodlands, respectively, for

foraging in winter or during migration. Similarly, western burrowing owl and northern harrier use foraging habitat that is widespread outside of the primary study area. Impacts on suitable raptor habitat by CWHR type in the primary study area is summarized in Table 7-6. For these species, given the prevalence of surrounding suitable habitat, this impact would not be substantial.

Table 7-6. Impacts on Suitable Habitat for Special-Status Raptors in the Primary Study Area

Suitable Habitat	Area (acres)
Bald Eagle, Osprey, Cooper's Hawk, Sharp-Shinned Hawk, Merlin	
Foothill Pine Oak Woodland	5,029
Blue Oak Woodland	1,388
Live Oak Woodland	57
Foothill Pine Woodland	9
Foothill Pine Chaparral Woodland	5
Mixed Riparian Forest	12
Sycamore Riparian Woodland	0.4
Total	**6,500.4**
California Spotted Owl	
Mixed Riparian Forest	12
Sycamore Riparian Woodland	0.4
Total	**12.4**
Western Burrowing Owl, Northern Harrier	
Annual Grassland	317
Vernal Pool and Swales	6
Total	**323**

In addition, vegetation removal during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of active raptor nests. Noise generated by vegetation removal, such as noise caused by helicopter use, excavators, and chainsaws that occurs during the breeding season, could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. The potential for direct take for these special-status raptors associated with construction of the project would be substantial.

An increase in human activity close to remaining suitable nesting habitat for bald eagles, osprey, and cliff-nesting raptors such as golden eagle, prairie falcon, and peregrine falcon could occur during operation of the project. The increased elevation in the Temperance Flat RM 274 Reservoir could increase access to these species' nests by recreational boaters. In addition, the creation and future use of the Temperance Flat

boat-in campground upstream from Millerton Lake would result in more human activity close to potential nest trees.

The increase in noise and human disturbance could lead to nest abandonment and the incidental loss of fertile eggs or young. These indirect impacts would be moderate in intensity.

This impact would be **significant**. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses. No impact of future development would occur in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Yellow warbler (California Species of Special Concern) is known to occur within the primary study area along Big Sandy Creek (see the Special-Status Species section under Birds). Although nesting habitat within the primary study area is marginal, there is the potential for this species to nest within the primary study area, and loss of riparian habitat for this species would be substantial.

Little willow flycatcher, yellow-breasted chat, and least Bell's vireo are riparian-dependent species and are unlikely to occur within the primary study area due to lack of suitable riparian habitat. Therefore, ground-disturbing activities related to construction of the new Temperance Flat RM 274 Dam and resulting in loss or inundation of riparian habitat would be unlikely to result in impacts on little willow flycatcher, yellow-breasted chat, or least Bell's vireo. Because they are not likely to be present, these riparian-dependent bird species

would not be substantially affected by construction and operation within the primary study area.

Grasshopper sparrow, a California Species of Special Concern, and California horned lark, a watch list species, are not known to occur in the primary study area. However, suitable breeding and foraging habitat is present in the table top grasslands along the proposed southeastern transmission line. If ground-disturbing activities and vegetation removal related to the transmission line occurs during the nesting season, this could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests. Noise generated by vegetation removal, such as noise caused by helicopter use, excavators, and chainsaws, could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. The potential for direct take resulting from ground-disturbing construction associated with construction of the project would be substantial.

Grasshopper sparrow and California horned lark use grasslands or extensive, dense riparian woodlands for foraging in winter or during migration, and these habitats are widespread in the areas outside of the primary study area. For these species, given the prevalence of suitable habitat in the immediate vicinity of the primary study area, the loss of suitable habitat associated with construction and operation of the project would not be substantial.

Loggerhead shrike, a California Species of Special Concern, is a known migrant within the primary study area and suitable breeding and foraging habitat occurs in open habitats with scattered perches (see the Special-Status Species section under Birds). If ground-disturbing activities related to construction of project facilities occur during the nesting season, there is a potential for loss of loggerhead shrike individuals. Vegetation removal during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests.

Noise generated by machinery used in vegetation removal, including helicopters, excavators, and chainsaws, could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. The potential for mortality of loggerhead shrike individuals associated with construction of the project would be substantial.

Vegetation removal and other construction activities as well as inundation from construction of the Temperance Flat RM 274 Dam within or near suitable habitat for loggerhead shrike would result in a loss of suitable nesting and foraging habitat. Impacts on suitable loggerhead shrike habitat by CWHR type in the primary study area is summarized in Table 7-7. The permanent loss of habitat through vegetation removal and inundation associated with construction of the project would be substantial.

Table 7-7. Impacts on Suitable Habitat for Loggerhead Shrike in the Primary Study Area

Suitable Habitat	Area (acres)
Annual Grassland	317
Foothill Pine Chaparral Woodland	5
Total	**322**

The Migratory Bird Treaty Act (MBTA) also covers a variety of common bird species known to occur within the primary study area. As with special-status bird species, construction and operation of the Temperance Flat RM 274 Dam could result in loss of bird species protected by the MBTA through incidental loss of fertile eggs or nestlings due to direct removal of nests or through nest abandonment.

Vegetation removal and Temperance Flat RM 274 Reservoir inundation that occurs during the nesting season would result in the permanent loss of habitat for nesting bird species protected by the MBTA. The permanent loss of nesting habitat through vegetation removal and inundation associated with construction of the project for bird species covered by the MBTA would be substantial.

This impact would be **significant**. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-5: Substantial Impact on Ringtail

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in

accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from noise, increased light and glare, and other disturbances associated with developed land uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives Ringtails are a State fully protected species that could occur within riparian and forest habitats within the primary study area. Ground-disturbing activities and vegetation removal during project construction would result in the loss of suitable habitat for ringtail within the primary study area. Suitable habitat for ringtail within the zone of inundation of the Temperance Flat RM 274 Reservoir would also be lost. It is assumed that all vegetation would be removed within the zone of inundation; therefore, no habitat value would remain for upland wildlife species even during periods of Temperance Flat RM 274 Reservoir drawdown. Estimated loss of suitable habitat for ringtail within the primary study area is presented in Table 7-8. The permanent loss of suitable habitat for ringtail would be substantial.

Table 7-8. Impacts on Suitable Habitat for Special-Status Mammals in the Primary Study Area

Species	Habitat Affected	Estimated Impact Acreage
Pallid bat[1] *Antrozous pallidus*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Townsend's big-eared bat[1] *Corynorhinus townsendii*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Spotted bat[1] *Euderma maculatum*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Western mastiff bat[1] *Eumops perotis californicus*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]

Table 7-8. Impacts on Suitable Habitat for Special-Status Mammals in the Primary Study Area (contd.)

Species	Habitat Affected	Estimated Impact Acreage
Western small-footed myotis[1] *Myotis ciliolabrum*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Long-eared myotis[1] *Myotis evotis*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Fringed myotis[1] *Myotis thysanodes*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Yuma myotis[1] *Myotis yumanensis*	All woodland, shrub, riparian herbaceous wetland, aquatic, and herbaceous upland habitat types are suitable foraging habitat.	7,418
	Roosting caves, mines, and rock faces.	31[2]
Ringtail *Bassariscus astutus*	The species is found in oak and foothill pine woodlands, riverine, seasonal wetland, sycamore woodland, willow woodland, riparian woodland, button bush scrub, bush lupine scrub, and buckbrush scrub.	7,036
San Joaquin pocket mouse *Perognathus inornatus inornatus*	The species could potentially occur in annual grassland, bush lupine scrub, and buckbrush scrub.	351
American badger *Taxidea taxus*	The species could potentially occur in annual grassland, bush lupine scrub, and buckbrush scrub.	351

Notes:

[1] Lacustrine shoreline and lacustrine unconsolidated bottom can also serve as foraging habitat for bats. However, because these habitats would continue at the same or greater acreage after construction, they are not included in the impact acreage for bat species.

[2] There are approximately 31 acres of barren habitat within the primary study area that would be affected by Temperance Flat RM 274 Reservoir inundation. This habitat includes rock faces. The exact acreage of caves or mines that would be affected by inundation cannot be determined. Under the maximum inundation level of 985 feet, the Millerton Lake Cave System would be inundated. At lower water levels, some of the cave system would be available to roosting bat species.

The use of construction equipment and increased roadway traffic during project construction could result in ringtails being struck and injured or killed. Removal of trees could also result

in the loss of occupied ringtail dens. These impacts would be moderate in intensity.

Increased noise and lighting within the primary study area during construction could result in displacing ringtails from the construction area. These impacts would be moderate in intensity.

The creation of additional recreational facilities within the primary study area could result in indirect impacts on remaining suitable habitat during project operation. These new facilities, including campgrounds, boat launches, trails, and access roads, could increase human activity near ringtails or ringtail dens, resulting in indirect impacts and reduction in habitat suitability for ringtail within the primary study area. These indirect impacts would be moderate in intensity.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-6: Substantial Impact on American Badger

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses No impact of future development would occur in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives American badger is a State Species of Special Concern. Ground-disturbing activities and vegetation removal would occur with Temperance Flat RM 274 Dam construction activities and associated structures that would permanently remove suitable habitat for American badger within the primary study area. Suitable habitat for badgers within the zone of inundation of the Temperance Flat RM 274

Reservoir would also be lost. It is assumed that all vegetation would be removed within the zone of inundation and therefore, no habitat value would remain for upland wildlife species even during periods of Temperance Flat RM 274 Reservoir drawdown. Estimated loss of suitable habitat for American badger within the primary study area is provided in Table 7-8. The permanent loss of suitable habitat for American badger would be substantial.

The use of construction equipment and increased roadway traffic during project construction could result in American badgers being struck and injured or killed. Construction activity and subsequent inundation could result in the loss of active badger dens within the primary study area. These impacts would be moderate in intensity.

Increased noise and lighting within the primary study area during construction could result in displacing badgers from the construction area. These impacts would be moderate in intensity.

The creation of additional recreational facilities within the primary study area could result in increased human presence within the primary study area after project construction. These new facilities would include campgrounds, boat launches, trails, and access roads. The indirect impacts on remaining suitable habitat for badgers could result in avoidance of suitable habitat with human presence or increased interaction of badgers with humans and associated species such as dogs that could result in injury to or death of badgers. These indirect impacts would be moderate in intensity.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-7: Substantial Impact on San Joaquin Pocket Mouse

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans.

Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives San Joaquin pocket mouse is a BLM sensitive species. It is not known to occur within the primary study area, but suitable grassland habitat does occur within the primary study area. This habitat type is limited within the primary study area and therefore, this species is not expected to occur extensively within the primary study area. However, ground disturbance and vegetation removal would occur associated with construction of the Temperance Flat RM 274 Dam and associated facilities that would permanently remove suitable habitat for the San Joaquin pocket mouse. Suitable habitat within the zone of inundation of the Temperance Flat RM 274 Reservoir would also be lost. It is assumed that all vegetation would be removed within the zone of inundation and therefore, no habitat value would remain for upland wildlife species even during periods of Temperance Flat RM 274 Reservoir drawdown. The permanent loss of suitable habitat for San Joaquin pocket mouse would be of moderate intensity.

The use of construction equipment and increased roadway traffic during project construction could result in San Joaquin pocket mice being struck and injured or killed. Construction activity and subsequent inundation could result in the loss of active burrows within the primary study area. These impacts would be moderate in intensity.

Increased noise and lighting within the primary study area during construction could result in displacing the San Joaquin pocket mouse from the construction area. These impacts would be moderate in intensity.

The creation of additional recreational facilities within the primary study area could result in increased human presence within the primary study area after project construction. These facilities include campgrounds, boat launches, trails, and access roads. These indirect impacts on remaining suitable habitat for San Joaquin pocket mice could result in the species avoiding suitable habitat with human presence, or could cause increased interaction of mice with humans and associated species such as

dogs that could result in injury to or death of individuals. These indirect impacts would be moderate in intensity.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-8: Substantial Impact on Special-Status Bat Species

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans. Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives The primary study area is known to support several special-status bat species, including Townsend's big-eared bat and western mastiff bat. Ground disturbance and vegetation removal associated with construction of the Temperance Flat RM 274 Dam and associated facilities would result in the loss of suitable foraging and roosting habitat for a variety of bat species. The new Temperance Flat RM 274 Reservoir area would likely support foraging habitat for some bat species that currently use Millerton Lake and the San Joaquin River for foraging. However, some foraging habitats within upland areas would be permanently lost or altered, and potential roosting habitat would be permanently lost. This loss of foraging and roosting habitat would be substantial.

The primary study area also contains several mines and the Millerton Lake Cave System, which provide potential roosting habitat for bat species. Several mines and portions of the Millerton Lake Cave System would be inundated by the Temperance Flat RM 274 Reservoir. The Millerton Lake Cave System is located at a range of 540 to 980 feet in elevation. At the maximum inundation level of 985 feet, the entire Millerton

Lake Cave System would be inundated. At typical lower Temperance Flat RM 274 Reservoir levels, some portion of the cave system would be available to roosting bats. It is unclear whether the loss of Millerton Lake Cave System would result in a significant loss of bat roosting habitat. A California State University, Sacramento, report prepared in 2013 (Graening 2013) found Townsend's big-eared bat carcasses within the Millerton Lake Cave System. The report speculated that the structure of the caves could result in a sink for bat species because they might not be able to escape the caves; however, for purposes of this analysis, it is assumed that the Millerton Lake Cave System may still provide suitable habitat for some bat species.

Some bat species also roost in trees or rock piles that would be removed during project construction and the subsequent Temperance Flat RM 274 Reservoir inundation. It is assumed that vegetation would be removed consistent with the three vegetation removal prescriptions described in Chapter 2, "Alternatives," and little to no habitat value would remain for roosting bat species within the Temperance Flat Reservoir Area even during periods of Temperance Flat RM 274 Reservoir drawdown. This loss of potential roosting habitat would be substantial.

Construction lighting could result in prey items (insects) being attracted to construction areas, which could result in bat species using construction areas. This could create a higher potential for bats to collide with construction equipment or facilities during construction. This impact would be moderate in intensity.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-9: Substantial Impact on Migratory and Wintering Deer Herds

Primary Study Area

No Action Alternative Implementing the No Action Alternative would not result in any impacts associated with the development of the Temperance Flat RM 274 Dam and Reservoir on natural habitats that support wildlife species or result in changes to existing management activities. Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans.

Limited rural residential development is expected to occur, resulting in loss of open space and degradation of wildlife habitat from increased noise, increased light and glare, and other disturbances associated with developed land uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives The primary study area is known to support wintering deer ranges and migratory deer herds (see the Other Wildlife Resources section under Primary Study Area). Construction of the Temperance Flat RM 274 Dam and subsequent inundation could result in loss of wintering habitat for mule deer herds. Migrating mule deer could also encounter difficulty in crossing the San Joaquin River during times of high water. Suitable wintering habitat would remain above the inundation area after construction is complete and operation of the Temperance Flat RM 274 Reservoir is initiated. However, loss of a wintering ground could occur for any wintering grounds currently within the zone of inundation. This loss of potential wintering habitat would be moderate.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines

Primary Study Area

No Action Alternative Future development in Fresno and Madera counties would continue in accordance with these counties' respective general plans.

There would be **no impact** under the No Action Alternative.

Action Alternatives The Fresno County and Madera County General Plans have an objective to protect natural communities within their boundaries. Implementing any of the action alternatives would result in significant impacts on natural upland and wetland communities that provide habitat for wildlife species that are included in the county general plans.

This impact would be **significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Impact WLD-11: Potential Reduction in Habitat or Populations of Special-Status Invertebrates

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect habits for special-status invertebrates.

There would be **no impact** under the No Action Alternative.

Action Alternatives Most of the special-status invertebrates known to occur in the vicinity of the extended study area between Friant Dam and the Merced River, as discussed above in the Affected Environment section, are found in habitats that occur above the alluvial plain, such as grassland, vernal pool, and alkaline scrub habitats. Special-status invertebrates associated with these habitat types would not be affected by water releases within the current channel capacity of the San Joaquin River and other conveyance channels.

Valley elderberry longhorn beetle is associated with elderberry shrubs, which occur in riparian woodland and scrub habitat from Friant Dam to the Delta. There is limited potential for elderberry shrubs to be present in areas occasionally receiving additional water supply from the Temperance Flat RM 274 Reservoir; elderberry shrubs are not commonly found growing immediately next to the river's edge, but are often found on floodplain terraces or higher up the bank.

Implementing any of the action alternatives would increase water delivery reliability from Millerton Lake. This increased delivery would be conveyed within existing water conveyance channels. About 28 to 37 TAF of the added water supply provided by the new Temperance Flat RM 274 Reservoir would be discharged to the San Joaquin River for conveyance to SOD CVP and SWP water contractors; however, these additional water supplies would not exceed current channel capacity of the San Joaquin River or other waterways and would not result in a change in the current operation of Friant Dam. The host plant for valley elderberry longhorn beetle —blue elderberry—is adapted to annual variation in flooding and the overall flow patterns, water depth, and frequency and duration of flooding in these waterways would be within the

current normal range of variation. The increased water supply is not likely to prevent establishment or substantially reduce the vigor of existing elderberry shrubs in the extended study area. Therefore, valley elderberry longhorn beetle would not be substantially affected by the additional water supply.

Elderberry shrubs that could serve as host species for valley elderberry longhorn beetle are also found along the San Joaquin River downstream from the Merced River and in the CVP and SWP water service areas. Because the contribution from Friant Dam becomes a smaller proportion of the total flow, because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus Rivers), the additional water supply would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta, or in the Delta. Thus, any changes downstream from the Merced River confluence, in the Delta, or in the CVP and SWP water service areas, would not be sufficient to affect special-status invertebrate species.

Project implementation is not expected to substantially alter potential habitat for special-status invertebrate species or result in direct removal of any special-status invertebrate occurrences in the extended study area.

This impact would be **less than significant** under the action alternatives. Therefore, mitigation for this impact is not needed and thus not proposed.

Impact WLD-12: Potential Reduction in Habitat or Populations of Special-Status Amphibians and Reptiles

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect habits for special-status amphibians and reptiles.

There would be **no impact** under the No Action Alternative.

Action Alternatives Most of the special-status amphibians and reptiles known to occur in the vicinity of the extended study area between Friant Dam and the Merced River, as discussed in

the Affected Environment section, are found in habitats that occur above the alluvial plain, such as grassland and alkaline scrub habitats. Special-status amphibians and reptiles associated with these habitat types would not be affected by water releases within the current channel capacity of the San Joaquin River and other conveyance channels.

GGS, a species Federally and State listed as threatened, inhabits aquatic features such as emergent marsh and sloughs and adjacent upland habitat in isolated areas, particularly in suitable habitat within the San Luis NWR complex in the extended study area. GGS require, among other habitat components, adequate water during the snake's primary active period (i.e., early spring through mid-fall), abundant emergent, herbaceous wetland vegetation for escape cover and foraging habitat, and upland habitat for basking, cover, and retreat sites. Thus, there is limited potential for GGS to be present in areas occasionally receiving additional water supply from the Temperance Flat RM 274 Reservoir.

Western pond turtle is found throughout the extended study area in riparian habitat with abundant basking habitat and escape cover, particularly within the San Luis NWR complex. Western pond turtle use low-velocity areas of the main channels of the San Joaquin River and are not restricted to habitat closest to the water’s surface. More suitable aquatic habitats generally have standing and slow-moving water, which typically occurs in off-channel areas, such as side channels and backwater areas.

Implementing any of the action alternatives would increase water delivery reliability from Millerton Lake. This increased delivery would be conveyed within existing water conveyance channels. About 28 to 37 TAF of the added water supply provided by the new Temperance Flat RM 274 Reservoir would be discharged to the San Joaquin River for conveyance to SOD CVP and SWP water contractors; however, these additional water supplies would not exceed current channel capacity of the San Joaquin River or other waterways and would not result in a change in the current operation of Friant Dam. GGS and western pond turtles are adapted to annual variation in flooding and the overall flow patterns, water depth, and frequency and duration of flooding in these waterways would be within the current normal range of variation. The increased water supply is not likely to eliminate foraging or basking habitat for either the GGS or western pond turtle, and is not expected to result in direct take of individuals at nest

sites, because the water would not be released at a higher velocity.

GGS and western pond turtles are also found along the San Joaquin River downstream from the Merced River and in the CVP and SWP water service areas. Because the contribution from Friant Dam becomes a smaller proportion of the total flow because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus Rivers), the additional water supply would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta, or in the Delta. Thus, any changes downstream from the Merced River confluence, in the Delta, or in the CVP and SWP water service areas, would not be sufficient to affect special-status amphibian and reptile species.

Project implementation is not expected to substantially alter potential habitat for special-status amphibian and reptile species or result in direct removal of any special-status amphibian and reptile occurrences in the extended study area.

This impact would be **less than significant** under the action alternatives. Therefore, mitigation for this impact is not needed and thus not proposed.

Impact WLD-13 Potential Reduction in Habitat or Populations of Special-Status Bird Species

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect habits for special-status bird species.

There would be **no impact** under the No Action Alternative.

Action Alternatives Several special-status birds known to occur in the vicinity of the extended study area between Friant Dam and the Merced River, as discussed in the Affected Environment section, are found in habitats that occur above the alluvial plain, such as grassland, rock ledges, and alkaline scrub habitats. Special-status birds associated with these habitat types would not be affected by water releases within the

current channel capacity of the San Joaquin River and other conveyance channels.

The riparian and wetland habitats along the San Joaquin River between Friant Dam and the Merced River provide potential nesting and foraging habitat for a wide array of protected bird species. Least Bell's vireo (Federally and State listed as endangered) and yellow warbler, for example, nest in riparian vegetation in channels of the San Joaquin River within the San Luis NWR. In addition, there are rookeries for species such as double-crested cormorant (Watch List species) which could occur in snags and trees within the stream channel. Raptors, such as Cooper's hawk (Watch List species), white-tailed kite (fully protected species), and Swainson's hawk (State listed as threatened) could nest in trees in the riparian woodlands within the stream channel.

Implementing any of the action alternatives would increase water delivery reliability from Millerton Lake. About 28 to 37 TAF of the added water supply provided by the new Temperance Flat RM 274 Reservoir would be discharged to the San Joaquin River for conveyance to SOD CVP and SWP water contractors; however, these additional water supplies would not exceed current channel capacity of the San Joaquin River or other waterways and would not result in a change in the current operation of Friant Dam. Birds that use riparian habitat within the San Joaquin Valley are adapted to annual variation in flooding; and the overall flow patterns, water depth, and frequency and duration of flooding in these waterways would be within the current normal range of variation. The increased water supply is not likely to substantially reduce the available roosting, foraging, or nesting habitat in the extended study area. Therefore, special-status bird species would not be substantially affected by the additional water supply.

Protected bird species, such as California black rail (State listed as threatened), Modesto population song sparrow (California Species of Special Concern) and yellow-headed blackbird (California Species of Special Concern), are also found along the San Joaquin River downstream from the Merced River and/or in the CVP and SWP water service areas. Because the contribution from Friant Dam becomes a smaller proportion of the total flow because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus Rivers), the additional water supply would not result in substantial changes in water levels, flood frequency or magnitude, or other

conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta, or in the Delta. Thus, any changes downstream from the Merced River confluence, in the Delta, or in the CVP and SWP water service areas, would not be sufficient to affect special-status bird species.

Project implementation is not expected to substantially alter potential habitat for special-status bird species or result in direct removal of any special-status birds in the extended study area.

This impact would be **less than significant** under the action alternatives. Therefore, mitigation for this impact is not needed and thus not proposed.

Impact WLD-14: Potential Reduction in Habitat or Populations of Special-Status Mammal Species

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect habits for special-status mammal species.

There would be **no impact** under the No Action Alternative.

Action Alternatives Several special-status mammals known to occur in the vicinity of the extended study area between Friant Dam and the Merced River, as discussed in the Affected Environment section, are found in habitats that occur above the alluvial plain, such as grassland, rock ledges, and alkaline scrub habitats. Special-status mammals associated with these habitat types would not be affected by water releases within the current channel capacity of the San Joaquin River and other conveyance channels.

Special-status mammals known to occur, or with the potential to occur, in the extended study area between Friant Dam and the Merced River include pallid bat, Townsend's big-eared bat, western red bat, western mastiff bat, ringtail, riparian woodrat, and riparian brush rabbit. Riparian habitat can provide important foraging and roosting habitat for bats and ringtail, but none of the bat species listed are typically solely dependent on riparian habitats, and neither is the ringtail. Therefore,

potential foraging and roosting habitat would not be substantially affected.

The riparian brush rabbit (Federally and State listed as endangered) and riparian woodrat (Federally listed as endangered, California Species of Special Concern) are more dependent on high-quality riparian habitat. The riparian brush rabbit is restricted to several populations at Caswell Memorial State Park, along the Stanislaus River near Manteca in San Joaquin County; and along Paradise Cut, a channel of the San Joaquin River in the southern part of the Delta. These populations inhabit woodlands dominated by dense wild rose and grape. In addition, the species was recently reintroduced on the San Joaquin River NWR (Williams 1993; Williams and Basey 1986). The riparian woodrat is known to occur only at Caswell Memorial State Park in riparian woodlands with live oak and shrub components. Both species are not expected to be present within the area between Friant Dam to the Merced River.

Implementing any of the action alternatives would increase water delivery reliability from Millerton Lake. This increased delivery would be conveyed within existing water conveyance channels. About 28 to 37 TAF of the added water supply provided by the new Temperance Flat RM 274 Reservoir would be discharged to the San Joaquin River for conveyance to SOD CVP and SWP water contractors; however, these additional water supplies would not exceed current channel capacity of the San Joaquin River or other waterways and would not result in a change in the current operation of Friant Dam. The increased water supply is not likely to eliminate foraging or nesting habitat for either the riparian brush rabbit or riparian woodrat.

As mentioned above, small, restricted populations of riparian brush rabbit and riparian woodrat are found adjacent to the San Joaquin River downstream from the Merced River west of Modesto. Because the contribution from Friant Dam becomes a smaller proportion of the total flow because of contributions from other major tributaries (e.g., the Merced, Tuolumne, and Stanislaus Rivers), the additional water supply would not result in substantial changes in water levels, flood frequency or magnitude, or other conditions or events that could affect vegetation in the San Joaquin River from the Merced River to the Delta or in the Delta. Thus, any changes downstream from the Merced River confluence, in the Delta, or in the CVP and

SWP water service areas, would not be sufficient to affect special-status mammal species.

Project implementation is not expected to substantially alter potential habitat for special-status mammal species or result in direct removal of any special-status mammal occurrences in the extended study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact WLD-15: Potential Interference with Migratory Corridors or Nursery Sites

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect movement of migratory species, or migratory corridors, or nursery sites.

There would be **no impact** under the No Action Alternative.

Action Alternatives Because of historical habitat loss, many of the remaining areas that provide habitat connections between areas containing suitable habitat throughout the San Joaquin Valley are concentrated around numerous riparian corridors, including the San Joaquin River as it flows from Friant Dam until it reaches the Delta. These riparian corridors and their associated vegetation serve as some of the most important remaining functional wildlife corridors connecting natural lands throughout the Sacramento and San Joaquin Valley watersheds. The action alternatives would not interfere substantially with the movement of any native resident or migratory wildlife species, would not alter established native resident or migratory wildlife corridors, and wound not impede the use of native wildlife nursery sites. The average additional water supply delivery would not exceed current channel capacity of the San Joaquin River or other waterways and would not result in a change in the current operation of Friant Dam. This would not substantially change the riparian habitat within the channel.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact WLD-16: Potential Impact on Riparian Habitat for Special-Status Bird Species

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. These changes would enhance ecosystem values of the river, benefiting a variety of fish and aquatic species. These changes are not expected to adversely affect riparian habits for special bird species.

There would be **no impact** under the No Action Alternative.

Action Alternatives The flooding frequency could be reduced within the San Joaquin River system downstream from Friant Dam. Reduced frequency of scouring and sediment loading within riparian habitats could result in later successional stages of riparian habitat (i.e., more mature riparian) developing in areas that are currently subject to more frequent scouring.

Bird species that nest in early- to mid-successional riparian habitat, such as least Bell's vireo or yellow-breasted chat, could be substantially affected if this potential modification to riparian habitats were to occur. The SJRRP (anticipated under the No Action Alternative and action alternatives alike) includes monitoring and management activities to benefit riparian habitat. All action alternatives described in this Draft EIS would enhance riparian habitat restoration along the San Joaquin River under the SJRRP, by providing the following effects:

- The reduced frequency, magnitude, and duration of Friant Dam releases greater than Restoration Flows would:
    - Reduce the risk of damage to SJRRP instream and floodplain investments
    - Increase flexibility for managing riparian recruitment flows and flexible flow periods
    - Reduce the potential for riparian zone/bank erosion

- Reduce frequency, magnitude, and duration of floodplain habitat inundation

- Improve flexibility in management of Restoration Flows with no effect on water deliveries, including increased operational flexibility for providing buffer flows and pulse flows for gravel mobilization

Least Bell's vireo and yellow-breasted chat are not widespread within the San Joaquin River system currently, but as stated earlier, least Bell's vireo does appear to be spreading northward and expanding into historical parts of its range. Given the potential for riparian bird species that use mid-successional riparian stages to be present within the San Joaquin River system in the extended study area and the potential for conversion of existing riparian to more mature riparian habitat, this potential impact may substantially affect nesting habitat for these bird species.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact WLD-17: Conflict with Local or Regional Policies Protecting Wildlife Resources

Extended Study Area

No Action Alternative Under the No Action Alternative, continued modifications to San Joaquin River instream flows and channel dimensions will be implemented by the SJRRP. Implementing the No Action Alternative would not result in changes to the current implementation of local or regional policies and plans protecting wildlife resources.

There would be **no impact** under the action alternatives.

Action Alternatives As discussed in Chapter 6, "Biological Resources – Botanical and Wetlands," there would be no change in existing use of adjacent lands or changes to habitat types that could substantially adversely affect resources for special-status wildlife protected under local and regional policies and plans. Implementing any of the action alternatives therefore would not conflict with local land use policies, such as county and city general plan policies.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact WLD-18: Potential Conflict with Adopted Conservation Plans

Extended Study Area

No Action Alternative Implementing the No Action Alternative would not result in conflicts with adopted conservation plans.

There would be **no impact** under the No Action Alternative.

Action Alternatives There would be no change in existing use of adjacent lands or changes to habitat types that could substantially adversely affect resources for special-status wildlife protected under adopted conservation plans.

Implementing any of the action alternatives would not change the regular operation of Friant Dam so it would not interfere with the recovery or maintenance goals for covered wildlife species within the extended study area. Therefore, implementing any of the action alternatives would not conflict with goals of conserving protected wildlife species.

Implementing any of the action alternatives also would not conflict with CALFED Bay-Delta Program objectives up through the Delta and in the CVP and SWP water service areas, as described in Chapter 7, "Biological Resources – Botanical and Wetlands." Implementing any of the action alternatives therefore would not conflict with goals of adopted conservation plans.

There would be **no impact** under the action alternatives. Therefore, mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section.

No mitigation is required for Impacts WLD-11 through WLD-18 within the primary study area or for Impacts WLD-1 through WLD-15, WLD-17, and WLD-18 within the extended study area because there would be no impact or the impact would be less than significant for all action alternatives.

Impacts WLD-1, WLD-2, and WLD-4 through WLD-9 within the primary study area would be significant. Implementing Mitigation Measures WLD-1a through WLD-2d, and WLD-4d

through WLD-9 would reduce these impacts to a **less-than-significant** level.

Impact WLD-3 within the primary study area would be significant. Implementing Mitigation Measures WLD-3a through WLD-3g would reduce this impact on California spotted owl, burrowing owl, American peregrine falcon, prairie falcon, merlin, Cooper's hawk, sharp-shinned hawk, osprey, and northern harrier to a less-than-significant level. Implementing Mitigation Measure WLD-3a would reduce the significant impact on bald eagle and golden eagle, but not to a less-than-significant level. This impact would be **significant and unavoidable**.

Impact WLD-10 within the primary study area would be significant. Mitigating Impact WLD-10 is infeasible because it would require an amendment to the Fresno County and Madera County general plans. An amendment to these plans is not considered likely in the near term. Therefore, Impact WLD-10 (within the primary study area) would be **significant and unavoidable**.

Impact WLD-16 within the extended study area would be potentially significant. Implementing Mitigation Measure WLD-16 would reduce this impact to a **less-than-significant** level.

Mitigation Measure WLD-1a: Mitigate Impacts on VELB
To avoid, minimize, or mitigate impacts on valley elderberry longhorn beetle, Reclamation will implement the following measures in accordance with the USFWS's *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (USFWS 1999b):

a) Preconstruction surveys shall be conducted by a qualified biologist in accessible suitable habitat within the primary study area and a 100-foot buffer to identify all elderberry shrubs that could potentially be affected by construction and operation of the project. Observed elderberry shrubs shall be mapped with a GPS unit to determine whether the shrubs can be avoided during construction or would likely be located outside of the eventual Temperance Flat RM 274 Reservoir inundation area. The preconstruction survey shall be conducted in a suitable timeframe to allow for adequate time to develop an appropriate elderberry mitigation

plan (approximately 1 year before the initiation of construction).

b) All elderberry shrubs within 100 feet of the construction area or the Temperance Flat RM 274 Reservoir area of inundation shall be assessed for stem counts and to determine whether potential valley elderberry longhorn beetle exit holes are present. If elderberry shrubs with a stem diameter greater than 1 inch are observed within 100 feet of the construction area or the area of inundation, Reclamation will consult with USFWS to determine the appropriate mitigation measures.

c) Elderberry shrubs to be avoided shall have a minimum 100-foot buffer zone established around each shrub to the extent possible. If the avoidance buffer must be less than 100 feet, USFWS shall be consulted as to whether a reduced buffer is adequate or whether the shrub shall require transplanting.

d) All shrubs to be avoided during construction shall be flagged before construction, and exclusion fencing shall be erected around the shrubs so that they are not inadvertently damaged during project construction activities. The fencing shall be placed at least 20 feet from the dripline of the shrub. Signs shall be placed every 50 feet on the fencing that state: “This area is habitat of the valley elderberry longhorn beetle, a threatened species, and it must not be disturbed. This species is protected by the ESA. Violators are subject to prosecution, fines, and imprisonment.” The signs shall be clearly readable from a distance of 20 feet. The signs and the fencing shall be maintained for the duration of construction.

e) Before any work occurs in the primary study area, including grading, a qualified wildlife biologist shall conduct mandatory contractor/worker awareness training for all construction personnel. The awareness training will brief personnel on the need to avoid impacts on valley elderberry longhorn beetle and the penalties for not complying with biological mitigation requirements. If new construction personnel are added to the project, the contractor shall ensure that the personnel receive the mandatory training before starting work.

f) Dust control measures shall be implemented for all ground-disturbing activities in the primary study area. These measures could include application of water to graded and disturbed areas that are unvegetated. To avoid attracting Argentine ants, at no time will water be sprayed within the driplines of elderberry shrubs.

g) For elderberry shrubs located in previously inaccessible habitat during the preconstruction survey, as well as shrubs that cannot be avoided within the primary study area, Reclamation will consult with USFWS to identify the appropriate mitigation ratio for shrub transplantation in a designated area or purchase credits in a USFWS-approved valley elderberry longhorn beetle mitigation bank. USFWS general compensation guidelines call for replacement of elderberry plants in designated mitigation areas at a ratio from 1:1 to 8:1 depending on stem size, habitat, and evidence of occupancy by beetles. Replacement stock shall be obtained from local sources.

h) Transplantation of shrubs shall occur during the shrub's dormancy phase as prescribed by the USFWS guidelines.

i) Reclamation will prepare a summary report for submittal to USFWS documenting the number of shrubs transplanted, associated plantings, and location of transplantation. If shrubs are transplanted by Reclamation, Reclamation will be responsible for providing periodic monitoring reports to USFWS to document the success or failure of transplants according to USFWS reporting guidelines (USFWS 1999b). If valley elderberry longhorn beetle mitigation credits are purchased, the mitigation bank operator shall be responsible for the preparation of monitoring reports.

Implementing Mitigation Measure WLD-1a would reduce the significant impact on valley elderberry longhorn beetle to a **less-than-significant** level.

Mitigation Measure WLD-1b: Mitigate Impacts on Pipevine Swallowtail

To avoid, minimize, or mitigate impacts on the pipevine swallowtail, the following measures shall be implemented by Reclamation or its designated representative where habitat with California pipevine populations occurs:

a) Preconstruction surveys shall be conducted by a qualified biologist to locate and map populations of the host plant for pipevine swallowtail (California pipevine) within the primary study area, where accessible. Surveys shall be conducted sufficiently in advance of project construction to allow for development of a mitigation plan as needed for pipevine swallowtail (approximately 6 to 8 months before construction begins).

b) All identified suitable pipevine swallowtail habitat shall be avoided, if feasible, during construction activities. California pipevine plants to be avoided during construction shall be flagged, and orange construction fencing shall be erected with a 10-foot buffer around the plants.

c) A qualified wildlife biologist shall conduct mandatory contractor/worker awareness training for construction personnel as described in the discussion of Mitigation Measure WLD-1a that includes a summary of pipevine swallowtail habitat to be avoided during construction. The awareness training shall be provided to all construction personnel to brief them on the need to avoid impacts on pipevine swallowtail.

d) Dust control measures shall be implemented for all ground-disturbing activities in the primary study area. These measures could include application of water to graded and disturbed areas that are unvegetated.

e) For California pipevine populations located in habitats that were previously inaccessible during the preconstruction survey, as well as for plants that cannot be avoided within the primary study area, including the inundation area, Reclamation will consult with BLM to use the appropriate mitigation ratio for pipevine restoration, transplanting, or propagation in an approved riparian habitat conservation easement with suitable habitat. Reclamation will prepare a monitoring plan for any transplanted or nursery-grown pipevine plants that includes appropriate success criteria to reasonably assure the continued persistence of California pipeline populations within the primary study area.

Implementing Mitigation Measure WLD-1b would reduce the significant impact on pipevine swallowtail to a **less-than-significant** level.

Mitigation Measure WLD-1c: Mitigate Impacts on Listed Vernal Pool Branchiopods

To avoid, minimize, or mitigate impacts on listed vernal pool branchiopods, the following measures shall be applied where suitable vernal pool habitat for listed vernal pool branchiopods occurs within the primary study area.

a) To the extent possible, Reclamation will design the transmission lines and associated ground-disturbing features, such as access roads, to avoid vernal pool habitat. Vernal pool habitat would be considered to not be affected if towers and transmission poles are located a minimum of 250 feet from the outer edge of any vernal pool, swale or other suitable wetland feature for vernal pool invertebrates. Alternatively, Reclamation and USFWS may conduct site visits to inspect the unique characteristics of specific vernal pool habitat and approve reductions to the 250-foot buffer, if appropriate. Buffers shall be marked by brightly colored fencing or flagging throughout the construction process.

b) Construction personnel shall participate in a USFWS-approved worker environmental awareness program that shall include avoidance and minimization measures for working in or near suitable vernal pool invertebrate habitat. A qualified biologist approved by USFWS shall inform all construction personnel about the life history of listed vernal pool invertebrates, and the importance of avoiding their habitat.

If impacts on vernal pool habitat cannot be fully avoided, the following measures shall be implemented:

a) Protocol-level surveys shall be conducted based on USFWS protocols (USFWS 1996b) to determine presence or absence of listed vernal pool branchiopod species within vernal pools or other wetlands that represent potential habitat. The results of those surveys are subject to approval by USFWS. If Reclamation does not conduct protocol-level surveys, then presence shall be assumed.

b) Mitigation for loss of suitable vernal pool branchiopod habitat shall be achieved by one of the following means:

   1. Acquire creation and preservation vernal pool credits in a USFWS-approved mitigation bank at an acreage ratio approved by USFWS.

   2. Create and manage suitable vernal pool habitat and preserved vernal pool habitat in perpetuity at the same acreage ratio as required under the mitigation bank credit option above. USFWS shall approve any habitat preservation and creation that is proposed by Reclamation.

Implementing Mitigation Measure WLD-1c would reduce the potentially significant impact on listed vernal pool branchiopods to a **less-than-significant** level.

Mitigation Measure WLD-2a: Mitigate Impacts on California Tiger Salamander and Western Spadefoot

To avoid, minimize, or mitigate impacts on California tiger salamander and western spadefoot, the following measures shall be implemented where suitable habitat for these species occurs within the primary study area:

a) Habitat assessments shall be conducted by a qualified biologist within suitable breeding, and associated upland refugia habitat that is accessible to the species and within the maximum dispersal distance (up to 1 mile) from suitable breeding habitat, within the primary study area to identify all potential California tiger salamander and western spadefoot habitat that could potentially be affected by construction and operation of the project. The habitat assessment shall be conducted in a suitable timeframe to allow for adequate time to develop an appropriate California tiger salamander and western spadefoot mitigation plan (approximately 1 year before the expected initiation of construction).

b) To the extent possible, suitable breeding habitat and associated accessible upland habitat for California tiger salamander and western spadefoot within the primary study area shall be avoided. Suitable breeding habitat shall be considered to be avoided if construction activities and the Temperance Flat RM 274 Reservoir zone of inundation are located outside of the modeled

watershed of potential California tiger salamander and western spadefoot breeding habitat.

c) Protocol-level surveys of California tiger salamander are infeasible within most portions of the primary study area because of steep terrain that precludes establishment of drift fences. Therefore, any suitable breeding habitat and associated upland habitat that cannot be precluded as occupied to the satisfaction of CDFW and USFWS shall require mitigation.

d) Habitat mitigation for California tiger salamander and western spadefoot shall be incorporated into the overall habitat mitigation plan for the project. Mitigation lands shall be required to support all life cycles of California tiger salamander and western spadefoot.

e) A special-status amphibian and reptile relocation plan shall be prepared by a biologist familiar with the herpetofauna that could potentially occur within the primary study area. The relocation plan shall include handling techniques for California tiger salamander and western spadefoot individuals and shall identify a designated relocation area outside of the construction area. The relocation plan shall be approved by USFWS and CDFW before the initiation of construction within suitable breeding habitat or associated upland habitat.

f) Preconstruction surveys shall be performed by a permitted and USFWS- and CDFW-approved biologist no more than 30 days before construction activities that occur within suitable California tiger salamander or western spadefoot breeding habitat that is or would be naturally inundated during the time of construction. Any California tiger salamander or western spadefoot individuals located during the preconstruction survey shall be relocated to the designated relocation area identified in the special-status amphibian and reptile relocation plan. The permitted biologist shall report the results of the preconstruction survey, including information on the relocation of California tiger salamander or western spadefoot within 30 days of completion of the survey.

Implementing Mitigation Measure WLD-2a would reduce the significant and potentially significant impacts on California

tiger salamander and western spadefoot to a **less-than-significant** level.

Mitigation Measure WLD-2b: Mitigate Impacts on Foothill Yellow-Legged Frog and California Red-Legged Frog

To avoid, minimize, or mitigate impacts on foothill yellow-legged frog and California red-legged frog, the following measures shall be implemented where suitable habitat for these species occurs within the primary study area:

a) Habitat assessments shall be conducted by a qualified biologist within suitable breeding habitat and adjacent upland refugia habitat accessible to the species within the primary study area that is within the known dispersal distance of the species (up to 1 mile) to identify all potential foothill yellow-legged frog and California red-legged frog habitat that could potentially be affected by construction and operation of the project and all accessible upland refugia habitat that could potentially be affected by the project. The habitat survey shall be conducted in a suitable timeframe to allow for adequate time to develop an appropriate mitigation plan as needed (approximately 1 year before the expected initiation of construction).

b) To the extent possible, suitable breeding habitat and associated accessible upland habitat for foothill yellow-legged frog and California red-legged frog within the primary study area shall be avoided.

c) If determined to be necessary by USFWS and CDFW, protocol-level surveys for foothill yellow-legged frog and California red-legged frog shall be conducted within the primary study area to assist in the determination of the presence or absence of foothill yellow-legged frog and California red-legged frog and the usage patterns of habitat within the primary study area by these species. The results of those surveys shall be presented to USFWS and CDFW.

d) Habitat mitigation for foothill yellow-legged frog and California red-legged frog shall be incorporated into the overall habitat mitigation plan for the project if the species are found to occur within the primary study area and their habitat would be affected by construction and operation of the project. Any mitigation lands for foothill yellow-legged frog and California red-legged

frog shall be required to support all life cycles of foothill yellow-legged frog and California red-legged frog.

e) A special-status amphibian and reptile relocation plan shall be prepared by a biologist familiar with the herpetofauna that could potentially occur within the primary study area including foothill yellow-legged frog and California red-legged frog. The relocation plan shall be approved by USFWS and CDFW before the initiation of construction within suitable breeding habitat or associated upland habitat.

f) Preconstruction surveys shall be performed by a permitted and USFWS- and CDFW-approved biologist no more than 30 days before construction activities that occur within suitable foothill yellow-legged frog or California red-legged frog breeding habitat that is or would be naturally inundated during the time of construction. Any foothill yellow-legged frog or California red-legged frog individuals located during the preconstruction survey shall be relocated to the designated relocation area identified in the special-status amphibian and reptile relocation plan. The permitted biologist shall report the results of the preconstruction survey, including information on the relocation of California red-legged frog or foothill yellow-legged frog individuals, within 30 days of the completion of the survey.

Implementing Mitigation Measure WLD-2b would reduce the significant impact on foothill yellow-legged frog and California red-legged frog to a **less-than-significant** level.

Mitigation Measure WLD-2c: Mitigate Impacts on Western Pond Turtle

To avoid, minimize, or mitigate impacts on western pond turtle, Reclamation will implement the following measures where suitable habitat for this species occurs within the primary study area:

a) Habitat surveys shall be conducted by a qualified biologist within accessible suitable habitat within the primary study area and up to a 1,650-foot buffer, depending on accessibility of upland habitat to western pond turtle, to identify all potential western pond turtle habitat that could potentially be affected by

construction and operation of the project and all accessible upland refugia habitat that could potentially be affected by the project. The habitat survey shall be conducted in a suitable timeframe to allow for adequate time to develop an appropriate mitigation plan as needed (approximately 1 year before the expected initiation of construction).

b) To the extent possible, suitable habitat for western pond turtle within the primary study area shall be avoided.

c) Habitat mitigation for western pond turtle shall be incorporated into the overall habitat mitigation plan for the project if the species is found to occur within the primary study area and its habitat would be affected by construction and operation of the project.

d) A special-status amphibian and reptile relocation plan shall be prepared by a biologist familiar with the herpetofauna that could potentially occur within the primary study area including western pond turtle. The relocation plan shall be approved by USFWS and CDFW before the initiation of construction within suitable breeding habitat or associated upland habitat.

e) Preconstruction surveys shall be performed by a permitted and USFWS- and CDFW-approved biologist no more than 30 days before construction activities that occur within suitable western pond turtle habitat that is or would be naturally inundated during the time of construction. Any western pond turtle individuals located during the preconstruction survey shall be relocated to the designated relocation area identified in the special-status amphibian and reptile relocation plan. The permitted biologist shall report the results of the preconstruction survey, including information on the relocation of western pond turtle individuals, within 30 days of the completion of the survey.

Implementing Mitigation Measure WLD-2c would reduce the significant and potentially significant impacts on western pond turtle to a **less-than-significant** level.

Mitigation Measure WLD-2d: Mitigate Impacts on Coast Horned Lizard

To avoid, minimize, or mitigate impacts on coast horned lizard, the following measures shall be implemented where suitable habitat for this species occurs within the primary study area:

a) Habitat mitigation for coast horned lizard shall be incorporated into the overall habitat mitigation plan for the project.

b) A special-status amphibian and reptile relocation plan shall be prepared by a biologist familiar with the herpetofauna that could potentially occur within the primary study area, including coast horned lizard. The relocation plan shall be approved by USFWS and CDFW before the initiation of construction within suitable habitat.

c) Any coast horned lizards found during project construction shall be moved to a designated relocation area as prescribed in the special-status amphibian and reptile relocation plan.

Implementing Mitigation Measure WLD-2d would reduce the significant impact on coast horned lizard to a **less-than-significant** level.

Mitigation Measure WLD-3a: Mitigate Impacts on Bald Eagle and Golden Eagle

To avoid, minimize, or mitigate impacts on bald eagle and golden eagle, Reclamation will prepare and implement a plan to protect bald eagles and golden eagles that incorporates guidelines found in the USFWS *Bald Eagle Management Guidelines* (USFWS 2007) and that is approved by USFWS and CDFW. The plan shall be prepared before the initiation of construction that could affect suitable habitat for bald and golden eagle within the primary study area. Specific to nesting eagles in the primary study area, the plan shall describe in detail actions for:

- Survey protocols for each species
- Nest monitoring for each species with conditions based on type and intensity of construction or recreational activity that could potentially affect an eagle nest
- Population monitoring within the primary study area after the majority of construction activities have been

completed and the Temperance Flat RM 274 Reservoir has been inundated

- Improving nesting sites at existing locations in adjacent habitat, such as retrofitting transmission lines for nesting golden eagles, and reporting data on use of those features to USFWS and CDFW

- Habitat conservation for bald and golden eagles, including management guidelines for determining the quality of existing eagle nesting and foraging habitat and measures to enhance and preserve existing habitat; success criteria shall be established for mitigation sites, including annual long-term nest monitoring of eagle populations and reporting those data to the USFWS and CDFW each year

Reclamation will implement the following measures to avoid, minimize, or mitigate impacts on bald eagle and golden eagle:

a) Whenever feasible, construction near currently or recently active nest sites shall start outside the active nesting season (from December 15 through August 15 for bald eagles, and from January through August 15 for golden eagles).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 14 to 30 days before the start of each new activity phase to search for eagle nests within 0.5 mile of proposed activities. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

    - Construction contractors shall observe CDFW avoidance guidelines, which stipulate a minimum 0.25-mile buffer zone around active eagle nests. Buffer zones shall remain until young have fledged or until a qualified biologist has determined that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the eagle nest(s) at least twice weekly to monitor eagle reactions to activities. If activities are deemed to have a negative impact on nesting eagles, the biologist shall immediately inform the

construction manager that work shall be halted, and CDFW shall be consulted to address potential impacts on active nests.

- After construction has been completed, Reclamation will have a qualified biologist survey for and monitor eagle nesting sites in the primary study area within 0.5 mile of known recreational sites to ensure that recreational activity and other beneficial uses of the Temperance Flat RM 274 Reservoir do not disrupt eagle nest sites. Surveys shall be performed at the beginning of the nesting season and continue throughout the nesting season at a schedule to be determined in the eagle management plan. Recreational access and other disruptive activities shall be suspended within 0.25 mile of active eagle nests until the young eagles have fledged or until a qualified biologist has determined that the nest is no longer active.

- The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the surveys.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including bald eagles and golden eagles.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of eagles or their nests during construction, no pets shall be allowed in the primary study area.

A substantial amount of suitable foraging habitat for golden eagle would be inundated as a result of construction of Temperance Flat RM 276 Dam. Although implementing a habitat mitigation plan would protect important oak woodland habitat that is suitable habitat to support golden eagle foraging, impacts on these habitats cannot be fully mitigated because the

overall net loss of habitat that would result from construction and operation of the project would be substantial.

Implementing Mitigation Measure WLD-3a would reduce the significant impact on bald eagle and golden eagle, but not to a less-than-significant level. Impact WLD-3 would be **significant and unavoidable** because of the loss of a known bald eagle nesting location and foraging habitat for golden eagles within the primary study area.

Mitigation Measure WLD-3b: Mitigate Impacts on California Spotted Owl

To avoid, minimize, or mitigate impacts on California spotted owl, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) A protocol-level survey shall be conducted during the nesting season for at least one breeding season before the initiation of construction within the primary study area. A protocol-level survey shall be led by a qualified biologist experienced conducting California spotted owl surveys. The qualified biologist shall be approved by Reclamation and CDFW before preparing a protocol survey plan or conducting surveys. The protocol survey plan shall be prepared by the qualified biologist and submitted to Reclamation and CDFW for review and approval.

c) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 14 to 30 days before the start of each new activity phase to search for California spotted owl nests within 0.5 mile of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

    - Construction contractors shall observe a minimum 0.25-mile buffer zone around active California spotted owl nests. Buffer zones shall remain until young have fledged. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and

the owl nest(s) to monitor owl reactions to activities. If activities are deemed to have a negative impact on nesting spotted owls, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

- The permitted biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the nest monitoring.

d) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including California spotted owls.

e) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

f) To prevent harassment and mortality of California spotted owls or their nests, no pets shall be allowed during construction in the primary study area.

g) The habitat mitigation plan for the project shall include suitable foraging and nesting habitat for California spotted owls.

Implementing Mitigation Measure WLD-3b would reduce the significant impact on California spotted owl to a **less-than-significant** level.

Mitigation Measure WLD-3c: Mitigate Impacts on Burrowing Owl

To avoid, minimize, or mitigate impacts on burrowing owl, Reclamation will follow the guidelines set forth by the Staff Report on Burrowing Owl Mitigation (CDFW 2012), including the following measures:

a) *Nonbreeding season surveys*. Whenever feasible, construction near burrowing owl habitat shall start outside the active nesting season, from February 1 through August 31. For construction activity within suitable habitat during the nonbreeding season the following mitigation is required for burrowing owls:

- A qualified biologist shall conduct at least four visits within suitable burrowing owl habitat spread evenly throughout the non-breeding season. If active burrows are not identified, no further action is required and construction may proceed. If active burrows are identified, the avoidance guidelines identified below shall be implemented:

  i. Construction exclusion areas (e.g., orange exclusion fence or signage) shall be established around occupied burrows, where no disturbance shall be allowed. During the nonbreeding season (September 1 through January 31), the exclusion zone shall extend at least 164 feet around occupied burrows.

  ii. If required construction work areas conflict with owl burrows and associated buffers, passive relocation of on-site owls may be implemented as an alternative, but only during the nonbreeding season and only with CDFW approval. Passive relocation shall be accomplished by installing one-way doors on the entrances of burrows within164 feet of the primary study area. The one-way doors shall be left in place for 48 hours to ensure the owls have left the burrow. The burrows shall then be excavated with a qualified biologist present. Construction shall not proceed until the primary study area is deemed free of owls.

  iii. Unoccupied burrows within the immediate construction area shall be excavated using hand tools, and then filled to prevent reoccupation. If any burrowing owls are discovered during the excavation, the excavation shall cease and the owl shall be allowed to escape. Excavation could be completed when the biological monitor confirms the burrow is empty.

  iv. CDFW-approved methods shall be established to prevent recolonization by ground squirrels in the immediate construction area.

  v. If feasible, artificial nesting burrows shall be provided as a temporary measure when natural burrows are lacking. To compensate for lost nest

burrows, artificial burrows shall be provided outside the buffer zone. The alternate burrows shall be monitored to confirm that the owls have moved in and acclimated to the new burrow.

vi. The qualified biologist shall report the results of the preconstruction surveys and observed burrows, including information on the success of the burrows, within 30 days of the completion of the burrow surveys and monitoring. Any monitoring of artificial nesting burrows shall also be reported to CDFW within 30 days following the completion of the monitoring.

b) *Breeding season surveys*. If ground-breaking activities will begin between February 1 and August 31, breeding season surveys shall be performed by a qualified biologist to determine the status of burrowing owl in suitable habitat within a suitable distance of construction boundaries according to the staff report. The staff report recommends conducting a total of four survey visits with at least one site visit between February 15 and April 15, and a minimum of three survey visits, at least 3 weeks apart, between April 15 and July 15, with at least one visit after June 15. A report of the breeding season surveys shall be provided to CDFW within 30 days of the completion of surveys.

c) *Take avoidance surveys*. As recommended in the staff report, take avoidance surveys shall be conducted in suitable burrowing owl habitat no less than 14 days before the initiation of construction, and a subsequent final survey shall be conducted in suitable burrowing owl habitat within 24 hours before ground disturbance. If active burrows are not identified, no further action is required and construction may proceed. If active burrows are identified, the avoidance guidelines identified below shall be implemented:

- During the breeding season (February 1 through August 31), impacts shall be minimized by establishing an appropriately sized buffer (according to the staff report) for all project-related construction activities until a qualified biologist confirms that the burrow is no longer active and CDFW concurs, or consultations with CDFW

specifically allow certain construction activities to continue. The size of the buffer may be adjusted in consultation with CDFW. CDFW also shall be consulted to determine whether it is necessary to temporarily preserve foraging habitat (in addition to the buffer area) until the nest is no longer active.

- For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and owl burrows to observe owl reactions to activities. If activities are deemed to have a negative impact on nesting owls, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

d) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including burrowing owls.

e) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

f) To prevent harassment and mortality of owls or their nests, no pets shall be allowed during construction in the primary study area.

g) The habitat mitigation plan for the project shall include suitable foraging and nesting habitat for burrowing owls.

Implementing Mitigation Measure WLD-3c would reduce the significant impact on burrowing owl to a **less-than-significant** level.

Mitigation Measure WLD-3d: Mitigate Impacts on American Peregrine Falcon and Prairie Falcon

To avoid, minimize, or mitigate impacts on American peregrine falcon and prairie falcon, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) A nest monitoring protocol following the USFWS nest monitoring guidelines for peregrine falcons (USFWS 2003) shall be initiated for any construction activity that occurs within 0.5 mile of a known peregrine nest site. The USFWS nest monitoring guidelines call for a minimum of two, 4-hour monitoring periods to determine if a nest is not active.

- Construction contractors shall observe a minimum 0.25-mile buffer zone around active falcon nests. Buffer zones shall remain until young have fledged or until the qualified biologist has determined that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the falcon nest(s) to monitor falcon reactions to activities. If activities are deemed to have a negative impact on nesting falcons, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

- The biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of completion of the nest monitoring.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including American peregrine falcon and prairie falcon.

d) The habitat mitigation plan for the project shall include suitable foraging habitat and cliff nesting habitat for American peregrine falcon and prairie falcon.

Implementing Mitigation Measure WLD-3d would reduce the significant impact on American peregrine falcon and prairie falcon to a **less-than-significant** level.

Mitigation Measure WLD-3e: Mitigate Impacts on Cooper's Hawk and Sharp-Shinned Hawk

To avoid, minimize, or mitigate impacts on Cooper's hawk and sharp-shinned hawk, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 14 to 30 days before the start of each new activity phase to search for raptor nests within 0.25 mile of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

   - Construction contractors shall observe a minimum 500-foot buffer zone around active Cooper's hawk or sharp-shinned hawk nests. Buffer zones shall remain until young have fledged or until a qualified biologist determines that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the raptor nest(s) to monitor raptor reactions to activities. If activities are deemed to have a negative impact on nesting raptors, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

   - The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the survey.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including Cooper's hawk and sharp-shinned hawk.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of raptors or their nests, no pets shall be allowed in the primary study area during construction.

f) The habitat mitigation plan for the project shall include suitable foraging and nesting habitat for Cooper's hawk and sharp-shinned hawk.

Implementing Mitigation Measure WLD-3ewould reduce the significant impact on Cooper's hawk and sharp-shinned hawk to a **less-than-significant** level.

Mitigation Measure WLD-3f: Mitigate Impacts on Osprey
To avoid, minimize, or mitigate impacts on osprey, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 14 to 30 days before the start of each new activity phase to search for osprey nests within 0.25 mile of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

- Construction contractors shall observe a minimum 500-foot buffer zone around active osprey nests. Buffer zones shall remain until young have fledged or until a qualified biologist has determined that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the osprey nest(s) to monitor osprey reactions to activities. If activities are deemed to have a negative impact on nesting osprey, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

- The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the survey.

c) A qualified biologist shall conduct a training session for all construction personnel focused on the protection and

conservation of protected, nonlisted special-status wildlife species, including osprey.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of ospreys or their nests, no pets shall be allowed in the primary study area during construction.

f) The habitat mitigation plan for the project shall include suitable oak woodland nesting habitat for osprey.

Implementing Mitigation Measure WLD-3f would reduce the significant impact on osprey to a **less-than-significant** level.

Mitigation Measure WLD-3g: Mitigate Impacts on Northern Harrier

To avoid, minimize, or mitigate impacts on northern harrier, the following measures shall be implemented:

a) Whenever feasible, construction shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 14 to 30 days before the start of each new activity phase to search for harrier nests within 0.5 mile of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

- Construction contractors shall observe a minimum 0.25-mile buffer zone around active harrier nests. Buffer zones shall remain until young have fledged or until a qualified biologist determines that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the harrier nest(s) to monitor harrier reactions to activities. If activities are deemed to have a negative impact on nesting harriers, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

- The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the nest survey.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including northern harrier.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of harriers or their nests, no pets shall be allowed in the primary study area during construction.

f) The habitat mitigation plan for the project shall include suitable grassland and marsh foraging and nesting habitat for northern harrier.

Implementing Mitigation Measure WLD-3g would reduce the significant impact on northern harrier to a **less-than-significant** level.

Mitigation Measure WLD-4a: Mitigate Impacts on Yellow Warbler

To avoid, minimize, or mitigate impacts on yellow warbler, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 7 to 14 days before the start of each new activity phase to search for nests within 500 feet of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

- Construction contractors shall observe a minimum 300-foot buffer zone around active yellow warbler nests. Buffer zones shall remain until young have fledged or until a qualified biologist has determined that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the nest(s) to monitor reactions to activities. If activities are deemed to have a negative impact on yellow warbler nests, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

- The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the surveys.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including yellow warbler.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of yellow warbler or their nests, no pets shall be allowed in the primary study area.

f) The habitat mitigation plan for the project shall include suitable riparian foraging and nesting habitat for yellow warbler.

Implementing Mitigation Measure WLD-4a would reduce the significant impact on yellow warbler to a **less-than-significant** level.

Mitigation Measure WLD-4b: Mitigate Impacts on Grasshopper Sparrow and California Horned Lark

To avoid, minimize, or mitigate impacts on grasshopper sparrow and California horned lark, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 7 to 14 days before the start of each new activity phase to search for nests within 500 feet of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

   - Construction contractors shall observe a minimum 250-foot buffer zone around active grasshopper sparrow or California horned lark nests. Buffer zones shall remain until young have fledged or until a qualified biologist determines that the nest is no longer active. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the nest(s) to monitor reactions to activities. If activities are deemed to have a negative impact on nests, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

   - The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the surveys.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including grasshopper sparrow and California horned lark.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of grasshopper sparrow and California horned lark or their nests, no pets shall be allowed in the primary study area.

Implementing Mitigation Measure WLD-4b would reduce the significant impact on grasshopper sparrow and California horned lark to a **less-than-significant** level.

Mitigation Measure WLD-4c: Mitigate Impacts on Loggerhead Shrike

To avoid, minimize, or mitigate impacts on loggerhead shrike, the following measures shall be implemented:

a) Whenever feasible, construction near recently active nest sites shall start outside the active nesting season (February 1 through August 31).

b) If ground-breaking activities begin during the nesting period, a qualified biologist shall perform a preactivity survey 7 to 14 days before the start of each new activity phase to search for shrike nests within 500 feet of proposed activities in suitable habitat. If active nests are not identified, no further action is required and construction may proceed. If active nests are identified, the avoidance guidelines identified below shall be implemented:

   - Construction contractors shall observe a minimum 250-foot buffer zone around active shrike nests. Buffer zones shall remain until young have fledged. For activities conducted with agency approval within this buffer zone, a qualified biologist shall monitor construction activities and the shrike nest(s) to monitor reactions to activities. If activities are deemed to have a negative impact on shrike nests, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

   - The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the surveys.

c) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including loggerhead shrike.

d) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

e) To prevent harassment and mortality of loggerhead shrikes or their nests, no pets shall be allowed in the primary study area during construction.

f) The habitat mitigation plan for the project shall include suitable savanna and grassland foraging and nesting habitat for loggerhead shrike.

Implementing Mitigation Measure WLD-4c would reduce the significant impact on loggerhead shrike to a **less-than-significant** level.

Mitigation Measure WLD-4d: Mitigate Impacts on Bird Species Protected by the Migratory Bird Treaty Act

To avoid, minimize, and mitigate for impacts on nesting bird species protected under the MBTA, Reclamation will consult with CDFW and USFWS to implement the following measures:

a) Whenever feasible, construction within the primary study area shall start outside the active avian nesting season (February 1 through August 31).

b) If ground-breaking activities would occur during the avian nesting season, Reclamation will have a qualified biologist perform preactivity surveys to determine presence of nesting birds that project activities may affect. Surveys shall be conducted an appropriate distance beyond the construction area, typically 300 feet for passerine birds and 500 feet for raptors. Larger survey buffers may be required in specific instances or in specific habitats. Wildlife agencies will be involved in determining final survey protocols for nesting birds. If no nests are found, then no further mitigation is required.

c) If biologists observe active nests (i.e., those containing eggs or live young) of species protected under the MBTA, the biologist shall establish a buffer zone based on species biology and characteristics of the project activity between the nest and the construction activity. The buffer zone may be reduced upon consultation with

CDFW and the presence of a qualified biologist monitoring the nest and adult behavior for signs of distress or nest failure. If activities are deemed to have a negative impact on a nest, the biologist shall immediately inform the construction manager that work shall be halted, and CDFW shall be consulted.

d) The qualified biologist shall report the results of the preconstruction surveys and observed nests, including information on the success of the nest, within 30 days of the completion of the surveys.

e) A qualified biologist shall conduct a training session for all construction personnel focused on the protection and conservation of wildlife species including bird species protected under the MBTA.

f) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily from buffer zones near active nest sites to avoid attracting avian predators.

g) To prevent harassment and mortality of avian nesters, no pets shall be allowed in the primary study area during construction.

Implementing Mitigation Measure WLD-4d would reduce the significant impact on bird species protected under the MBTA to a **less-than-significant** level.

Mitigation Measure WLD-5: Mitigate Impacts on Ringtail

To avoid, minimize, or mitigate impacts on ringtail, the following measures shall be implemented where suitable habitat for ringtail occurs within the primary study area:

a) A qualified biologist shall conduct a training session for all construction personnel. This training shall focus on the protection and conservation of protected, nonlisted special-status wildlife species, including ringtails. At a minimum, the training shall include a species and habitat description for the ringtail and shall identify the general measures that are being implemented to minimize impacts on the species.

b) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily.

c) To prevent harassment and mortality of ringtails, no pets shall be allowed.

d) The habitat mitigation plan for the project shall include suitable habitat for ringtail within the known range of occurrence of the species.

Implementing Mitigation Measure WLD-5 would reduce the significant impact on ringtail to a **less-than-significant** level.

Mitigation Measure WLD-6: Mitigate Impacts on American Badger

To avoid, minimize, or mitigate impacts on American badger, the following measures shall be implemented where suitable habitat for this species occurs within the primary study area:

a) A qualified biologist shall perform a preactivity survey to identify the presence of American badgers or dens within the primary study area. A formal survey protocol for this species is not available; therefore, the project biologist shall discuss survey protocols with CDFW and USFWS. Examples of badger surveys conducted in similar habitat types also will be considered. If this species is not found, no further mitigation shall be required.

b) A qualified biologist shall prepare a relocation plan for American badgers. The relocation shall be prepared and approved by CDFW before the initiation of construction that may affect suitable habitat for American badger. The relocation plan shall include techniques for relocation of badgers, potentially including passive or active relocation of individuals to designated relocation sites within the primary study area.

c) A qualified biologist shall conduct a training session for all construction personnel focused on the protection and conservation of protected, nonlisted special-status wildlife species, including American badgers.

d) If badgers are identified within the primary study area that may be affected by project construction, a qualified biologist shall implement the appropriate measures included in the relocation plan. The biologist shall have authority to halt construction work to allow for the

implementation of appropriate measures as specified in the relocation plan.

e) To minimize the possibility of inadvertent badger mortality, project-related vehicles shall observe a maximum 20-mile-per-hour speed limit on private roads.

f) To prevent accidental entrapment of badgers or other animals during construction, all excavated holes or trenches greater than 2 feet deep shall be covered with suitable materials at the end of each work day, or escape routes constructed of earthen materials or wooden planks shall be provided. Before filling, such holes shall be thoroughly inspected for trapped animals.

g) All food-related trash items (such as wrappers, cans, bottles, and food scraps) shall be disposed of in closed containers and removed daily.

h) To prevent harassment and mortality of badgers or destruction of their dens, no pets shall be allowed.

i) The habitat mitigation plan for the project shall include habitat for American badger within the known range of the species.

Implementing Mitigation Measure WLD-6 would reduce the significant impact on American badger to a **less-than-significant** level.

Mitigation Measure WLD-7: Mitigate Impacts on San Joaquin Pocket Mouse

To avoid, minimize, or mitigate impacts on San Joaquin pocket mouse within the primary study area, the following measure shall be implemented:

a) The habitat mitigation plan for the project shall include suitable habitat for San Joaquin pocket mouse within the known range of the species.

Implementing Mitigation Measure WLD-7 would reduce the significant impact on San Joaquin pocket mouse to a **less-than-significant** level.

Mitigation Measure WLD-8: Mitigate Impacts on Special-Status Bat Species

To avoid, minimize, or mitigate impacts on special-status bat species, the following measures shall be implemented:

a) Reclamation shall conduct preconstruction surveys for special-status bats no more than 60 days before the initiation of construction. Preconstruction surveys shall include all areas that could potentially support roosting bats, including trees, caves, abandoned structures, bridges, or other potential roosting habitat within 200 feet of the construction area.

b) Buffers shall be established around active bat roosting sites found during preconstruction surveys (April 15 through August 15).

c) Removal of trees showing evidence of active bat activity shall occur during the period least likely to affect bats, as determined by a qualified bat biologist (generally between February 15 and October 15 for winter hibernacula, and between August 15 and April 15 for maternity roosts).

d) If the exclusion of bats from potential roost sites is necessary to prevent indirect impacts due to construction noise and human activity, bat exclusion (e.g., installation of netting to block roost entrances) shall also be conducted during the periods of low activity as defined above. Any bat exclusion measures shall be coordinated with approved by CDFW before their initiation.

e) The habitat mitigation plan for the project shall include suitable foraging and roosting habitat for bats.

Implementing Mitigation Measure WLD-8 would reduce the significant impact on special-status bat species to a **less-than-significant** level.

Mitigation Measure WLD-9: Mitigate Impacts on Migratory and Wintering Deer Herds

To avoid, minimize, or mitigate impacts on migratory deer and deer fawning grounds within the primary study area, the following measures shall be implemented:

a) The habitat mitigation plan for the project shall include potential fawning grounds for deer herds in the vicinity of the primary study area.

b) If deer migration is expected to be significantly affected by construction and operation of the project, crossing opportunities shall be made available within the primary study area as available.

Implementing Mitigation Measure WLD-9 would reduce the significant impact on migratory deer and deer fawning grounds to a **less-than-significant** level.

Mitigation Measure WLD-16: Monitor and Manage Riparian Vegetation Structure Within Extended Study Area

To avoid, minimize, or mitigate impacts on riparian habitat for nesting bird species within the extended study area due to project operations, the following measure shall be implemented:

a) Conduct annual riparian vegetation monitoring within the extended study area through the duration of the SJRRP, but not less than 30 years following the start of operation of the project. The monitoring shall occur during the growing season and preferably during the peak nesting season (April-June) to determine which bird species are utilizing the riparian habitat and successional stages of the riparian habitat. At least 20 permanent monitoring locations shall be established within riparian habitat within the extended study area. The first year (year 0) of monitoring will be conducted before the initiation of project operations to establish a baseline condition of riparian habitat within the extended study area. Monitoring will be conducted every three years.

b) In conjunction with the above-described monitoring activities, photographs will be taken from permanent photo point locations to be established in riparian habitat within the extended study area. Photo point locations will be selected during the first year (Year 0) of monitoring and recorded with a submeter GPS unit for future relocation needs.

A qualified botanist or biologist shall prepare a Riparian Monitoring Report for each year that an inspection of riparian habitat is conducted.

The Riparian Monitoring Report shall include at a minimum:

1. A description of the physical, biological, and ecological conditions of the monitoring locations including river gage data, rainfall, and information on flood events, where available;

2. Specific discussions of the general conditions of the riparian habitat at each monitoring location including health and structure of riparian habitats relative to previous monitoring periods;

3. A brief summary of relevant land use changes in any lands immediately adjacent to the monitoring locations (e.g., cropland conversion, road widening, housing development, etc.);

4. A brief summary of plant and wildlife species found during monitoring with an emphasis on special-status bird species that may be nesting in the vicinity based on nesting behaviors exhibited;

5. Recommendations for any corrective actions or adaptive management; and

6. Photographs from established photo-documentation points highlighting riparian structure and health. A map showing the location and photo direction of these points will be included. Latitude and longitude information (in UTM or any other convenient coordinate system) will also be included.

If substantial degradation of riparian habitat would occur, Reclamation will review and, as appropriate, implement the Riparian Monitoring Report recommendations for adaptive management and mitigation within the corridor. Implementing Mitigation Measure WLD-16 would reduce the potentially significant impact on riparian habitat for special-status nesting birds to a **less-than-significant** level.

Chapter 8
Climate Change

This chapter provides a summary of existing and potential future climate conditions in the Study Area; an assessment of the action alternatives under projected climate conditions; and a discussion of the potential for anticipated impacts of action alternatives, as described in Chapters 4 through 7 and 9 through 26, to change under future climate conditions. Emissions of GHGs contributing to global climate change are described separately in Chapter 4, "Air Quality and Greenhouse Gas Emissions."

Affected Environment

Historical Climate

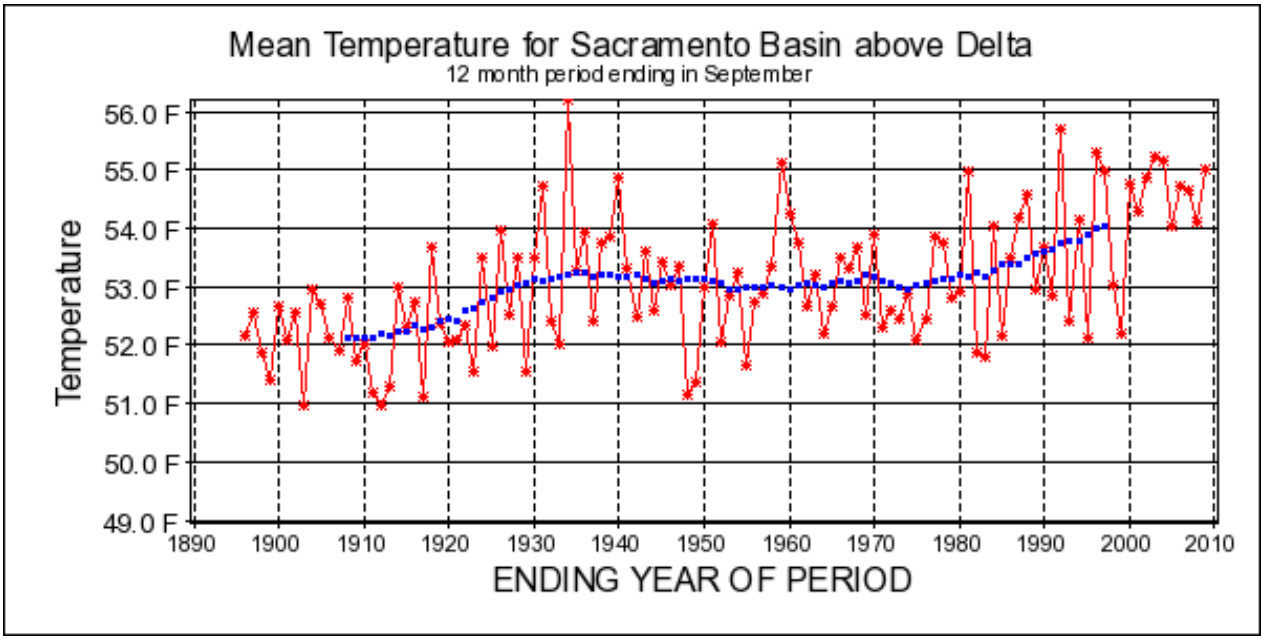
The historical climate of the Central Valley is characterized by hot, dry summers and cool, damp winters. Summer daytime temperatures can reach 90°F with occasional heat waves bringing temperatures exceeding 115°F. The majority of precipitation occurs from mid-autumn to mid-spring. In winter, temperatures below freezing may occur, but snow is rare in the valley lowlands and foothills. The Central Valley typically has a frost-free growing season ranging from 225 to 300 days. During the growing season, relative humidity is characteristically low; in the winter, humidity is usually moderate to high, and ground fog may form.

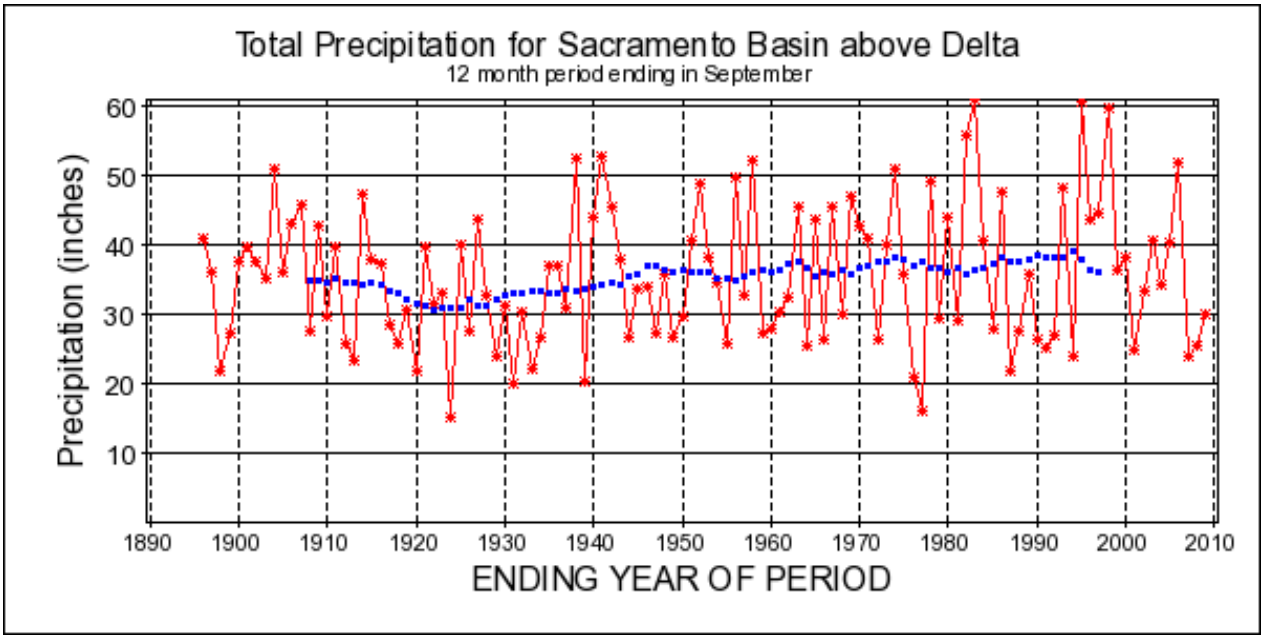
The inter-annual variability of the Central Valley climate is strongly influenced by conditions occurring in the Pacific Ocean, including the El Nino Southern Oscillation and the existence of a semi-permanent high-pressure area in the northern Pacific Ocean (or Pacific high). During the summer season, the northerly position of the Pacific high blocks storm tracks well to the north and results in little summertime precipitation. During the winter months, the Pacific high typically moves southward allowing storms into the Central Valley. Such storms often bring widespread, moderate rainfall to the Central Valley lowlands and foothills, and the accumulation of snow in the surrounding mountainous regions. When strong El Nino Southern Oscillation global circulation patterns occur, storm centers can approach the California coast from a southwesterly direction, carrying large amounts of

tropical moisture, resulting in heavy rains that can produce high runoff and the potential for widespread flooding in the Central Valley.

Over the course of the 20th century, warming has been prevalent over the Central Valley, including the San Joaquin River basin. Basin average mean-annual temperature has increased by approximately 2°F during the course of the 20th century for both the Sacramento River Basin above the Delta (Figure 8-1) and the San Joaquin River Basin above the Delta (Figure 8-2).

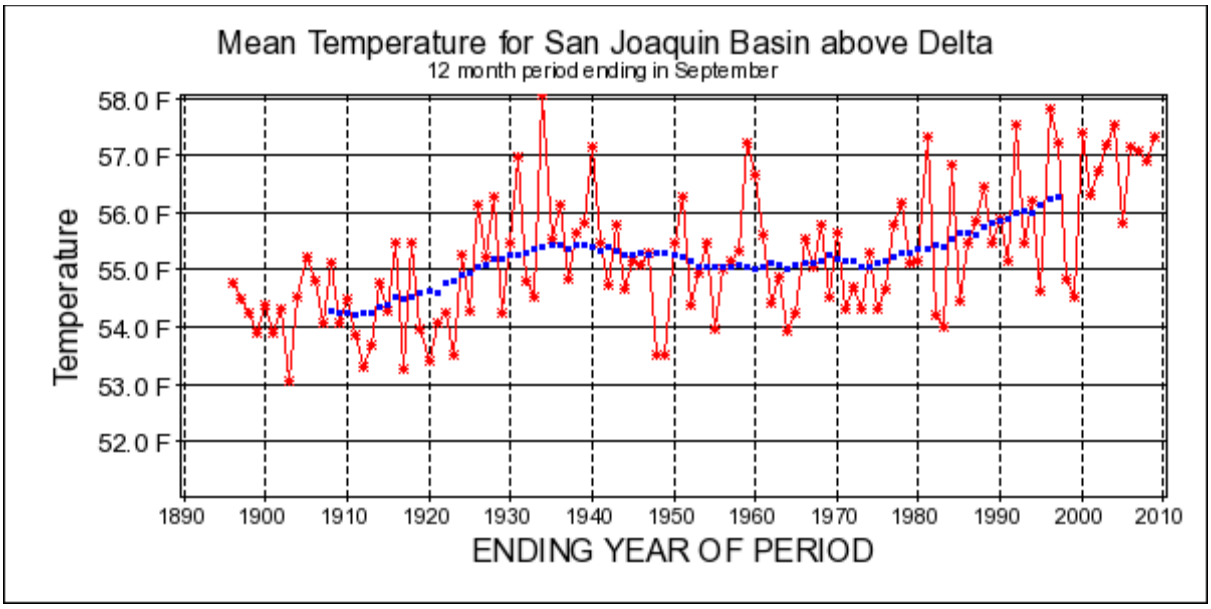
Warming has not occurred steadily throughout the 20th century. Increases in air temperatures occurred primarily during the early part of the 20th century between 1910 and 1935. Subsequently, renewed warming began again in the mid-1970s and appears to be continuing at present, as shown for the Sacramento River Basin in Figure 8-1. Similar results are apparent for the San Joaquin River Basin (Figure 8-2) and have been reported in other studies. Cayan et al. (2001) reported that Western United States spring temperatures have increased 1.8 to 5.4°F since the 1970s; whereas increased winter temperature trends in central California were observed to average about 0.9°F per decade (Dettinger and Cayan 1995). In both the Sacramento River and San Joaquin River basins, the overall 20th century warming has been about 3°F.

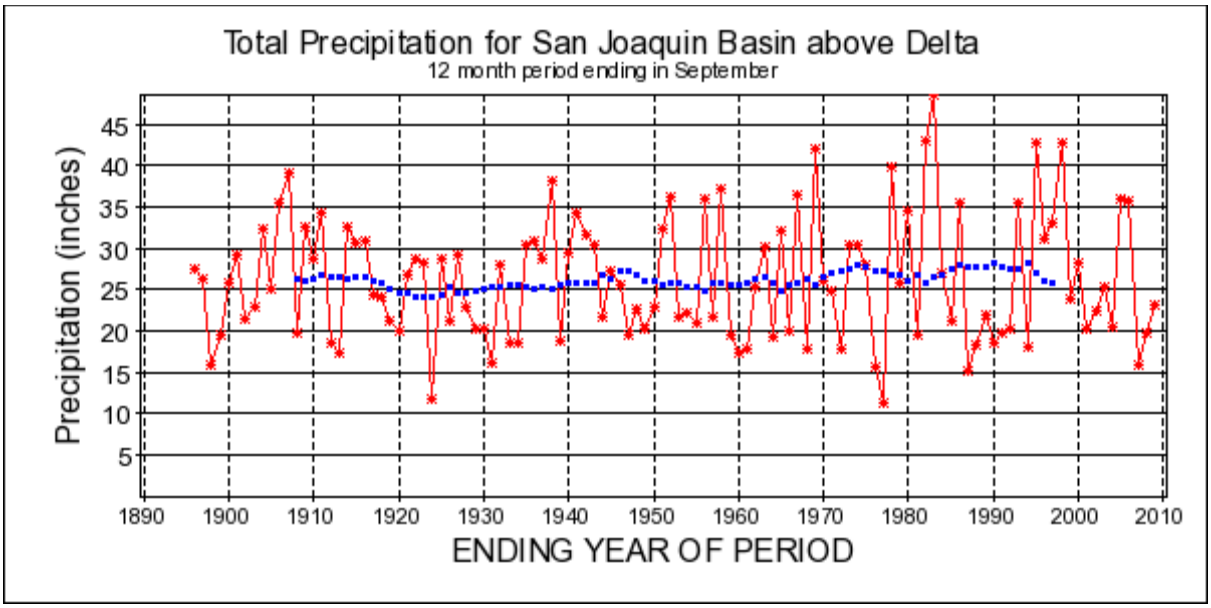




Source: WestMap 2010.

Figure 8-1. Observed Annual (red) and Moving-Mean Annual (blue) Temperature and Precipitation, Averaged over the Sacramento River Basin





Source: WestMap 2010.

Figure 8-2. Observed Annual (red) and Moving-Mean Annual (blue) Temperature and Precipitation, Averaged over the San Joaquin River Basin

Figure 8-1 shows that the warming trend in the Sacramento River Basin has been accompanied by a gradual trend toward increasing precipitation, beginning in 1930 (WestMap 2010). However, a similar precipitation trend is not evident in the San Joaquin River Basin (Figure 8-2). Other studies, such as Regonda et al. (2005), have shown similar results. The variability of annual precipitation appears to have increased in the latter part of the 20th century, as can be seen by comparing the range of differences in high and low values of the solid red line in Figure 8-1 and Figure 8-2. These extremes in wet and dry years have been especially frequent since the mid-1970s in both the Sacramento River and San Joaquin River basins.

Streamflow in the Sacramento River and San Joaquin River basins has historically varied considerably from year to year. Runoff also varies geographically; during any particular year, some portions of the basin may experience relatively greater runoff while other areas experience relatively less runoff (e.g., more abundant runoff in the northern Sacramento Valley versus relatively drier conditions in southern San Joaquin Valley). On a monthly to seasonal basis, runoff is generally greater during the winter to early summer months, with winter runoff generally originating from rainfall-runoff events and spring to early summer runoff generally supported by snowmelt from the Cascade Mountains and Sierra Nevada.

These historical changes in climate have resulted in several important effects on the hydrology of the Sacramento River and San Joaquin River basins. Although annual precipitation may have slightly increased or remained relatively unchanged, corresponding increases in mean annual runoff in the Sacramento and San Joaquin rivers did not occur (Dettinger and Cayan 1995). However, a shift in the seasonal timing of runoff has been observed in the Sacramento River Basin; a decrease of about 10 percent in the fraction of total runoff occurring between April and July has been observed over the course of the 20th century (Roos 1991). Dettinger and Cayan (1995) reported similar results for the combined Sacramento River and San Joaquin River runoff.

Along with the declining spring runoff, corresponding increases in winter runoff have been observed. Peterson et al. (2008) found earlier runoff trends for 18 Sierra Nevada river basins. Analyses such as Cayan (2001) have indicated that increasing spring temperatures, rather than increased winter precipitation, was the primary cause of the observed trends. Studies by these researchers and others showed correlation

between the magnitude of decreases in April through July runoff with the altitude of the basin watershed. High altitude basins, like the San Joaquin River Basin, exhibited less decrease in spring runoff than lower elevation watersheds, such as the Sacramento River Basin. However, it is noted that the appearance of runoff trends in the basins is dependent on location within the basin and the period of record assessed.

Other historical studies of 20th century spring snowpack, as measured by April 1st Snow Water Equivalent (SWE), showed a decreasing trend in the latter half of the 20th century (Mote 2005). Coincident with these trends, reduced snowpack and snowfall ratios are evidenced by analyses of SWE measurements made from 1948 through 2001 at 173 Western United States stations (Knowles et al. 2007). Additionally, Regonda et al. (2005) reported decreasing spring SWE trends in 50 percent of Western United States locations evaluated.

Within the Sacramento River and San Joaquin River basins, the abovementioned observations of temperature, precipitation, and snowpack are sensitive to uncertainties of station measurements as well as the temporal (period of record) and geographic scope of analyses. Observed trends of temperature, precipitation, snowpack, and streamflow over the Western United States may be partially explained by anthropogenic (e.g., human) influences on climate (e.g., Barnett et al. 2008; Pierce et al. 2008; Bonfils et al. 2008; Hidalgo et al. 2009; and Das et al. 2009). However, it remains difficult to attribute observed changes in climate to historical human influences or anthropogenic forcings. This is particularly the case for trends in precipitation (Hoerling et al. 2010), and for trends in basin-scale conditions rather than at the larger Western United States scale (Hidalgo et al. 2009).

Sea level change is also an important factor in assessing the effect of climate on California's water resources, because of its effect on water quality in the Delta. Higher sea levels are associated with increasing salinity in the Delta, which influences the suitability of Delta water supplies for agricultural, urban, and environmental uses. The global rate of msl change was estimated by the Intergovernmental Panel on Climate Change (IPCC) (2007) to be 1.8 +/- 0.5 millimeters per year (mm/year) (0.07 +/- 0.02 in/year) from 1961–2003 and 3.1 +/- 0.7 mm/year (0.12 +/0.03 in/year) during 1993–2003. During the 20th century, msl at Golden Gate Bridge in San Francisco Bay has risen by an average of 2 mm/year (0.08 in/year) (Anderson et al. 2008). Rates of sea level rise in San

Francisco Bay appear to be accelerating based on tidal gauges and remote sensing measurements (Church and White 2006; Beckley et al. 2007).

Projections of Future Climate

This section summarizes results from prior, relevant studies focused on potential future climate and hydrologic conditions within the Sacramento River and San Joaquin River basins. Literature relevant to the Study Area is summarized, followed by a discussion of results from Reclamation (2011b).

Summary of Relevant Studies of Future Climate and Hydrology

Potential changes in Central Valley climate and hydrology have been the subject of numerous studies. Moser et al. (2009) reports specifically on future climate possibilities for Central Valley watersheds and suggests warming temperatures during the 21st century, with an end-of-century increase of 3°F to 10.5°F. Mean annual precipitation in California is projected to decrease by 10 to 15 percent by the end of the 21st century.

Maurer (2007) assessed the effects of projected changes in future climate for four river basins in the western Sierra Nevada draining to the Central Valley, finding a tendency toward increased winter precipitation. Models analyzed by Maurer (2007) consistently exhibited similar increases in temperature and SWE, while increases in winter precipitation were variable. Increases in temperatures within the Central Valley were shown by Kapnick and Hall (2008) to result in a shift in the date of peak of snowpack accumulation from 4 to 14 days earlier in the winter season by end of century.

Using 2°C, 4°C, and 6°C increases in mean-annual air temperature relative to historical conditions to represent warming scenarios, Null et al. (2010) reported on climate change impacts for 15 western-slope watersheds in the Sierra Nevada. Under these scenarios, total runoff decreased; earlier runoff was projected in all watersheds; and decreased runoff quantities were expected to be most severe in the northern part of the Central Valley. Null et al. (2010) also indicated that the high elevation southern-central region of the Sierra Nevada was the most susceptible to earlier runoff, and the central region was the most vulnerable to longer low flow periods.

Sea level changes also have been projected to occur during the 21st century due to increasing air temperatures causing thermal expansion of the oceans and additional melting of the land-

based Greenland and Antarctic ice sheets (IPCC 2007). The CALFED Independent Science Board estimated a range of sea level rise at Golden Gate of 1.6 feet to 4.6 feet by the end of the 21st century (CALFED 2007). DWR 2009a used 12 future climate projections to estimate future sea levels, which indicate sea level rise by mid-century ranging from 0.8 feet to 1.0 feet with an uncertainty range spanning 0.5 feet to 1.3 feet. By the end of the 21st century, sea level was projected to rise between 1.8 feet and 3.1 feet, with an uncertainty range spanning from 1.0 feet to 3.9 feet. There is also the potential for increased extremely high sea level events to occur when high tides coincide with winter storms (Moser et al. 2009).

Summary of Future Climate Projections by Reclamation

This section summarizes climate projections developed by Reclamation (2011b) consistent with Public Law 111-11, Subtitle F (the SECURE Water Act). The Reclamation study encompassed a western United States-wide hydrologic analysis to identify risks to water supplies throughout the Colorado, Columbia, Klamath, Missouri, Rio Grande, Sacramento, San Joaquin, and Truckee river basins. The methods and assumptions used to develop the projections are described in detail in a report titled *West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections* (Reclamation 2011a).

A summary of projected future climate projections developed in Reclamation 2011b is presented in Table 8-1 for two locations in the Sacramento River Basin and two locations in the San Joaquin River Basin. The climate change projections described herein reflect results derived from multiple models and simulations, known as ensembles. Ensembles provide a range of potential conditions for planning purposes with consideration of uncertanties, and have been shown to better reflect historical conditions than single model runs. Before summarizing climate projection and climate change information, it should be noted that the projected changes exhibit geographic variation and temporal variation (changes vary through time), and the progression of change through time varies among climate projection ensemble members. Additional descriptions of the mean and range of hydroclimate metrics are included in the Climate Change Attachment to the Modeling Appendix.

Table 8-1. Summary of Simulated Changes in Decade-Mean Hydroclimate for Several Subbasins in the Sacramento River and San Joaquin River Basins

Hydroclimate Metric (change from 1990s)	2020s	2050s	2070s
Sacramento River at Bend Bridge			
Mean Annual Temperature (°F)	1.3	3.0	4.2
Mean Annual Precipitation (%)	1.0	1.8	-0.9
Mean April 1st Snow Water Equivalent (%)	-58.7	-79.0	-90.8
Mean Annual Runoff (%)	3.3	4.1	-3.8
Mean December–March Runoff (%)	7.0	11.6	8.6
Mean April–July Runoff (%)	-8.8	-17.7	-30.9
Mean Annual Maximum Week Runoff (%)	10.8	16.2	17.0
Mean Annual Minimum Week Runoff (%)	-0.4	-0.7	-1.0
Sacramento River at Freeport			
Mean Annual Temperature (°F)	1.3	3.0	4.2
Mean Annual Precipitation (%)	-0.3	0.6	-2.7
Mean April 1st Snow Water Equivalent (%)	-53.4	-75.9	-88.6
Mean Annual Runoff (%)	3.5	2.5	-3.6
Mean December–March Runoff (%)	9.0	13.6	11.0
Mean April–July Runoff (%)	-11.1	-23.0	-36.1
Mean Annual Maximum Week Runoff (%)	12.9	18.4	18.3
Mean Annual Minimum Week Runoff (%)	-0.3	-0.5	-0.6
San Joaquin River at Friant Dam			
Mean Annual Temperature (°F)	1.4	3.3	4.5
Mean Annual Precipitation (%)	-1.3	-5.3	-8.6
Mean April 1st Snow Water Equivalent (%)	-23.1	-39.6	-48.7
Mean Annual Runoff (%)	0.7	-8.7	-10.7
Mean December–March Runoff (%)	13.9	15.8	31.0
Mean April–July Runoff (%)	-6.1	-20.2	-25.0
Mean Annual Maximum Week Runoff (%)	-2.3	-6.6	-16.0
Mean Annual Minimum Week Runoff (%)	-4.0	-6.4	-7.6
San Joaquin River at Vernalis			
Mean Annual Temperature (°F)	1.3	3.1	4.3
Mean Annual Precipitation (%)	-1.0	-4.2	-7.7
Mean April 1st Snow Water Equivalent (%)	-27.2	-45.9	-56.3
Mean Annual Runoff (%)	0.8	-5.9	-8.4
Mean December–March Runoff (%)	10.1	10.7	17.2
Mean April–July Runoff (%)	-4.8	-20.6	-25.8
Mean Annual Maximum Week Runoff (%)	1.6	-1.8	-4.9
Mean Annual Minimum Week Runoff (%)	-1.2	-1.9	-2.3

Key:
ºF = degree Fahrenheit
% = percent

Climate Change Impact Assessment

Reclamation policy and NEPA guidance state that the characterization of uncertainty, including uncertainty related to climate change, is an important aspect of making informed decisions. The methodology implemented in this assessment is a scenario-based approach that addresses future uncertainties by considering multiple socioeconomic-climate scenarios. These scenarios are not forecasts of future conditions but, rather, are projections intended to characterize a wide range of potential future conditions; examination of these conditions may indicate the sensitivity of resource impacts identified in this Draft EIS to future climate uncertainties.

This section describes the methods and assumptions for the impact assessment, as well as results for simulated conditions with and without a project. Further details on the methodology, tools, and results of this climate change impact assessment are provided in the Climate Change attachment to the Modeling Appendix, and in Reclamation (2013).

Methods and Assumptions

The climate change impact assessment characterizes the sensitivity of Millerton Lake operations to uncertainties in potential future socioeconomic and climatic conditions. The assessment is intended as a sensitivity analysis, and is conducted at a level of detail sufficient for assessing the potential sensitivity of identified environmental impacts to future socioeconomic-climate uncertainties.

The analyses assess a particular socioeconomic-climate scenario under Baseline and Representative Alternative conditions. The term “Baseline” refers to a future socioeconomic-climate scenario simulated without a project in place. The action alternatives are simulated using a single, simplified Representative Alternative; consequently, the Representative Alternative does not fully represent all physical or operational details included in specific action alternatives described elsewhere in this Draft EIS (see Chapter 2, “Alternatives”). The effects of the Representative Alternative can be evaluated by comparison with the corresponding Baseline. However, results should not be directly compared to operational results for the No Action Alternative and action alternatives discussed within other chapters of this Draft EIS.

Modeling tools used for the climate change impact assessment presented herein are different from models used to support

quantitative impact assessments presented in other chapters. The climate change impact assessment tools are simplified representations, not intended to capture the detailed operation or complexity of CVP, SWP, and other water management systems in the Central Valley. Consequently, some results used to evaluate impact sensitivity under climate change may differ from quantified results presented in Chapters 4 through 7 and 9 through 27 of this Draft EIS.

An important aspect of the assessment relates to analysis uncertainties. Two major uncertainties affecting future impacts are socioeconomic and climate conditions, both of which are dynamic in nature. This aspect of the assessment was addressed by employing a transient analysis in which both socioeconomic and climate conditions are continuously changing over time. Uncertainties in future socioeconomic conditions are based on a series of different population and land use projections from present day to 2100. The climate uncertainties are addressed by including multiple 21st century projections from general circulation model or global climate model (GCM) simulations to represent a wide range of potential future climate conditions. Socioeconomic and climate futures were used to inform the operations, water quality, reservoir and river temperature modeling, and hydropower modeling performed for the Baseline and Representative Alternative under climate change and are described below. Descriptions of water supply, water quality, reservoir and river temperature, and hydropower modeling are described in detail in the Climate Change attachment of the Modeling Appendix.

Socioeconomic and Climate Future Scenarios

Water supplies and demands in the 21st century would be affected by changing socioeconomic and climate conditions. Socioeconomic conditions have a direct impact on water demands; as population increases, water demands for municipal, commercial, and industrial water supplies tend to increase. Furthermore, land use changes can have important effects on water demands, and urban growth can influence adjacent agricultural lands and demands for agricultural water supplies. Climate is the most important factor influencing water supply availability; changes in amount of precipitation directly affects water supplies, while changes in the seasonality of precipitation may also affect how much precipitation is available to meet particular water supply needs.

Several socioeconomic and climate scenarios were used in this assessment to address uncertainties in potential future socioeconomic and climate conditions, as described below.

Socioeconomic Future Scenarios

Three socioeconomic future scenarios, originally developed by DWR in the California Water Plan Update 2009 (DWR 2009b), were used to represent changes in population and land use during the 21st century:

- **Current Trends (CT)**, which assumes that recent trends will to continue into the future.
- **Slow Growth (SG)**, which assumes that future development is less resource intensive than under recent conditions.
- **Expansive Growth (EG)**, which assumes that future development is more resource intensive than under recent conditions.

For this assessment, 2005 (Base), 2050, and 2100 population projections in the Sacramento, San Joaquin, and Tulare Lake hydrologic regions were developed under each of the above growth trends, based on data by the California Department of Finance (DOF)(DOF 2007). Similarly, projected changes in irrigated lands were developed for these periods and regions using information in the California Water Plan Update 2009 (DWR 2009b).

Climate Futures

Eighteen climate projections were employed to characterize a wide range of future hydroclimate uncertainties as part of this sensitivity analysis:

- **No Climate Change (NoCC) Scenario**, which included simulations of hydroclimatic conditions under the historical climate.
- **Future Climate – Ensemble-Informed Scenario** used 5 ensemble-informed scenarios that were developed by the CVP IRP based on downscaled GCM projections.
- **Future Climate – Downscaled Climate Projections** used the 12 specific GCM projections identified by the State of California's Climate Action Team (CAT) for

use in climate studies performed by DWR for the California Water Plan.

The NoCC scenario was developed by using the unadjusted historical climate sequence from 1915 through 2003 to simulate the future period of 2011 through 2099. For the 17 climate change projections, temperature and precipitation projections were developed for a similar future period as the NoCC scenario.

The five ensemble-informed climate projections were developed from 112 GCM simulations, which were previously bias-corrected and spatially downscaled by Reclamation and others (Maurer 2007), as described in Reclamation (2013). The five projections include a central tendency projection (Q5) that is based on the bias-corrected and spatially downscaled projections near the median of changes in temperature and precipitation. The remaining four projections are based on ensembles of bias-corrected and spatially downscaled projections that differ from the central tendency by being drier with less warming (Q1); drier with more warming (Q2); wetter with more warming (Q3); and wetter with less warming than Q5 (Q4).

The 12 CAT projections were developed from six GCMs, and are described in DWR 2009a. These GCMs were selected by the State's CAT based on ability to reasonably simulate historical climatic conditions, including seasonal precipitation, temperature, and variability of annual precipitation in California, as well as important global climate conditions such as tropical Pacific Ocean sea surface temperatures associated with the El Nino Southern Oscillation. Additional details regarding the development of climate projections used in this sensitivity analysis are available in the Climate Change attachment of the Modeling Appendix.

Sea Level Changes

The CALFED Science Program, State of California, National Academy of Sciences, and others have assessed the range of potential future sea level rise through 2100. These studies indicate that as sea level rise progresses during the 21st century, the hydrodynamics of the Delta would change, causing the salinity of water in the Delta to increase. This increasing salinity is likely to have substantial impacts on water management throughout the Central Valley and other regions of the State.

Several transient sea level rise projections were developed based on the National Research Council (NRC) report projections (NRC 2012). The report suggested that the mean sea level rise projection in the San Francisco Bay would be approximately 6, 12, 36 inches by 2030, 2050, and 2100, respectively. These mean sea level rise projections were used in operations and water quality modeling that were performed for the Investigation, as discussed in the Climate Change Attachment of the Modeling Appendix.

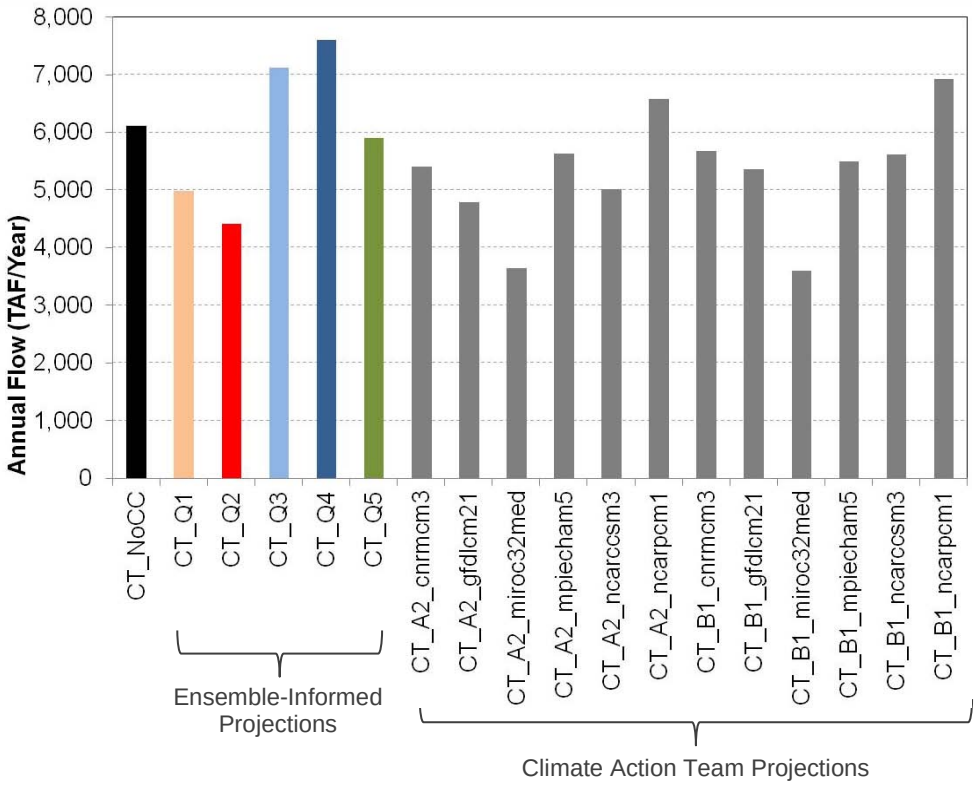
Climate Change Sensitivity Analysis–Baseline

As described previously, conditions without the Representative Alternative in place were evaluated for different projected future socioeconomic-climate scenarios using the methodology described above; these conditions are referred to herein as Baselines. The results of the Baselines sensitivity analysis are summarized below for the following categories:

- Water supplies
- Water demands
- CVP and SWP system operations
- Supplies and demands in CVP divisions
- Results of other performance-assessment tools including economics, water temperature, hydropower and GHG emissions

Water Supplies

Figure 8-3 shows the projected average annual runoff upstream from Vernalis in the San Joaquin River Hydrologic Region for the CT socioeconomic projection combined with the NoCC, six ensemble-informed climate projections (Q1, Q2, Q3, Q4, and Q5), and 12 CAT projections for the period of water years 2012 through 2099. As shown in the figure, substantial differences are evident in runoff among the different climate scenarios, and the range of the CAT projections is consistent with the range of the ensemble-informed projections.



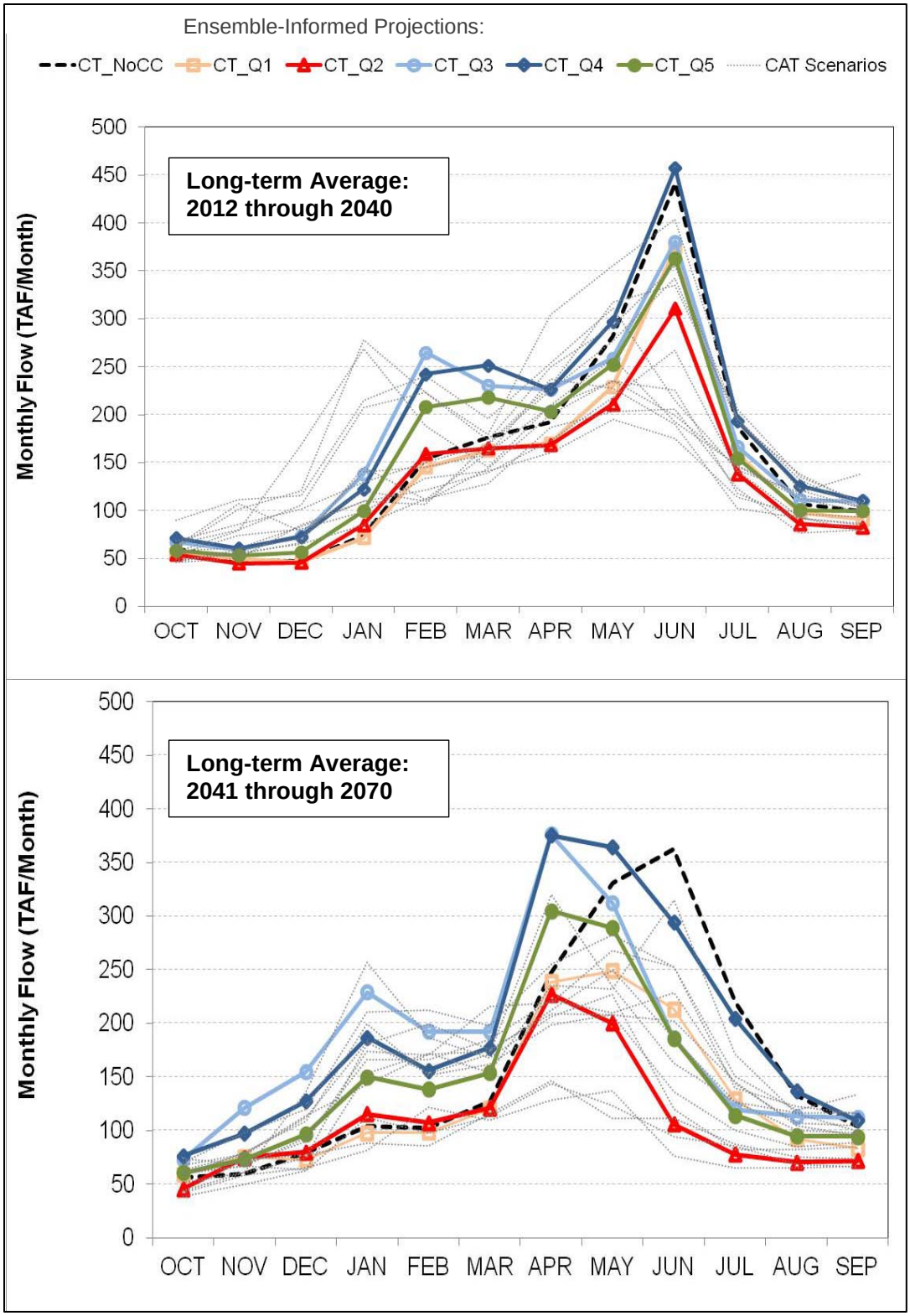
Key:
CT = current trends
NoCC = no climate change
TAF = thousand acre-feet

Figure 8-3. Average Annual Runoff in the San Joaquin River System under Future Climate Scenarios

Among the scenarios, the projected average annual runoff in the San Joaquin River Basin ranges between 3,604 and 7,609 TAF/year over the simulation period (water years 2012 through 2099). In the median climate scenario (Q5), average annual runoff is about 4 percent lower than the NoCC scenario. Compared with the NoCC scenario, the drier climate scenarios (Q1 and Q2) show substantially lower average annual runoff (ranging from 18 to 28 percent), while the wetter climate scenarios (Q3 and Q4) show substantially higher average annual runoff (ranging from 16.5 to 24.5 percent). Across the range of all climate scenarios, average annual runoff show a declining trend over the simulation period.

Figure 8-4 shows the monthly pattern of projected inflow into Millerton Lake in the early, mid, and late 21st century. The future climate scenarios exhibit a pattern similar to the CT_NoCC scenario (dashed line), but with a shift to more runoff in the winter and less in the spring months. This

projected shift occurs because higher temperatures during winter cause more precipitation to occur as rainfall, which increases runoff and reduces snowpack. This seasonal shift is most evident in basins where historical snowpack occurs at lower elevations and is, therefore, more susceptible to warming induced changes. For example, in the winter months (December to February) CT_Q5 projects greater runoff than CT_NoCC, but in the spring (March to May) CT_NoCC projects greater runoff.



Key:
CT = current trends
NoCC = no climate change
TAF = thousand acre-feet

Figure 8-4. Average Monthly Runoff into Millerton Lake by Climate Scenario

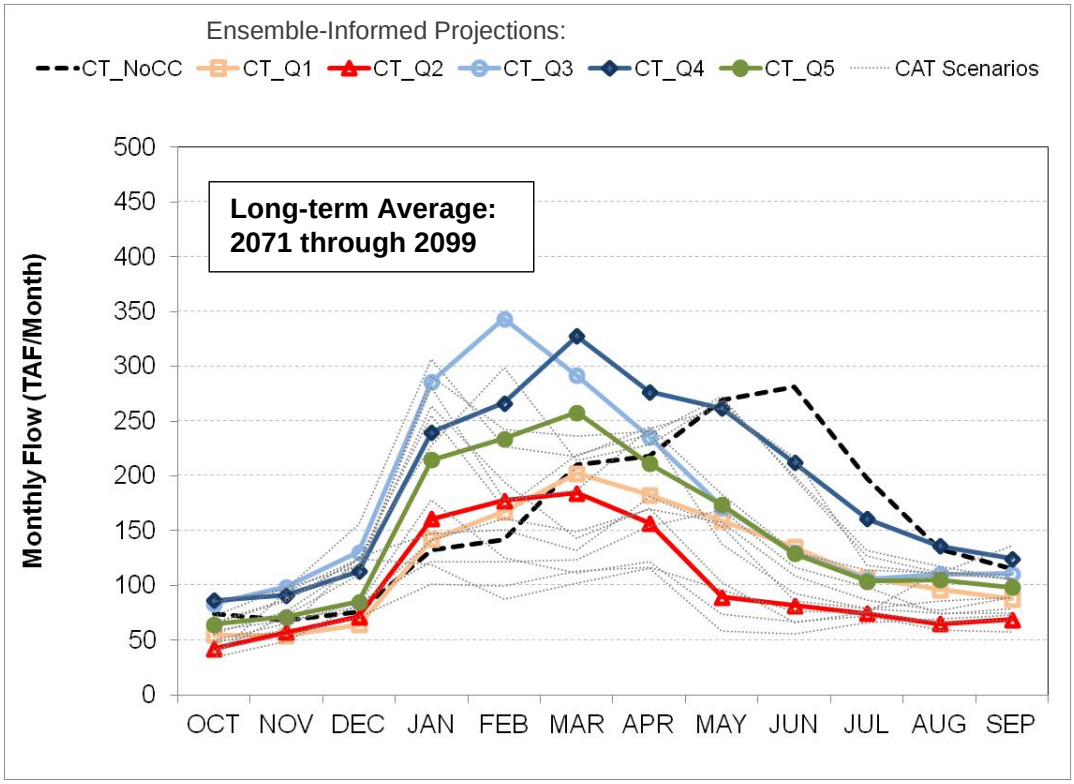


Figure 8-4. Average Monthly Runoff into Millerton Lake by Climate Scenario (contd.)

Figure 8-5 and Figure 8-6 shows the annual time series of runoff in the San Joaquin River and Tulare Lake hydrologic regions under each socioeconomic-climate scenario during the period from 2012 through 2099. The methodology used to develop the future time series uses the same inter-annual variability as observed during the historical period; extended drought periods with lower runoff values occur from 2025-2030 (corresponding to 1929-1934 dry period) and from 2083-2088 (corresponding to 1987-1992 drought), and a very substantial dry period occurs from 2072-2073 (corresponding to 1976-1977 minimum precipitation years). However, as can be observed in the figures, the magnitude of these hydrologic events differs from historical conditions (CTNoCC).

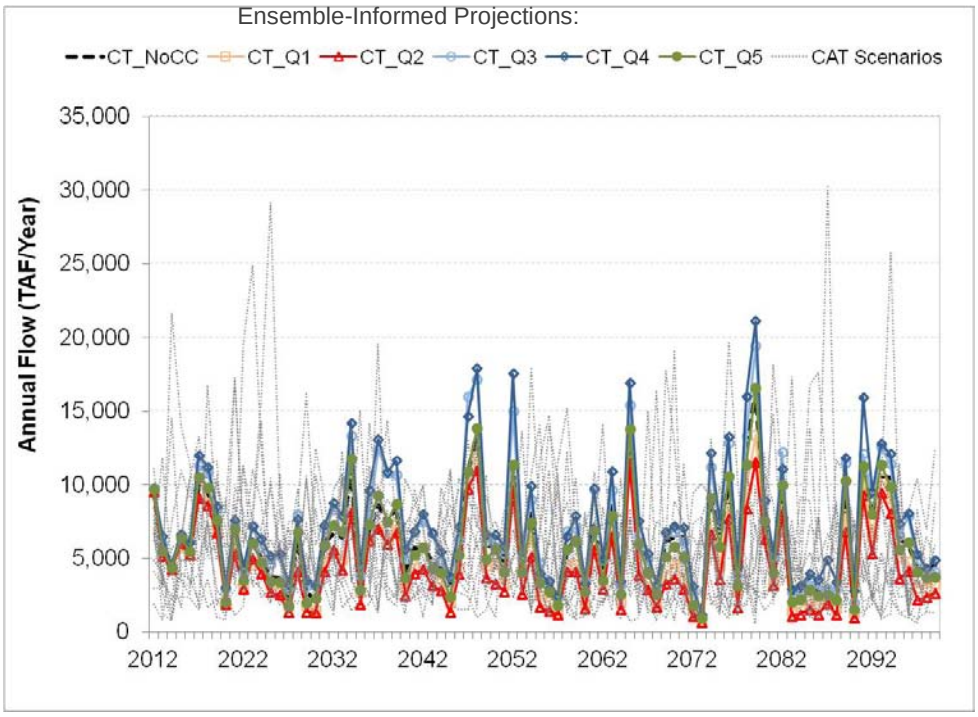


Figure 8-5. Annual Time Series of Runoff in the San Joaquin River Hydrologic Region in each Climate Scenario

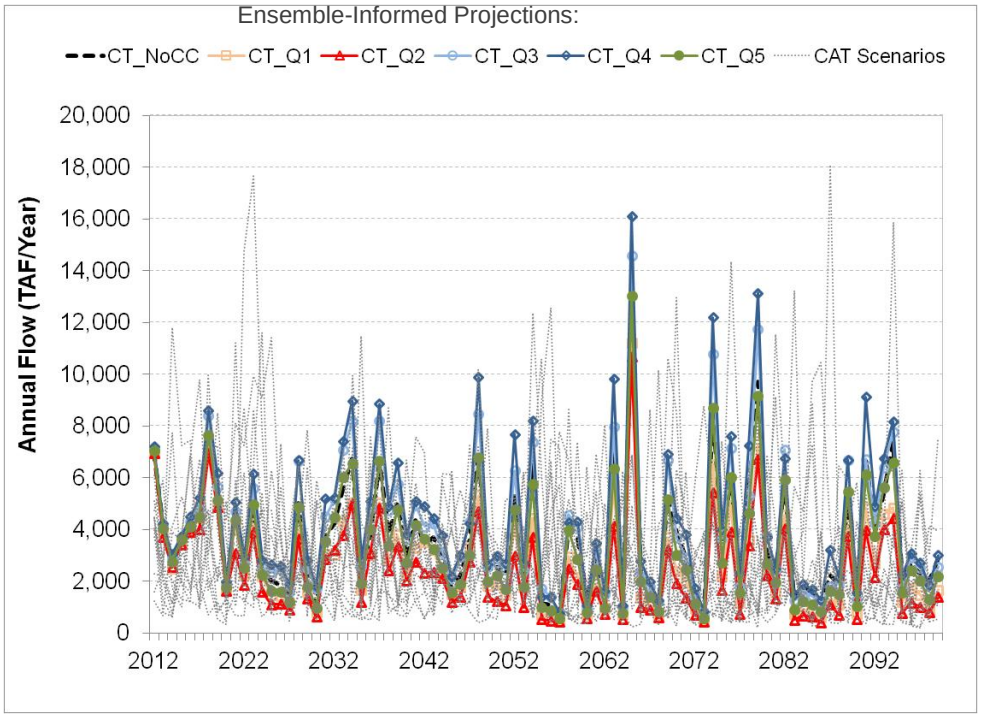


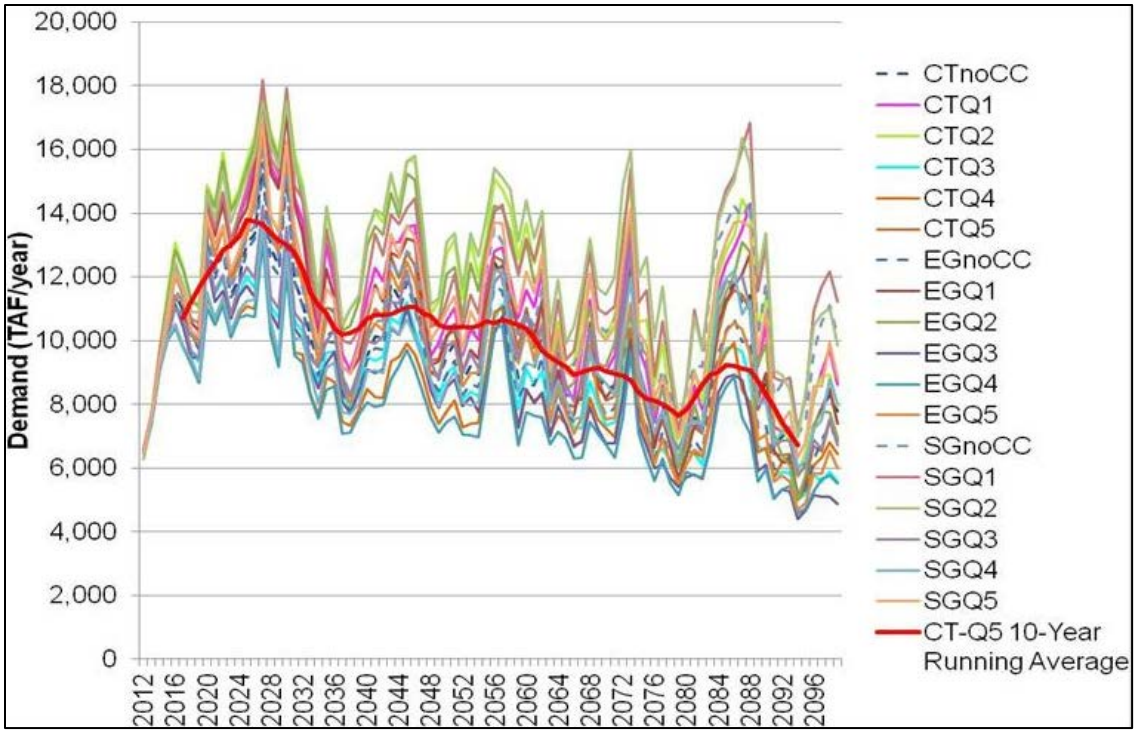
Figure 8-6. Annual Time Series of Runoff in the Tulare Lake Hydrologic Region in each Climate Scenario

In the San Joaquin River Basin, the mean annual change in runoff over the 21st century ranges from -27.9 percent (CT_Q2) to +24.5 percent (CT_Q4) with the central tendency projection being +-3.5 percent. In the Tulare Lake region, the mean annual change in runoff over the 21st century ranges from -33.4 percent (CT_Q2) to +23.8 percent (CT_Q4) with the central tendency projection being -7.4 percent. These ranges underscore the wide range of potential change in runoff volumes under climate change.

Water Demands

The impacts of potential climate changes on urban and agricultural water demands were assessed for each major hydrologic region in the Study Area. Additional water demand projections for each hydrologic region are presented in the Climate Change attachment of the Modeling Appendix.

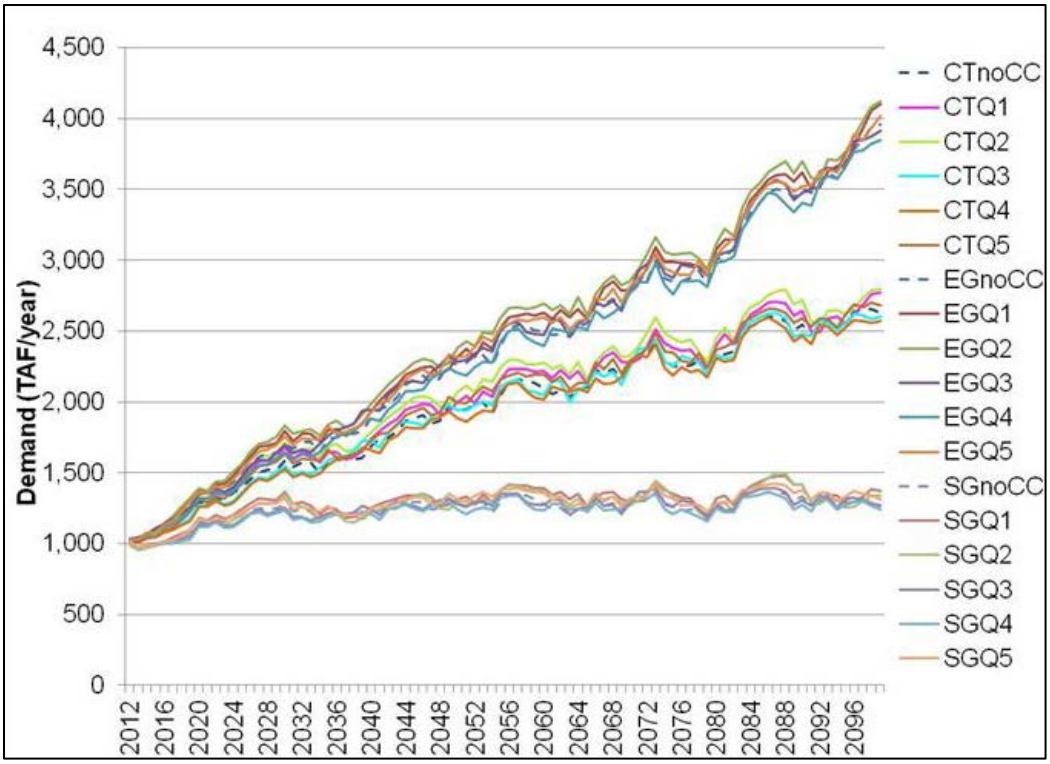
Figure 8-7 presents the annual time series of projected total agricultural water demand in Central Valley CVP water service areas for 18 socioeconomic-climate scenarios. The short-term demand variability seen in the figure is highly correlated with the variability in annual precipitation. In years of low precipitation, agricultural water demand is higher; and in years of high precipitation, water demands decrease. The longer-term trends include the effects of decreased irrigated lands and increasing carbon dioxide, especially in the latter half of the 21st century.



Key:
CT = current trends
EG=Expansive Growth scenario
NoCC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-7. Annual Time Series of Agricultural Applied Water Demand in the CVP Water Service Area in Each Socioeconomic-Climate Scenario

Figure 8-8 presents a similar annual time series of projected total urban water demands. In contrast to agricultural demands, urban demands do not show as large a degree of year-to-year variability because much of the urban demand is for indoor uses, which are assumed insensitive to precipitation variability. Because urban demands are driven largely by population, they tend to increase steadily over time with the growth in population and expansion of commercial activities.



Key:
CT = current trends
EG=Expansive Growth scenario
NoCC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

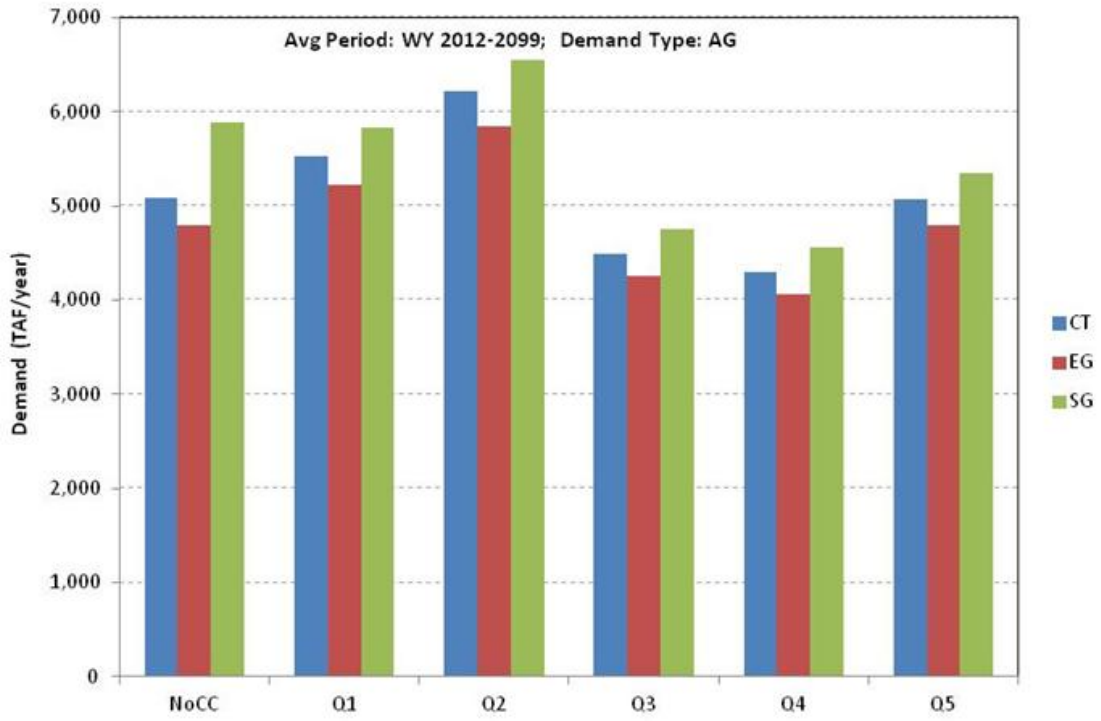
Figure 8-8. Annual Time Series of Urban Applied Water Demand in the CVP Water Service Area in each Socioeconomic-Climate Scenario

Figure 8-9 through Figure 8-12 show the average annual agricultural and urban applied water demands for the CVP, SWP, and non-project water users in the San Joaquin River and Tulare Lake hydrologic regions for each socioeconomic-climate scenario over the projected period of water years from 2012 through 2099.

Total agricultural and urban water demands (including CVP, SWP, and non-project) vary across both the range of socioeconomic scenarios and the range of climate scenarios. Although the magnitudes differ between basins because of differences in crops and acreages, the overall relationship between precipitation and agricultural demand is similar in all basins. While the median climate scenario (Q5) has similar demands to the NoCC, the drier climate scenarios (Q1 and Q2) have higher average demands than the NoCC, and the wetter climate scenarios (Q3 and Q4) have lower average demands

than the NoCC. Among the socioeconomic scenarios, the EG scenario has lower agricultural demands than the CT scenario because the assumed rate of urban expansion into agricultural lands is greater. Conversely, the SG scenario has higher agricultural demands than the CT scenario because it reflects less agricultural to urban land conversion.

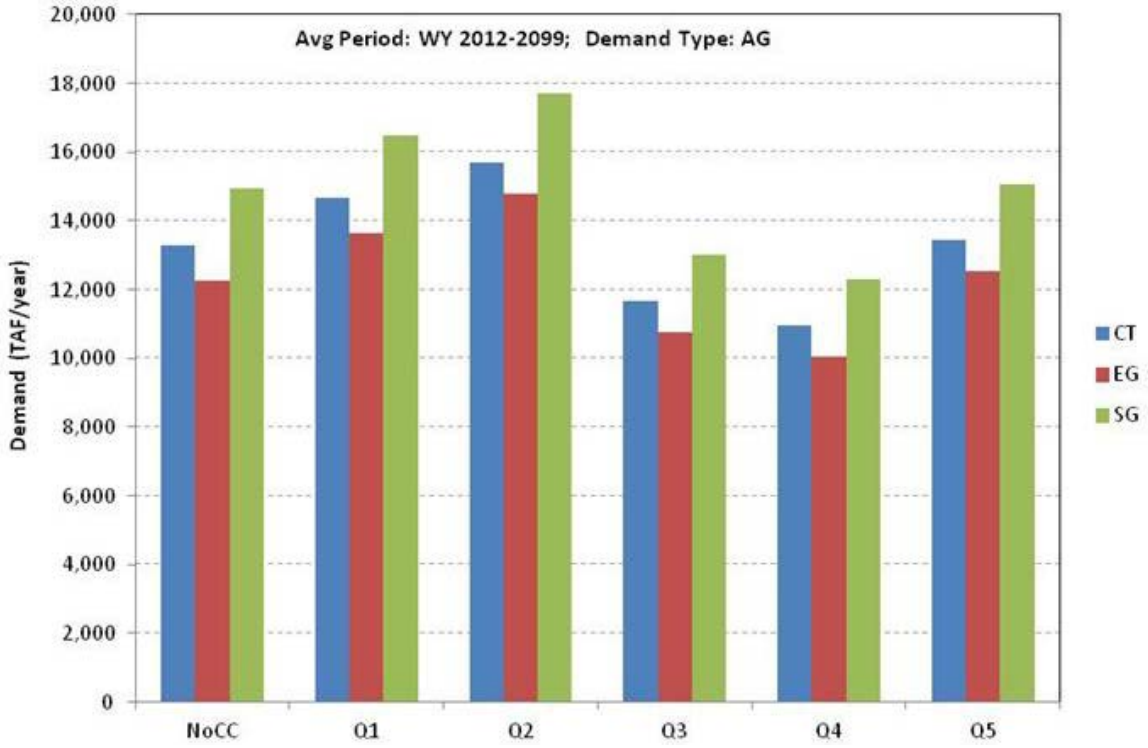
In the San Joaquin River hydrologic region, the overall average agricultural demand change relative to the no climate change scenario is 0 to +0.9 percent in Q5, ranging from an 11 to 22 percent decrease in the wetter Q3 and Q4 scenarios to a 10 to 22 percent increase in the drier Q1 and Q2 scenarios.



AG = agricultural
Avg = average
NoCC = No Climate Change
CT = Current Trends scenario
EG = Expansive Growth scenario
SG = Slow Growth scenario
TAF = thousand acre-feet
WY = water year

Figure 8-9. Average Annual Agricultural Applied Water Demand in the San Joaquin River Hydrologic Region in each Socioeconomic-Climate Scenario

In the Tulare Lake hydrologic region, the overall average agricultural demand change relative to the NoCC scenario is 1 to 2 percent higher in Q5, ranging from a 12 to 18 percent decrease in the wetter Q3 and Q4 scenarios to a 10 to 20 percent increase in the drier Q1 and Q2 scenarios.

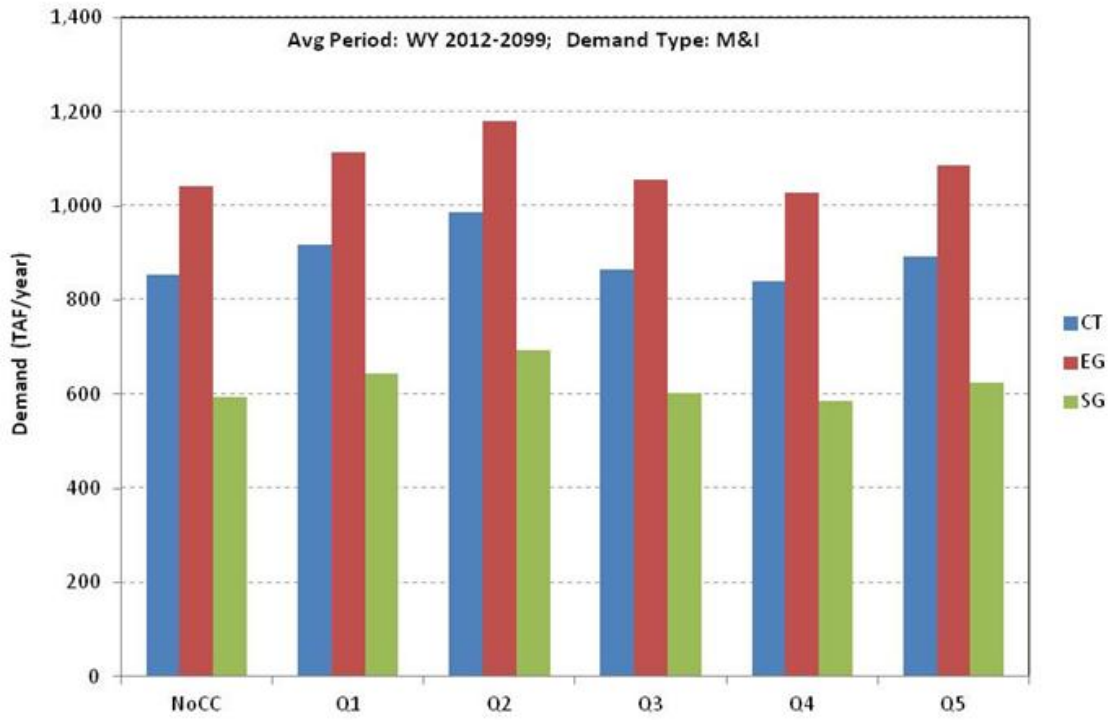


Key:
AG = agricultural
Avg = average
NoCC = No Climate Change
CT = Current Trends scenario
EG = Expansive Growth scenario
SG = Slow Growth scenario
TAF = thousand acre-feet
WY = water year

Figure 8-10. Average Annual Agricultural Applied Water Demand in the Tulare Lake Hydrologic Region in each Socioeconomic-Climate Scenario

In contrast with agricultural demands, the effect of precipitation variability on urban demands is minimal while the effect of population is significant. Consequently, the EG scenario has the largest urban demands and the SG scenario has the least. Across all climate scenarios and basins, the overall urban demand is about 4.4 to 4.8 MAF/year in the CT socioeconomic scenario, ranging from a low of about 2.9 to 3.1 MAF/year in the SG scenario to a high of about 5.2 to 5.7 MAF/year in the EG scenario.

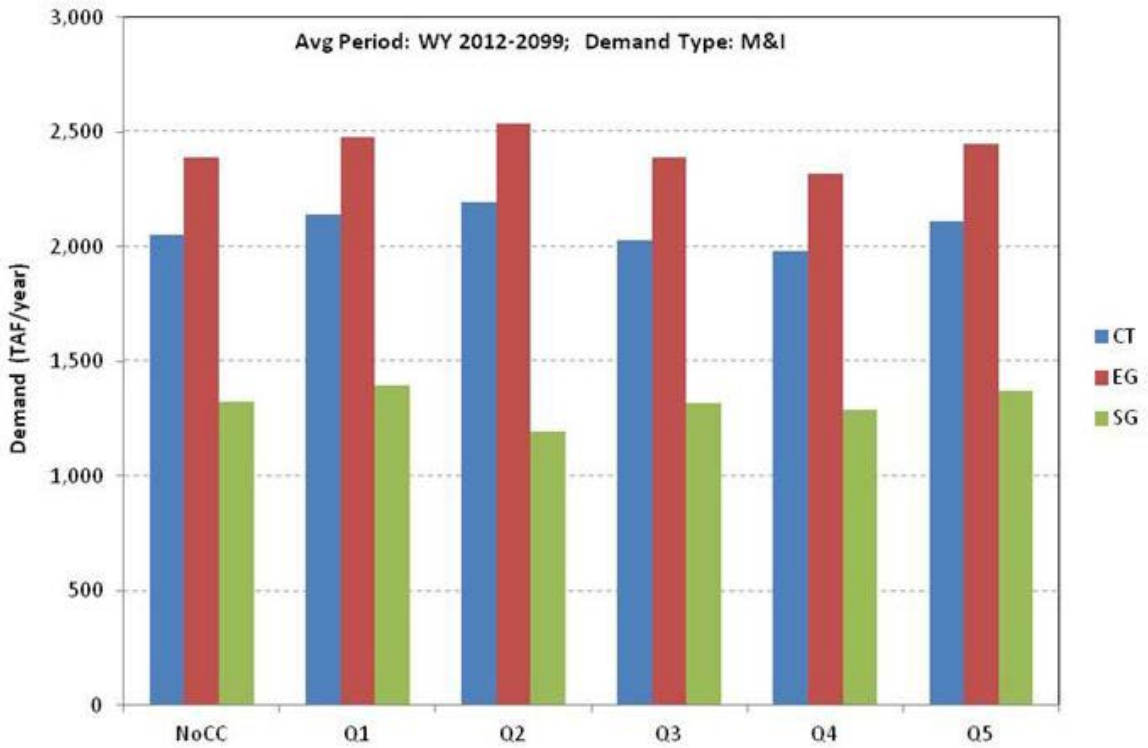
In the San Joaquin River hydrologic region, the average Q5 urban demand change is +4 to +5 percent, ranging from –1 percent to +2 percent in the wetter climate scenarios to +7 percent to +17 percent in the drier climate scenarios.



Key:
Avg = average
M&I = municipal and industrial
NoCC = No Climate Change
CT = Current Trends scenario
EG = Expansive Growth scenario
SG = Slow Growth scenario
TAF = thousand acre-feet
WY = water year

Figure 8-11. Average Annual Urban Applied Water Demand in the San Joaquin River System in each Socioeconomic-Climate Scenario

Trends in the Tulare Lake hydrologic region are similar to those observed in the San Joaquin River hydrologic region. The average Q5 urban demand change is +3 percent to +4 percent, ranging from 0 percent to -3 percent in the wetter Q3 and Q4 climate scenarios and from -10 percent to 7 percent in the drier Q1 and Q2 climate scenarios.



Key:
Avg = average
M&I = municipal and industrial
NoCC = No Climate Change
CT = Current Trends scenario
EG = Expansive Growth scenario
SG = Slow Growth scenario
TAF = thousand acre-feet
WY = water year

Figure 8-12. Average Annual Urban Applied Water Demand in the Tulare Lake Region in each Socioeconomic-Climate Scenario

CVP and SWP System Operations

The following sections summarize projected without-project storage, Delta export and outflow, and Delta salinity associated with the CVP and SWP under the socioeconomic and climate scenarios.

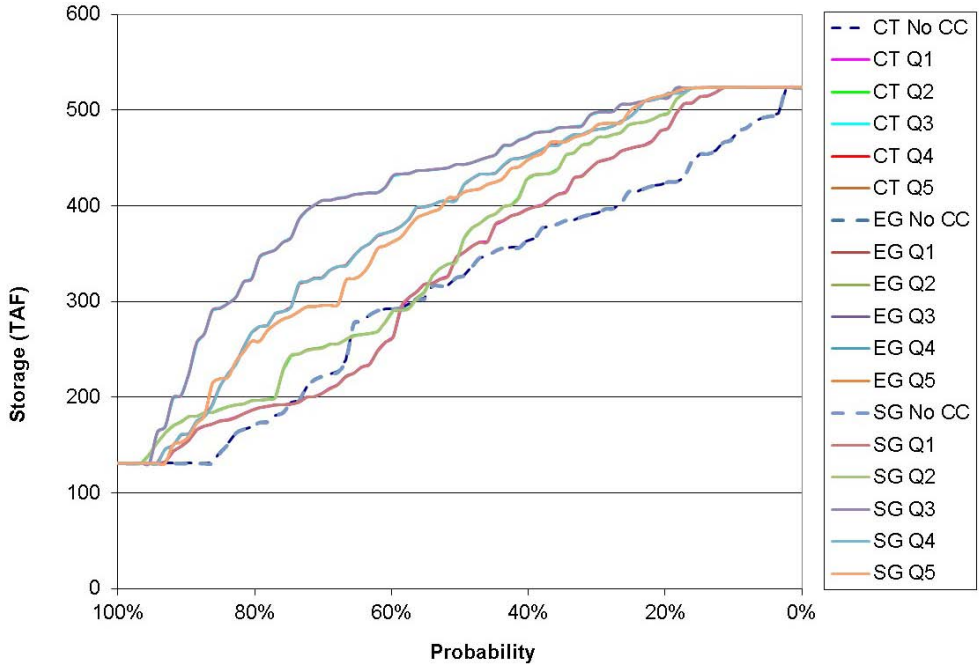
CVP and SWP Project Storage Exceedence plots of the end of May and end of September storages in Millerton Lake under each of the 18 socioeconomic-climate scenarios during the 21st century are presented on Figure 8-13 and Figure 8-14. The end of May storage typically represents the water supply available for meeting agricultural, urban and environmental water demands while end of September storage is an indicator of carryover storage that is reserved to meet demands in subsequent years. A 50 percent probability of exceedence may

be interpreted as the average reservoir storage volume over the entire 21st century period.

The reservoir storage results indicate limited variability between the different socioeconomic scenarios, but significant variability between the different climate scenarios. Reservoir storage is slightly higher under the EG scenario because this scenario reflects the largest decrease over time in agricultural demands (the largest demand type).

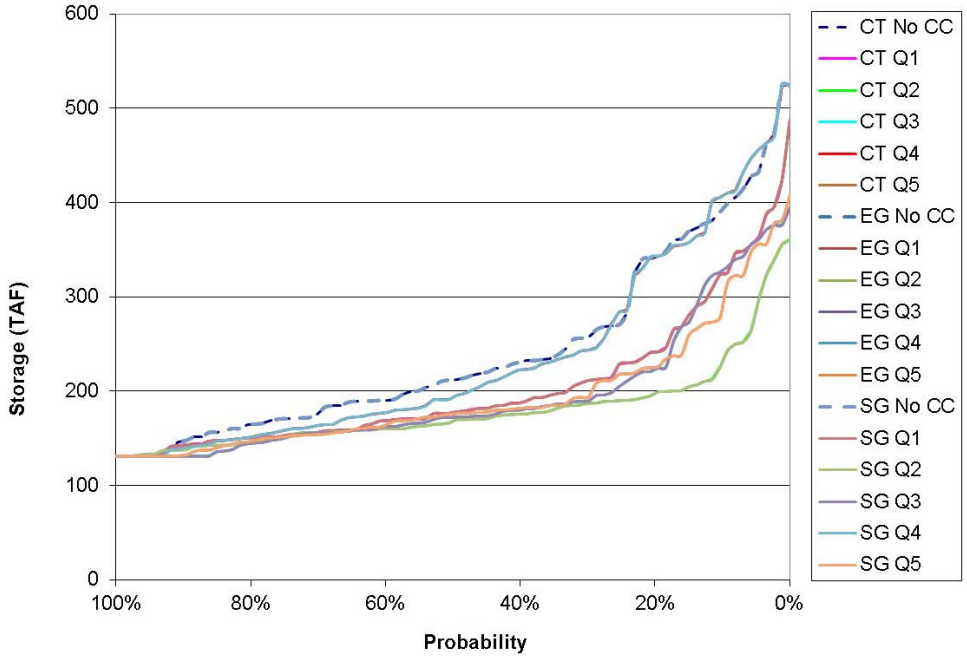
The median climate scenario (Q5) indicates storage levels slightly below the NoCC scenarios. The storage levels in both May and September are higher under the wetter climate scenarios (Q3 and Q4) than under the NoCC scenarios, with the highest storage levels in the wetter, less warming scenario (Q4). Conversely, storage levels in both months are lower under the drier climate scenarios (Q1 and Q2) than under the no climate change scenarios, with the lowest storage levels in the drier, more warming climate scenario (Q2).

The end of May storage in Millerton Lake under climate change scenarios is projected to be typically above the NoCC projections due to the occurrence of increased fall and early winter runoff. However, end of September storage is projected to be typically below the NoCC scenarios, with the lowest storage levels reflecting increased demands associated with the warmer, drier Q2 projections. It is also important to note that Millerton Lake storage volumes do not change with the different socioeconomic scenarios since it is assumed that any storage not directly released from Millerton Lake to meet agricultural demands would be released and used for groundwater recharge in the Friant Division water service area. Further, reservoir operations may be adapted under climate change to maintain greater end of September carryover storage than described here. Similar information on San Luis Reservoir carry-over storage is available in the Climate Change attachment to the Modeling Appendix.



Key:
CT = current trends NoCC = no climate change TAF = thousand acre-feet
EG=Expansive Growth scenario SG = Slow Growth scenario

Figure 8-13. Exceedence of Millerton Lake End-of-May Storage in each Socioeconomic-Climate Scenario



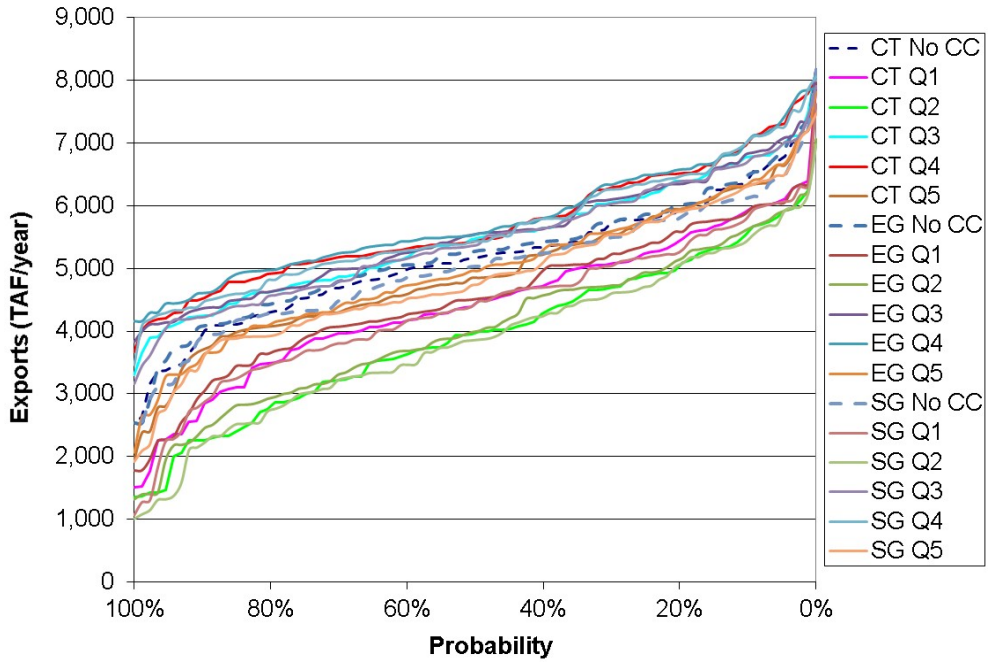
Key:
CT = current trends NoCC = no climate change TAF = thousand acre-feet
EG=Expansive Growth scenario SG = Slow Growth scenario

Figure 8-14. Exceedence of Millerton Lake End-of-September Storage in each Socioeconomic-Climate Scenario

CVP and SWP Delta Exports and Delta Outflow Annual exceedence plots and box plots of total CVP and SWP exports (at Banks Pumping Plant and C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant)) and Delta outflow are presented in Figure 8-15 through Figure 8-18. The box plots depict the mean (red triangle), median (black line), 25th and 75th percentile (gray rectangle), minimum and maximum values (line tip) for the annual flows in each socioeconomic-climate scenario.

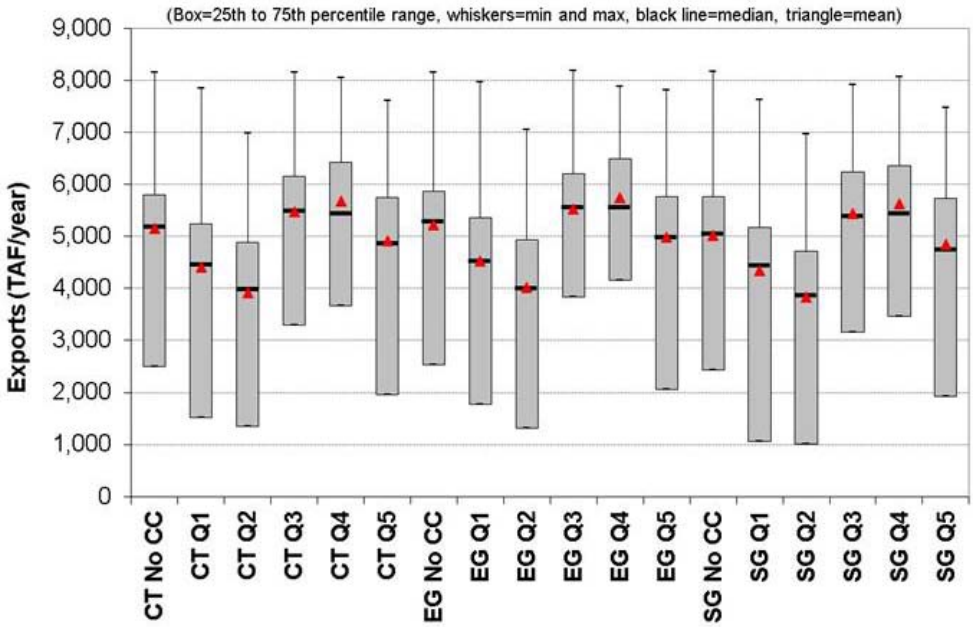
With respect to total exports (both pumping plants), the socioeconomic scenarios exert only small influences on Delta pumping and outflow, whereas the drier climate projections (Q1 and Q2) result in exports below the NoCC simulations. The central tendency projections (Q5) are slightly less than NoCC projections, corresponding to the slightly drier climate predictions in Q5.

Delta exports and outflows are lower under climate scenarios Q5, Q1, and Q2 than under the corresponding NoCC, with the lowest flows occurring in the warmer-drier Q2 scenario. Conversely, annual flows are greater under climate scenarios Q3 and Q4 than corresponding NoCC scenarios, with the highest flows occurring in the less warm-wetter Q4 climate scenario. The drier climate scenarios (Q1 and Q2) show a greater difference in Delta exports relative to corresponding NoCC scenarios than do the wetter climate scenarios (Q3 and Q4) because exports in the wetter climate scenarios are frequently limited by Delta conveyance capacities and Delta regulatory requirements. Total Delta exports are about 0.2 MAF/year and outflows 0.6 MAF/year lower for the central tendency Q5 than NoCC. For the warmer, drier Q2 projection, Delta exports are approximately 1.2 MAF/year lower and outflow is 4.2 to 5.0 MAF/year lower than corresponding NoCC scenarios. Conversely, total exports are about 0.5 MAF/year higher and Delta outflow is ranges from 6.0 to 6.2 MAF/year higher under the wetter Q4 projections than under the NoCC scenarios.



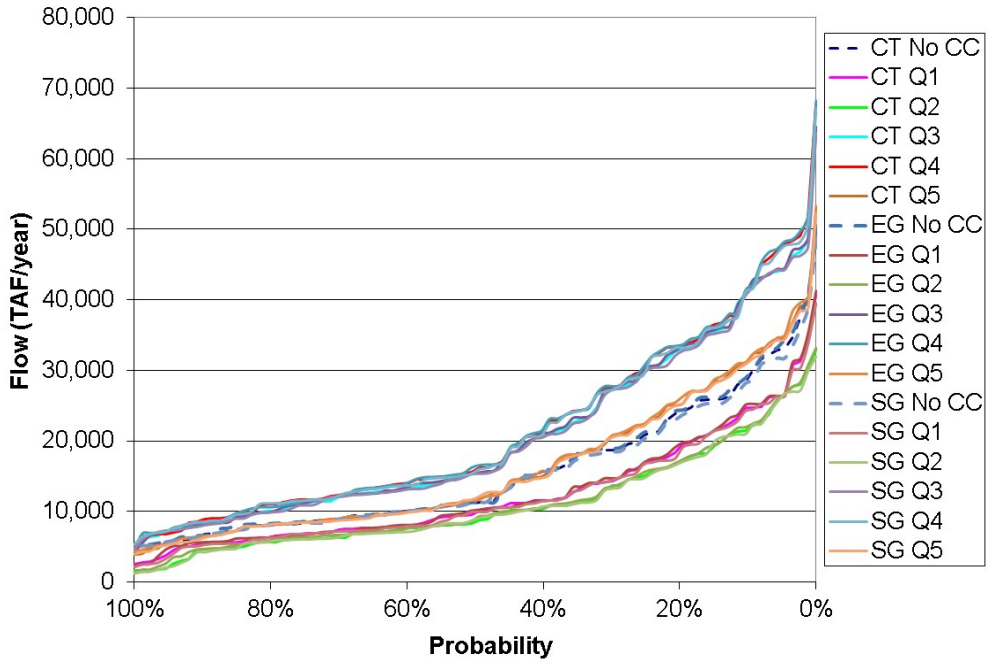
Key:
CT = current trends No CC = no climate change TAF = thousand acre-feet
EG=Expansive Growth scenario SG = Slow Growth scenario

Figure 8-15. Exceedence of Total Annual Delta Export Pumping in each Socioeconomic-Climate Scenario



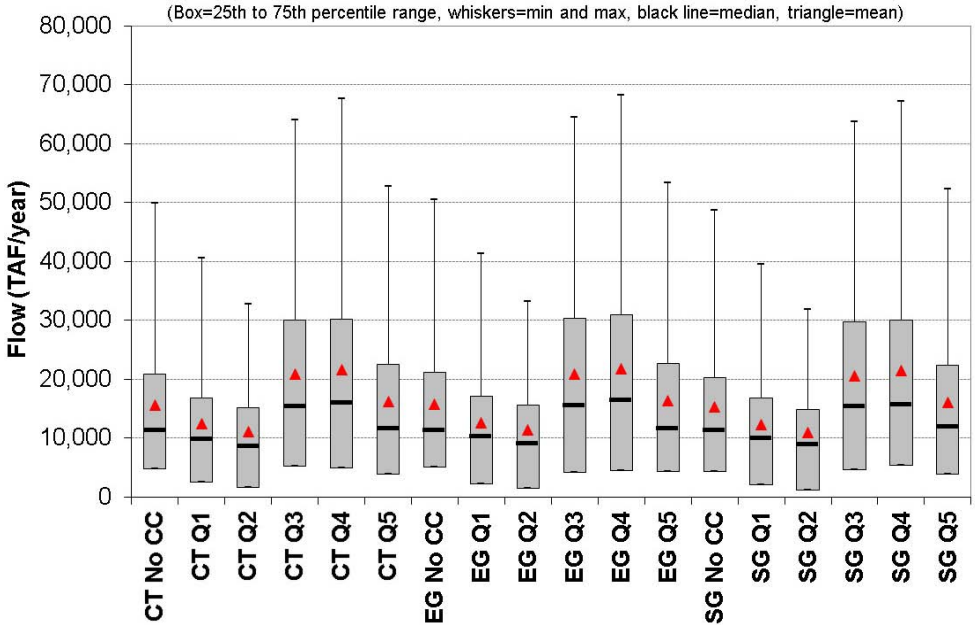
Key:
CT = current trends No CC = no climate change TAF = thousand acre-feet
EG=Expansive Growth scenario SG = Slow Growth scenario

Figure 8-16. Box Plot of Total Annual Delta Export Pumping in each Socioeconomic-Climate Scenario



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

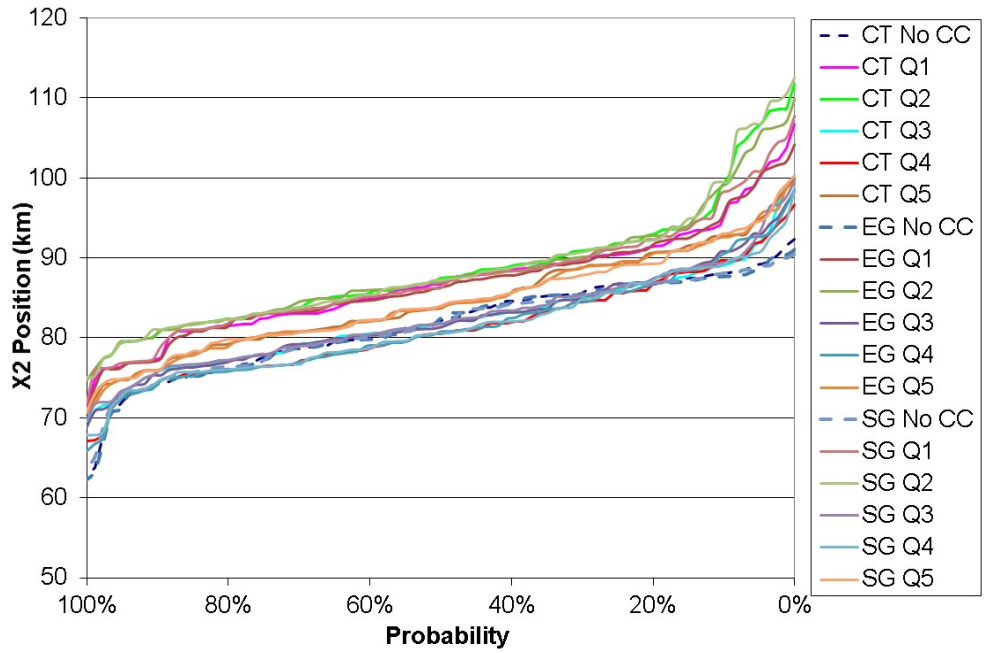
Figure 8-17. Annual Exceedence of Total Annual Delta Outflow in each Socioeconomic-Climate Scenario



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

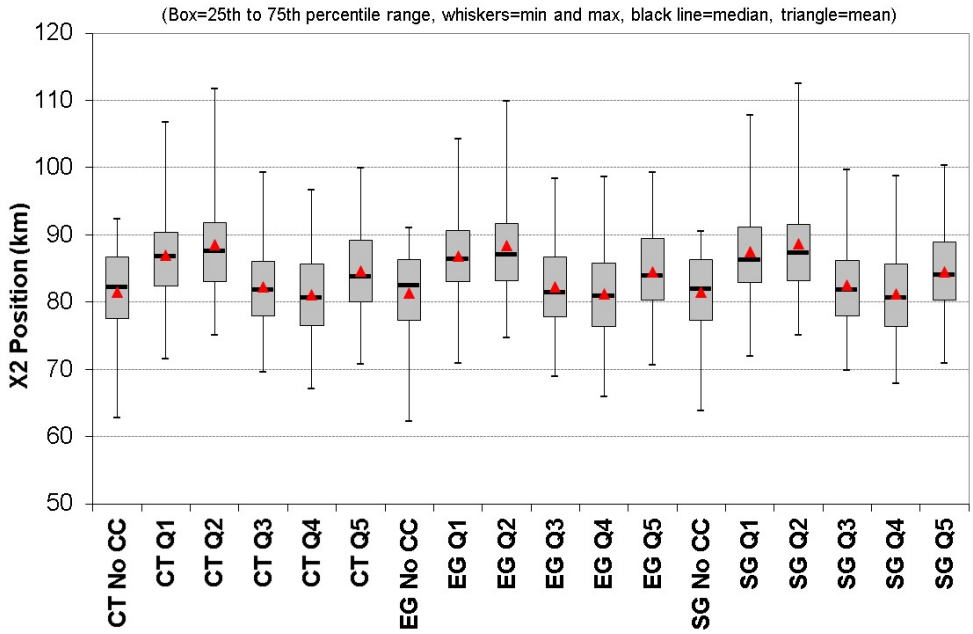
Figure 8-18. Box Plot of Total Annual Delta Outflow in each Socioeconomic-Climate Scenario

Delta Salinity Figure 8-19 and Figure 8-20 show exceedence and box plots, respectively, of the average distance measured from the Golden Gate Bridge of the X2 position (location in the Delta of 2 parts per thousand salinity concentration) from February through June for each socioeconomic-climate scenario. Greater X2 positions indicate that salinity has moved farther eastward into the Delta. During the period from February through June, CVP and SWP reservoirs are operated to maintain the location of X2 within the Delta to meet certain regulatory requirements. As shown, the X2 results are very similar between the different socioeconomic scenarios but differ significantly relative to the different climate scenarios.



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-19. Exceedence of Average February-to-June X2 Position in Each Socioeconomic-Climate Scenario



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-20. Box Plot of Average February-to-June X2 Position in each Socioeconomic-Climate Scenario

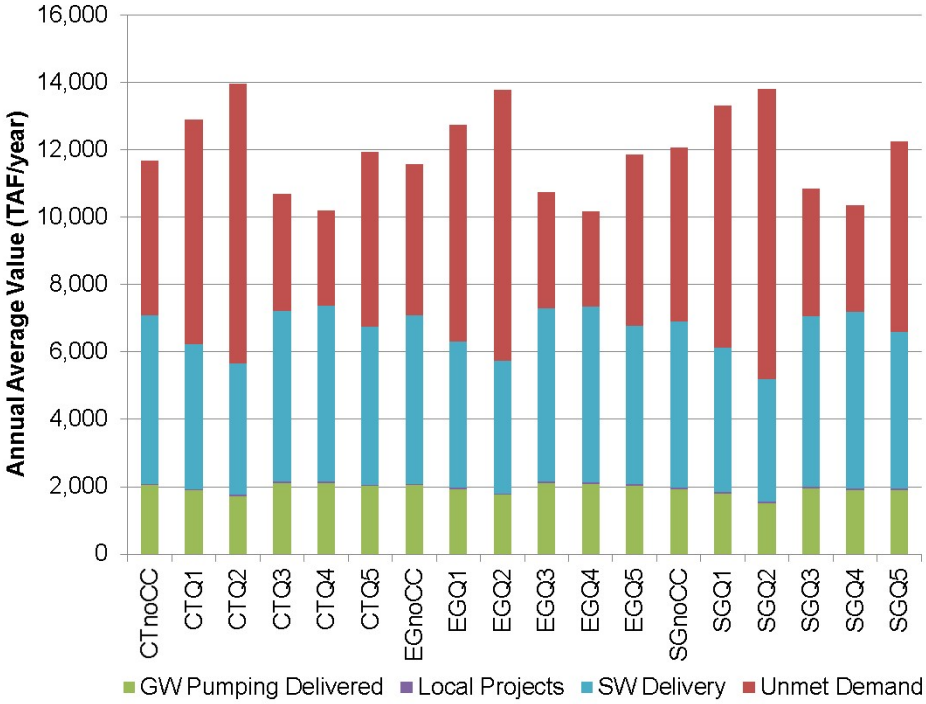
The X2 position results under the wetter climate scenarios (Q3 and Q4) are similar to corresponding NoCC scenarios because the increased flows into the Delta in those wetter scenarios compensate for increased sea level rise. The average X2 distance in the wetter Q4 scenario is about 0.4 km farther to the east than without climate change. However, the X2 location is greater under the central tendency Q5 scenario than the NoCC scenario by approximately 3 km eastward. The largest changes occur under the warmer-drier Q2 climate scenario in which the average X2 distance from February through June is about 7 km farther east with respect to the NoCC scenarios.

Supplies and Demands in CVP Divisions

Figure 8-21 shows the average annual total CVP water service area supplies from various sources during the 21st century, including surface water, groundwater, and local supply projects. Also shown on Figure 8-21 is the average annual unmet demand (defined as total demands minus surface water deliveries, groundwater pumping, and the effects of any local supply enhancement actions) for the CVP water service area. In

general, changes in climate have a greater influence on supplies and demands than changes in socioeconomics. In all scenarios, local supplies are relatively small compared with other supplies.

Over the 21st century, the average projected unmet demands in the CVP service area range from 2.8 to 8.6 MAF/year. The central tendency Q5 unmet demands are approximately 0.6 MAF/year greater than corresponding NoCC scenarios. The largest unmet demands occur in the warmer-drier Q2 climate scenarios and range from increases of 3.4 to 3.7 MAF/year, while the largest unmet demand decreases occur in the less warming-wetter Q4 climate scenarios and range from 1.6 to 1.9 MAF/year.



Key:
CT = Current Trends scenario
EG=Expansive Growth scenario
GW = groundwater
NoCC = no climate change
SG = Slow Growth scenario
SW = surface water
TAF = thousand acre-feet

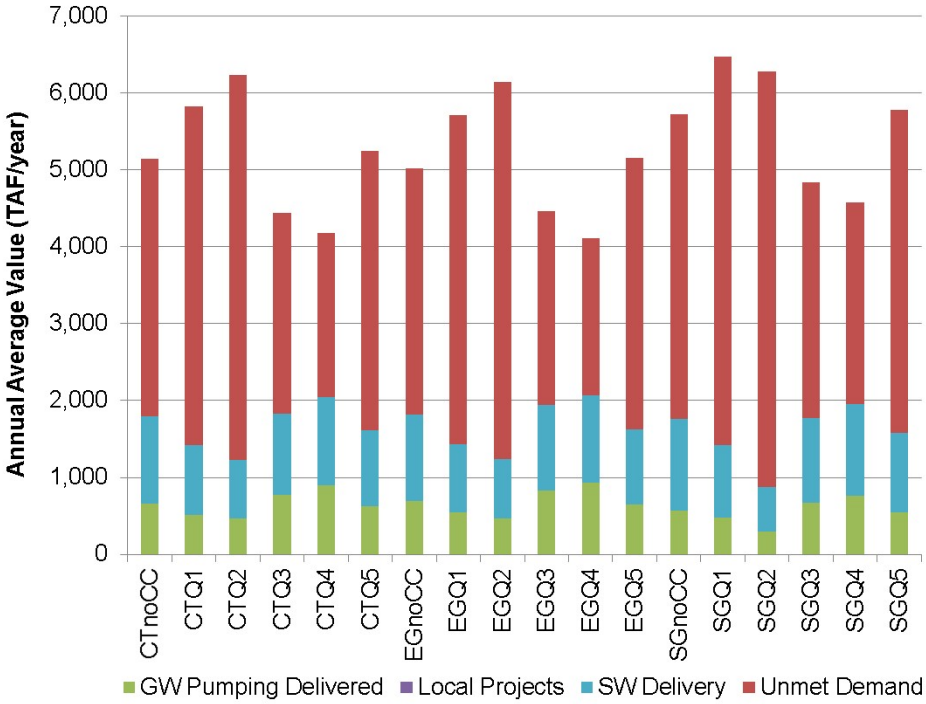
Figure 8-21. Average Annual Supplies and Unmet Demand in the CVP Water Service Area in Each Socioeconomic-Climate Scenario

Average annual surface water deliveries in the CVP water service area range from a minimum of 3.7 to a maximum of 5.1

MAF/year. The central tendency Q5 surface water deliveries are approximately 0.3 MAF/year less than corresponding NoCC scenarios. Surface water deliveries decrease in the warmer-drier Q2 climate scenarios (from 1.0 to 1.3 MAF/year less than the corresponding NoCC scenarios), while surface water deliveries increase in the less warming-wetter Q4 climate scenarios (from 0.2 to 0.3 MAF/year greater than the corresponding NoCC scenarios).

Average groundwater pumping in the CVP water service area ranges from 1.5 to 2.1 MAF/year. The greatest groundwater pumping occurs in the wetter Q3 and Q4 climate scenarios; this is because aquifer recharge is greater under the wetter climate scenarios, resulting in higher groundwater levels and less constraints on pumping relative to the drier Q1 and Q2 climate scenarios. Groundwater pumping in the central tendency Q5 is approximately 0.03 MAF/year less than NoCC scenarios. Groundwater pumping in the warmer-drier Q2 climate scenarios ranges from 0.3 to 0.4 MAF/year less than NoCC scenarios, while pumping in the less warming-wetter Q4 climate scenarios ranges from a slight increase of 0.04 MAF/year to a slight decrease 0.02 MAF/year compared to NoCC scenarios.

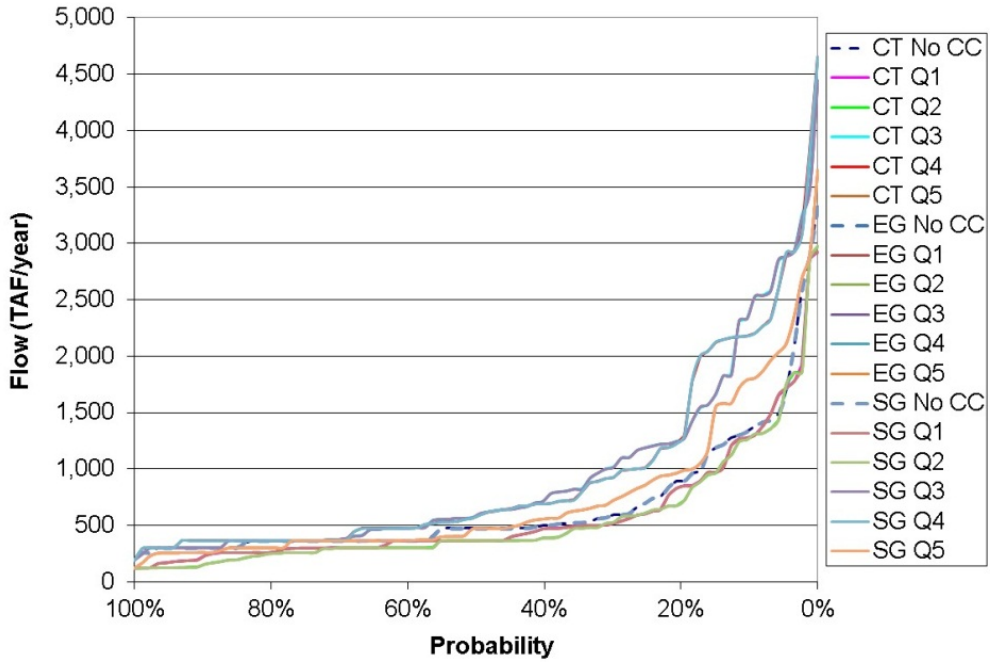
Figure 8-22 presents similar supply and demand information for the Friant Division of the CVP. The overall 21st century projected average annual unmet demands were 3,680 TAF/year, with a range from 2,040 to 5,400 TAF/year across all socioeconomic-climate scenarios. During this period, average annual surface water deliveries were 995 TAF/year, with a range from 590 to 1,190 TAF/year. Groundwater pumping averaged 630 TAF/year, with a range from 300 to 930 TAF/year.



Key:
CT = Current Trends scenario
EG=Expansive Growth scenario
GW = groundwater
NoCC = no climate change
SG = Slow Growth scenario
SW = surface water
TAF = thousand acre-feet

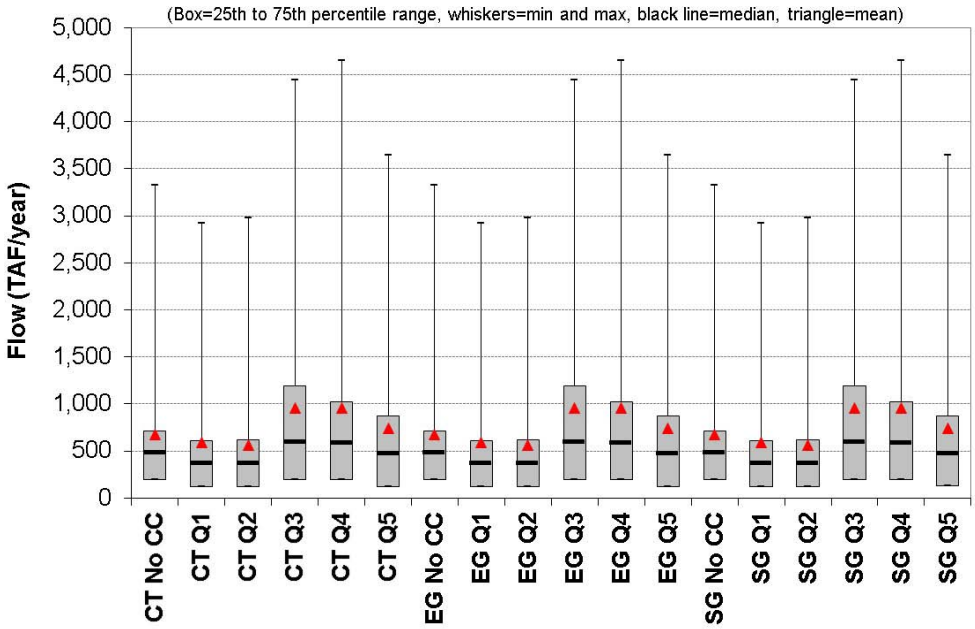
Figure 8-22. Average Annual Supplies and Unmet Demand in the Friant Division of the CVP in Each Socioeconomic-Climate Scenario

Figures 8-23 through 8-28 present additional exceedence and box plots showing the effects of potential climate changes on supplies and deliveries in the Friant Division of the CVP. Over all scenarios, 21st century average annual Friant Dam releases to the San Joaquin River range from 560 to 960 TAF/year. The central tendency Q5 releases are approximately 70 TAF/year greater than NoCC scenarios. Friant Dam releases in the warmer-drier Q2 climate scenarios decrease by about 100 TAF/year relative to NoCC scenarios, while releases in the less warming-wetter Q4 climate projections increase by about 285 TAF/year.



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

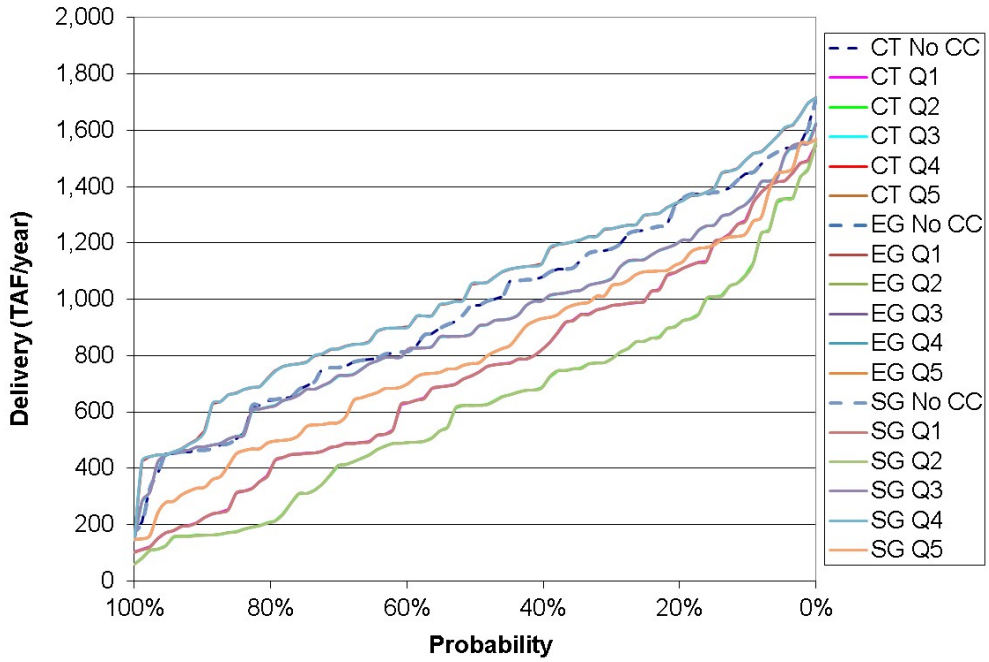
Figure 8-23. Annual Exceedence of Friant Dam Releases to San Joaquin River in Each Socioeconomic-Climate Scenario



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

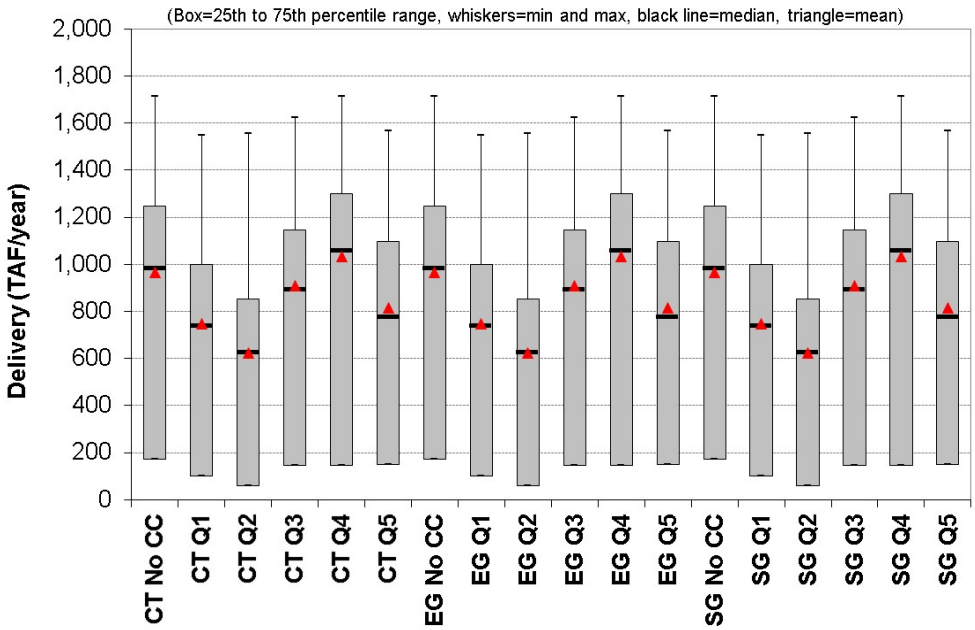
Figure 8-24. Box Plot of Friant Dam Releases to San Joaquin River in Each Socioeconomic-Climate Scenario

Across the scenarios shown in Figure 8-25 and Figure 8-26, mean annual Friant-Kern Canal deliveries range from approximately 600 TAF/year to 1 MAF/year. The central tendency Q5 Friant-Kern Canal deliveries are approximately 150 TAF/year less than NoCC. Friant-Kern Canal deliveries in the warmer-drier Q2 climate scenarios are approximately 340 TAF/year less than NoCC, while deliveries in the less warming-wetter Q4 climate projections increase by approximately 70 TAF/year.



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

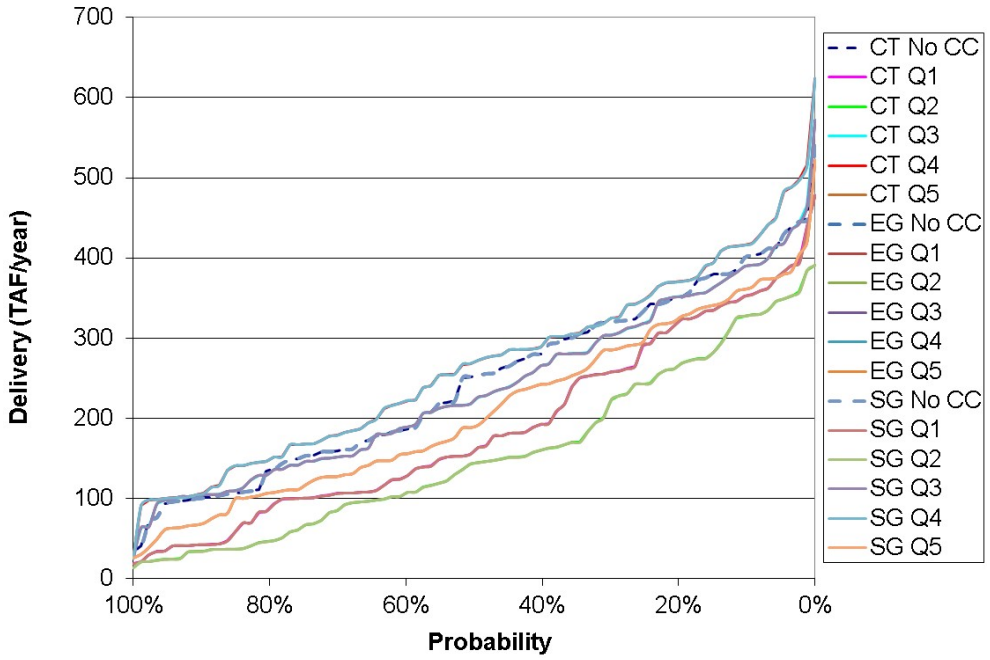
Figure 8-25. Annual Exceedence of Friant-Kern Canal Deliveries in Each Socioeconomic-Climate Scenario



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

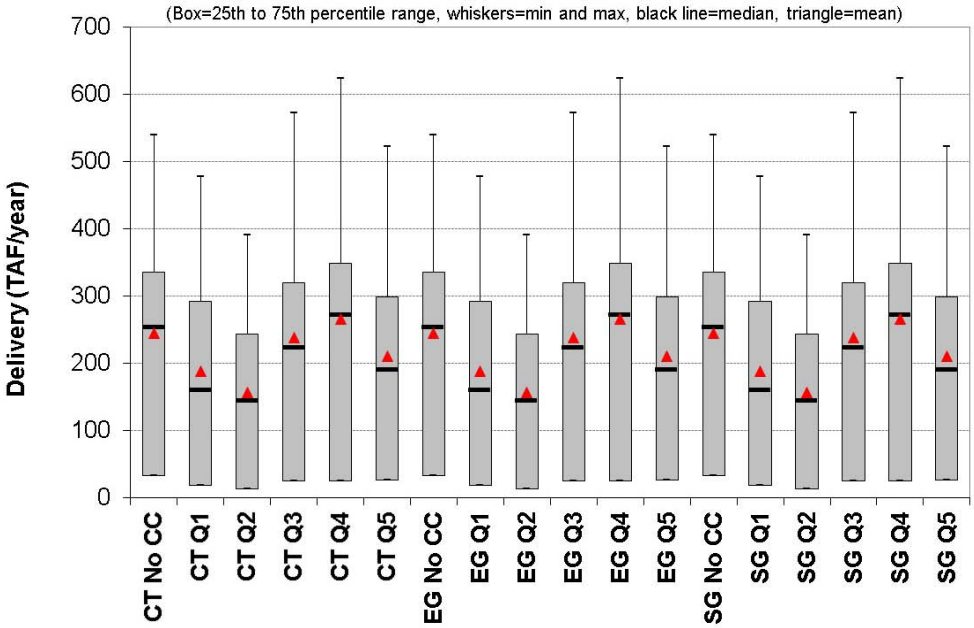
Figure 8-26. Box Plot of Friant-Kern Canal Deliveries in Each Socioeconomic-Climate Scenario

As shown in Figure 8-27 and Figure 8-28, mean annual Madera Canal deliveries over the 21st century range from approximately 190 TAF/year to 260 TAF/year. The central tendency Q5 Madera Canal deliveries are approximately 35 TAF/year less than NoCC. Friant-Kern Canal deliveries in the warmer-drier Q2 socioeconomic-climate scenarios are approximately 90 TAF/year less than NoCC, while deliveries in the less warming-wetter Q4 climate projections are approximately 20 TAF/year greater.



Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-27. Annual Exceedence of Madera Canal Deliveries in Each Socioeconomic-Climate Scenario

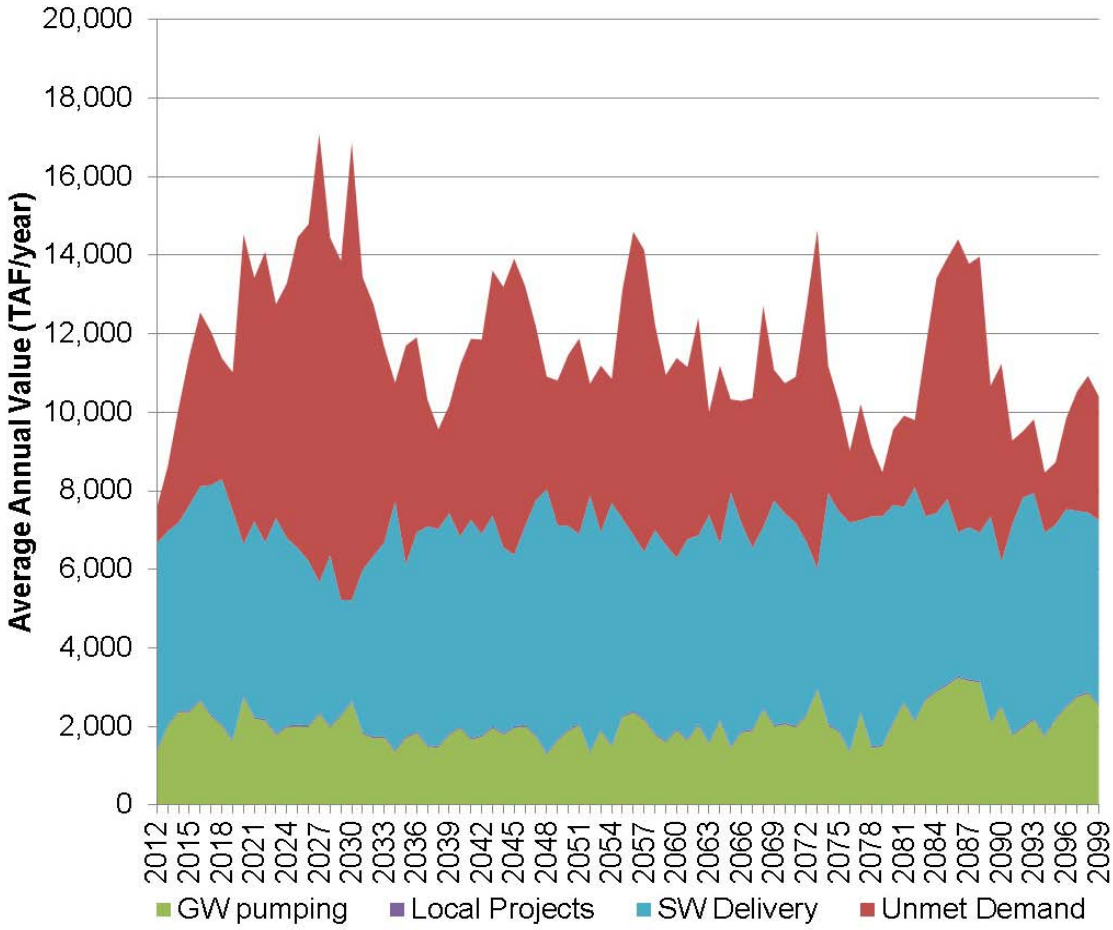


Key:
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-28. Box Plot of Madera Canal Deliveries in Each Socioeconomic-Climate Scenario

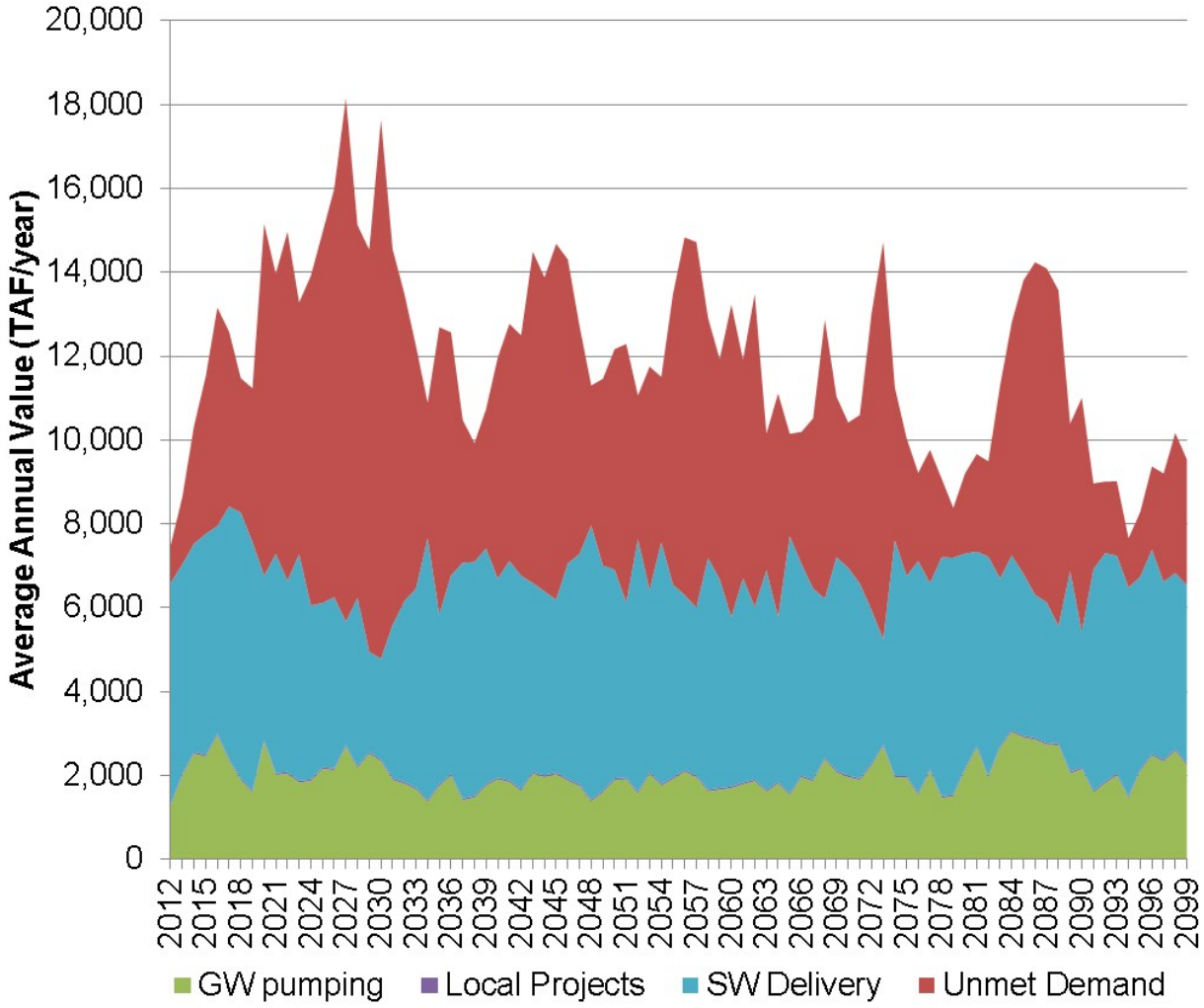
Figure 8-29 through Figure 8-32 present annual time series of groundwater, surface water, and local project supplies and unmet demands for the entire CVP water service area. The projected socioeconomic-climate scenarios analyzed under Baseline conditions include the current trends–median climate scenario (CT-Q5) to represent a midrange projection of socioeconomic-climate effects; expansive growth-warmer-drier scenario (EG-Q2) to represent the upper range of socioeconomic-climate effects; and slow growth-less warming-wetter scenario (SG-Q4) to represent the lower range of socioeconomic-climate effects.

The CT-NoCC time series, shown in Figure 8-29, is presented for comparison with other future climate projections using the same current trends socioeconomic scenario.



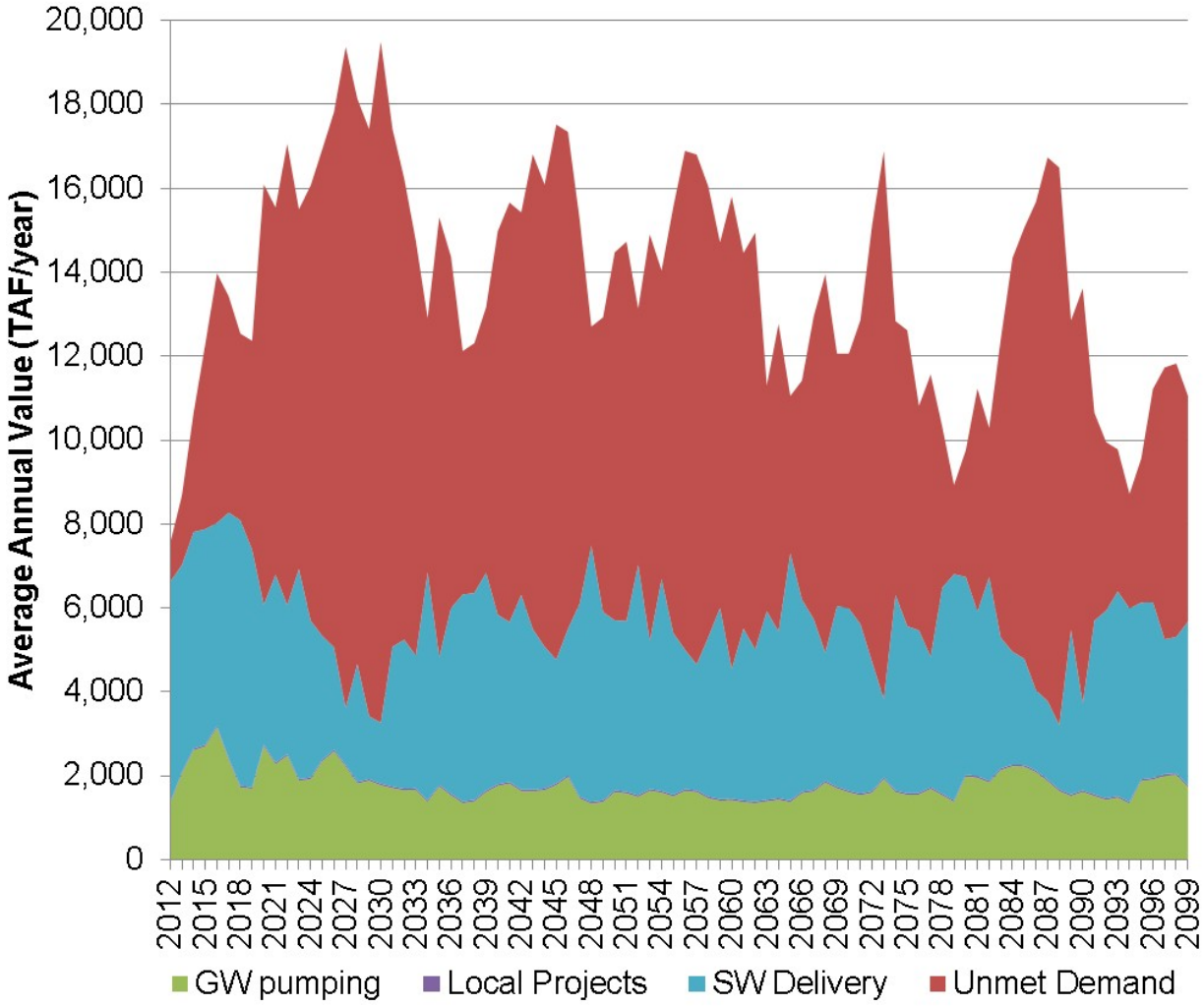
Key:
GW = groundwater
SW = surface water
TAF = thousand acre-feet

Figure 8-29. Annual Time Series of Supplies and Unmet Demands in CVP Water Service Area, CT–NoCC Socioeconomic-Climate Scenario



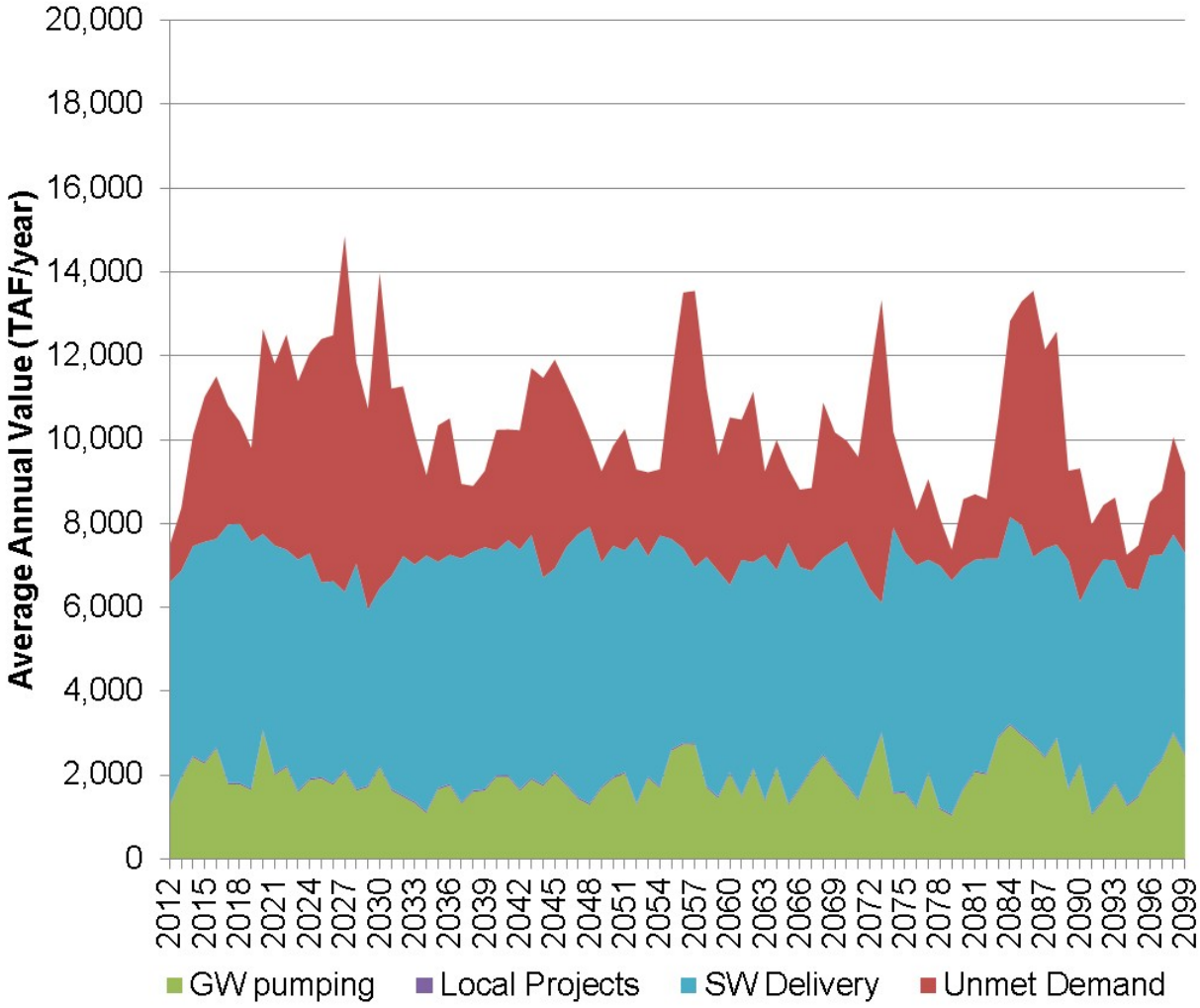
Key:
GW = groundwater
SW = surface water
TAF = thousand acre-feet

Figure 8-30. Annual Time Series of Supplies and Unmet Demands in CVP Water Service Area, CT–Q5 Socioeconomic-Climate Scenario



Key:
GW = groundwater
SW = surface water
TAF = thousand acre-feet

Figure 8-31. Annual Time Series of Supplies and Unmet Demands in CVP Water Service Area, EG–Q2 Socioeconomic-Climate Scenario



Key:
GW = groundwater
SW = surface water
TAF = thousand acre-feet

Figure 8-32. Annual Time Series of Supplies and Unmet Demands in CVP Water Service Area, SG–Q4 Socioeconomic-Climate Scenario

Over the 21st century, total supplies in the current trends–median climate projection (CT-Q5) range from a minimum of 4.8 to a maximum of 8.4 MAF/year, while unmet demands range from a minimum of 0.9 to a maximum of 12.8 MAF/year. For the expansive growth-warmer-drier scenario (EG-Q2), total supplies range from a minimum of 3.2 to a maximum of 8.3 MAF/year, while unmet demands range from a minimum of 0.9 to a maximum of 16.2 MAF/year. In the slow growth-less warming-wetter scenario (SG- Q4), total supplies range from a minimum of 5.9 to a maximum of 8.2

MAF/year, while unmet demands range from a minimum of 0.7 to a maximum of 8.4 MAF/year.

Results of Other Performance Assessment Tools

The following sections describe the results of other performance assessment tools for the Baseline condition. The projected socioeconomic-climate scenarios analyzed under Baseline conditions include the current trends–median climate scenario (CT-Q5) to represent a midrange projection of socioeconomic-climate effects; expansive growth-warmer-drier scenario (EG-Q2) to represent the upper range of socioeconomic-climate effects; and slow growth-less warming-wetter scenario (SG-Q4) to represent the lower range of socioeconomic-climate effects.

Because of the sensitivity of economic and temperature models to climate inputs, additional socioeconomic scenarios without climate change were simulated to better understand the effects of climate change on the results. Results of these simulations are described below, with further detail provided in the Climate Change attachment to the Modeling Appendix.

Economics The results from four economically based water management models are presented in this section:

- Least Cost Planning Simulation Model (LCPSIM) provides economic results for the South San Francisco Bay-South Region, used to represent California urban areas outside the Central Valley.

- Other Municipal Water Economics Model (OMWEM) provides economic results for urban regions in Central Valley.

- South Bay Water Quality Model (SBWQM) estimates salinity costs for deliveries to the South San Francisco Bay Region, used to represent California urban areas outside of the Central Valley.

- Statewide Agricultural Production Model (SWAP) provides economic results for agricultural regions in the Central Valley.

These economic models analyze differences between two scenarios rather than the absolute values of a single scenario; consequently, results are summarized in terms of differences in average annual net benefit between the different

socioeconomic-climate scenarios described above. In addition, results are presented at three future levels of development (LOD) representing early (2025), mid (2050) and late (2085) 21st century socioeconomic and climate conditions. This approach allows for a clearer understanding of how socioeconomic and climate changes affect net economic benefits in the CVP service area over different timeframes during the 21st century.

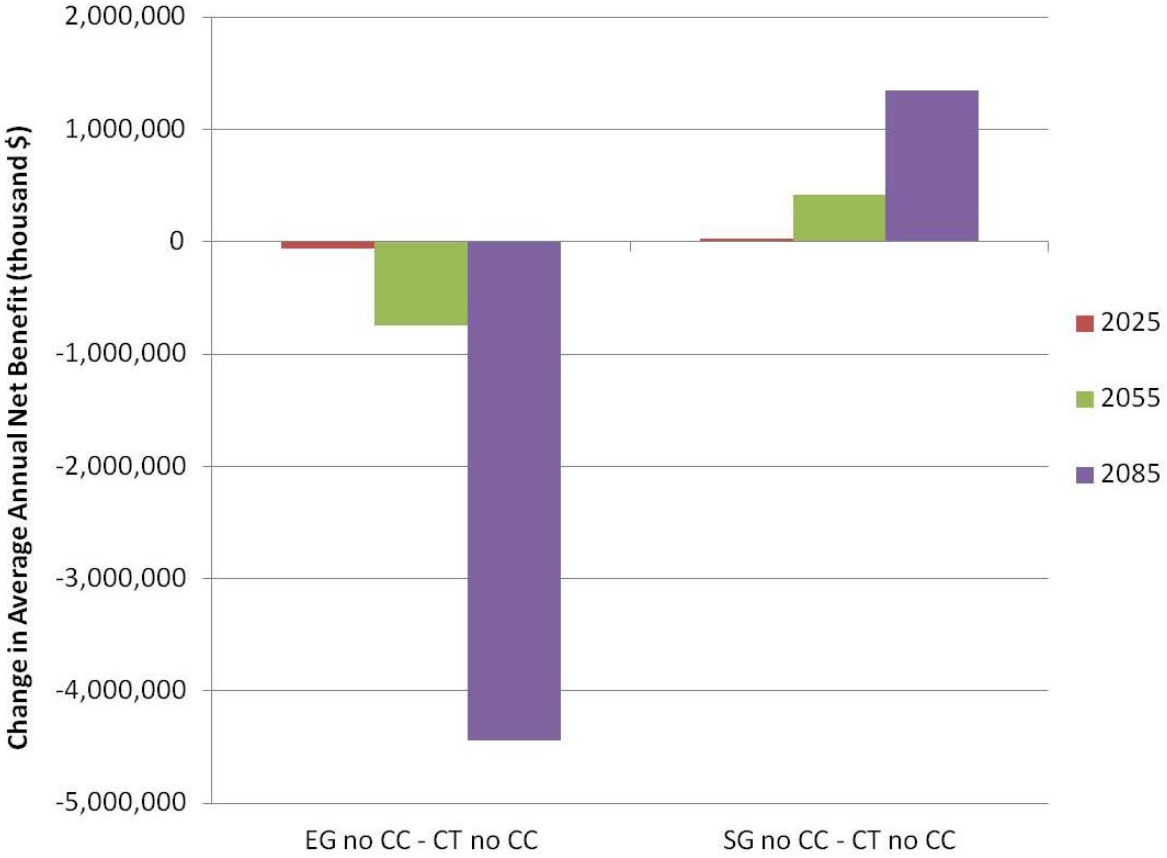
The following discussion presents the results in two steps:

1. Comparisons of the three socioeconomic scenarios without climate change, to understand the effect of socioeconomic changes

2. Comparisons of CT-Q5, EG-Q2, and SG-Q4 socioeconomic-climate scenarios with the corresponding NoCC scenario, to understand the effects of climate changes

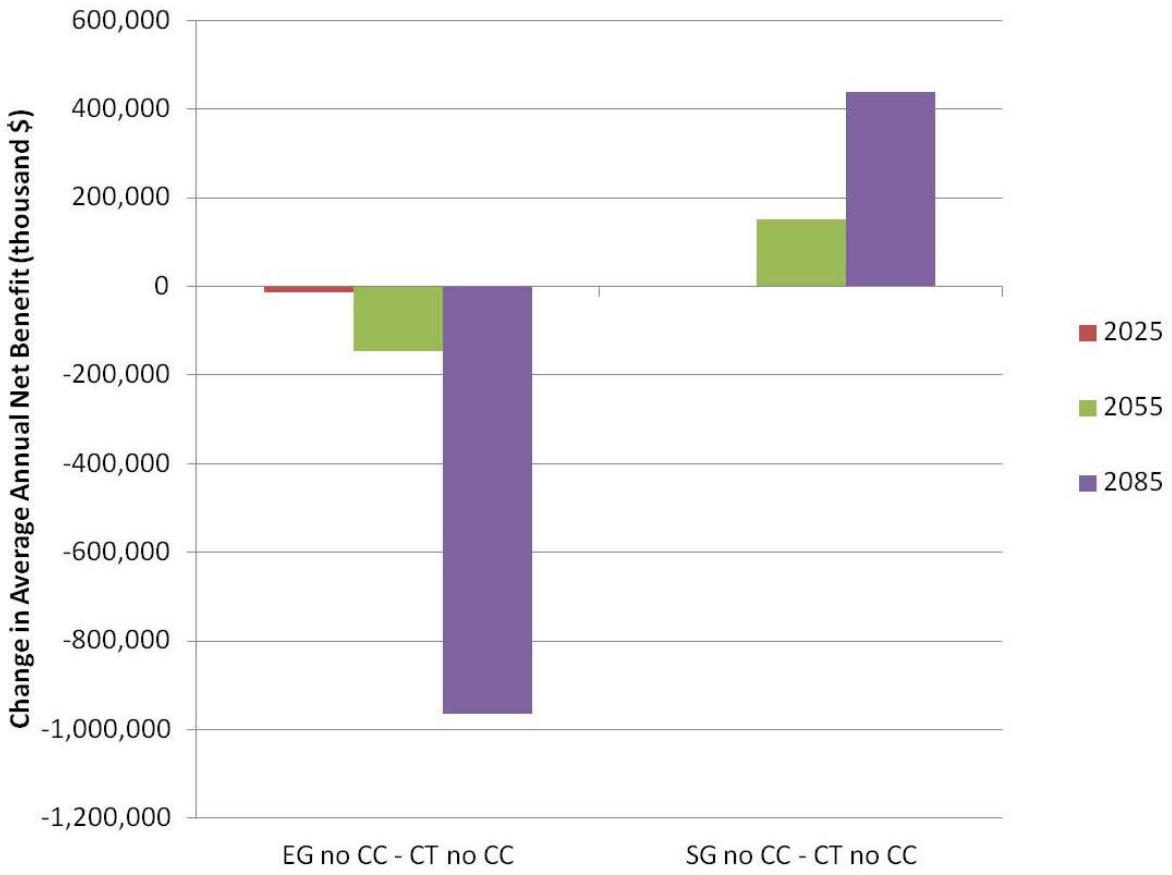
Figure 8-33 through Figure 8-35 show the changes in net water supply system costs in LCPSIM and OMWEM and in net revenue in SWAP for the EG and SG scenarios relative to the CT, at the 3 LODs. The SBWQM is not capable of producing comparisons between simulations at different socioeconomic conditions and is therefore not included in this comparison. A brief discussion of these models is included herein, with further documentation available in Reclamation 2013.

All three models indicate significantly less net water supply system costs and significantly more net revenue in the slow growth scenario than in the current trends scenario, and significantly more net water supply system costs and significantly less net revenue in the expansive growth scenario than in the current trends scenario. Furthermore, these differences increase over the course of the 21st century. The primary factors accounting for these differences are changes in population and corresponding agricultural- to-urban land use conversion. The expansive growth scenario represents the greatest increase in population and land conversion, reflected in higher water supply system costs in the urban models and the lowest net revenue in the agricultural model as compared to the current trends scenario. Conversely, the slow growth scenario has the lowest increase in population and the smallest conversion of agricultural land to urban, which results in lower water supply system costs in the urban models and greater net revenue in the agricultural model relative to current trends.



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

Figure 8-33. Change in Average Annual Net Benefit in South San Francisco Bay Region from LCPSIM



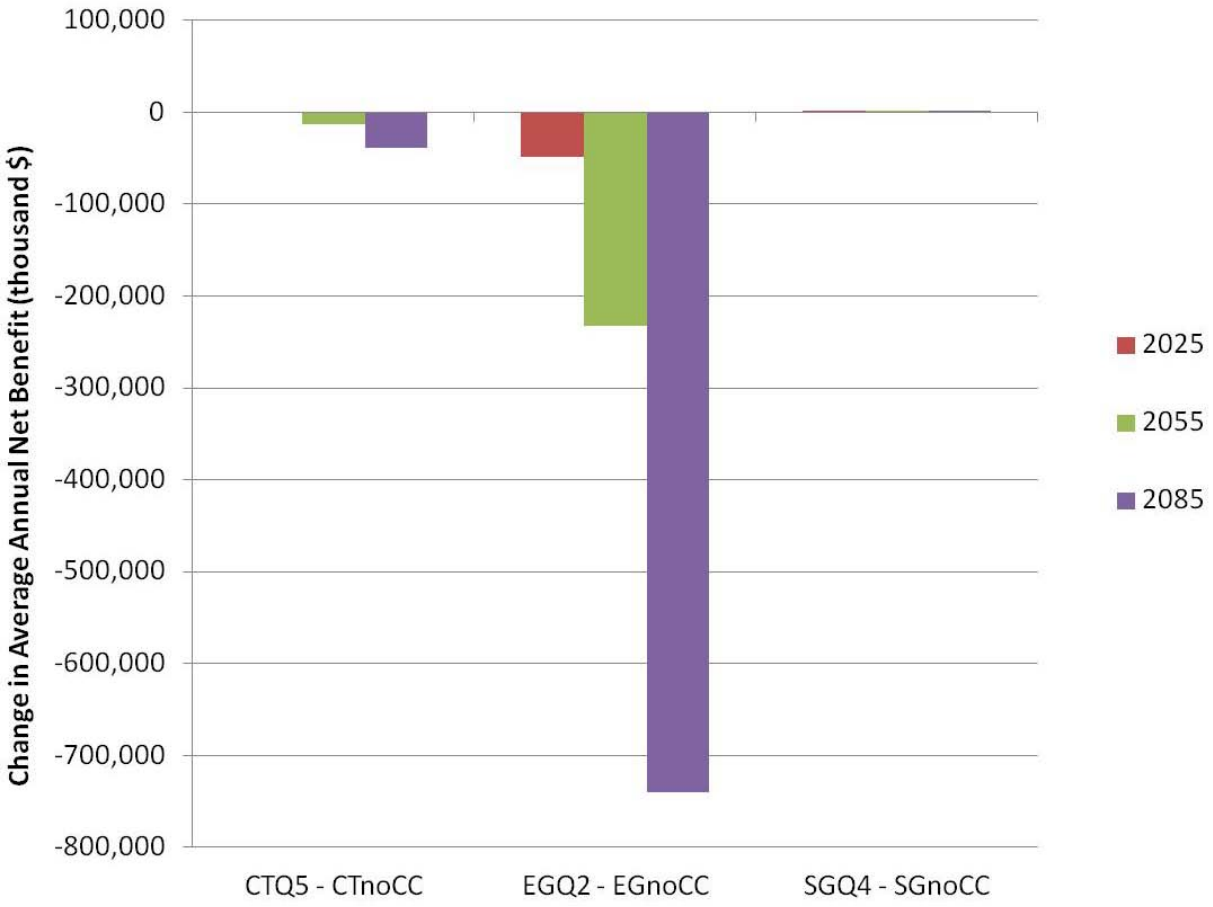
Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

Figure 8-34. Change in Average Annual Net Benefit in Central Valley Urban Areas from OMWEM

Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

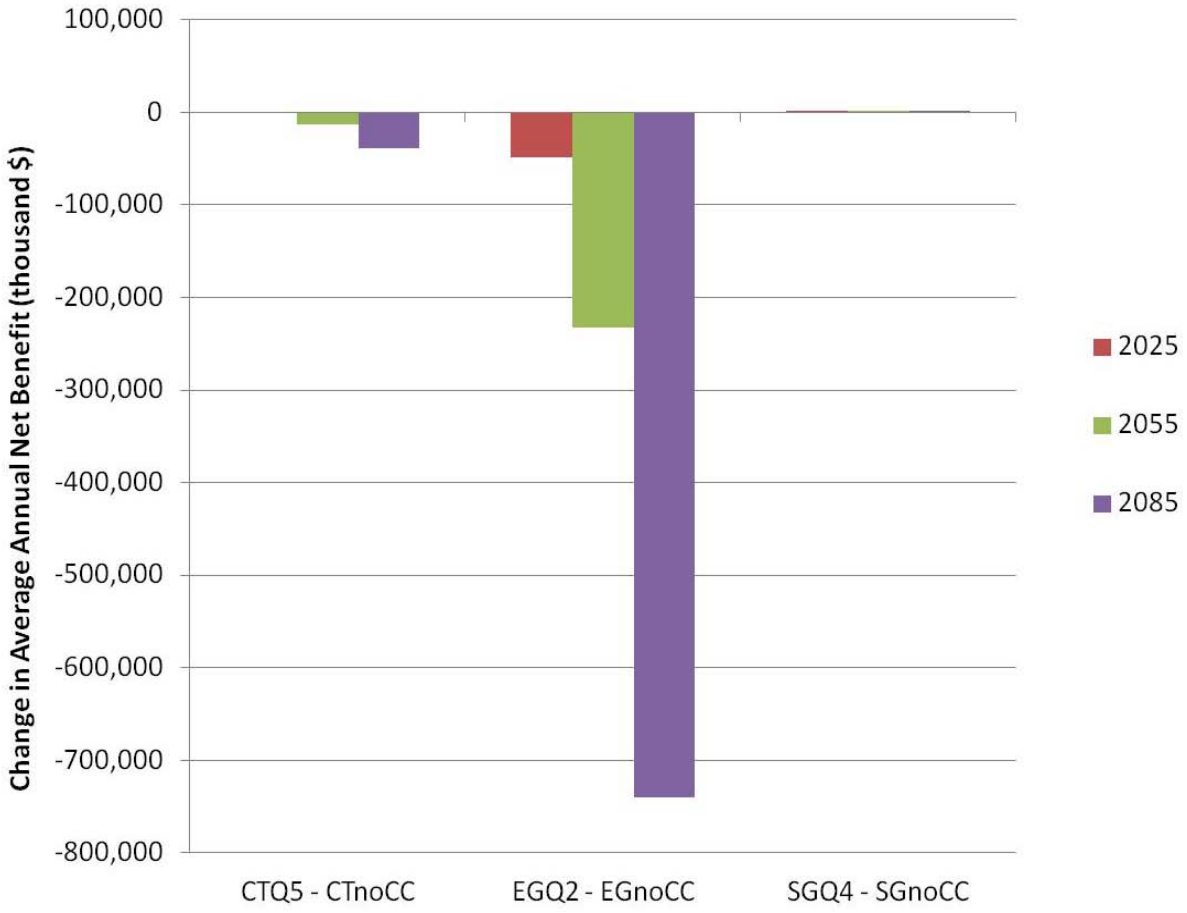
Figure 8-35. Change in Average Annual Net Benefit in Central Valley Agricultural Areas from SWAP

To evaluate the effects of changes in climate on net economic benefits independent of socioeconomics, simulations of all three climate scenarios were compared with corresponding NoCC socioeconomic scenarios. Figures 8-36 through 8-39 show the changes in net economic benefits for scenarios CT-Q5 relative to CT-NoCC, EG-Q2 relative to EG-NoCC, and SG-Q4 relative to SG-NoCC, at the 3 LODs. In general, net economic benefits decrease for scenarios in which Delta salinity increases (reducing Delta exports), and increase for scenarios in which Central Valley deliveries increased and/or agricultural production increased (due to increasing CO_2, for example).



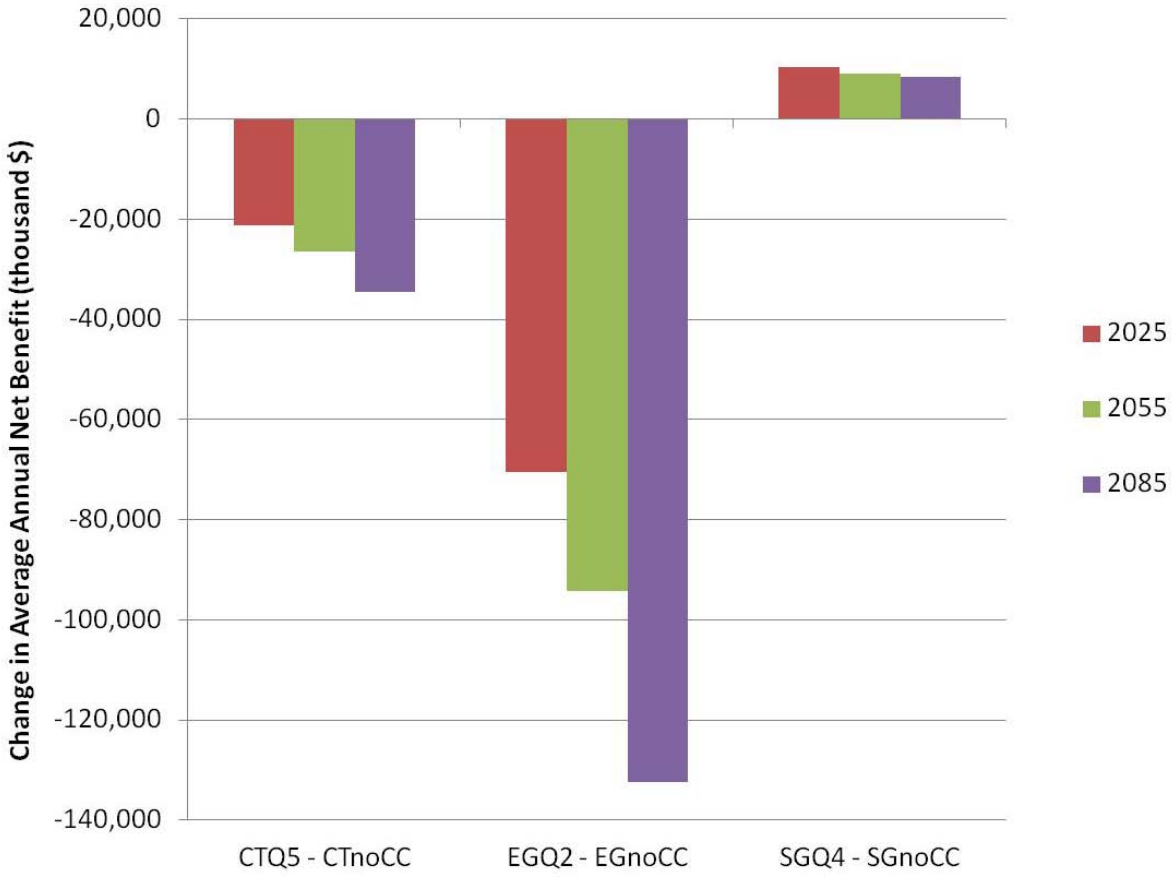
Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

Figure 8-36. Change in Average Annual Net Benefit in South San Francisco Bay Region from LCPSIM



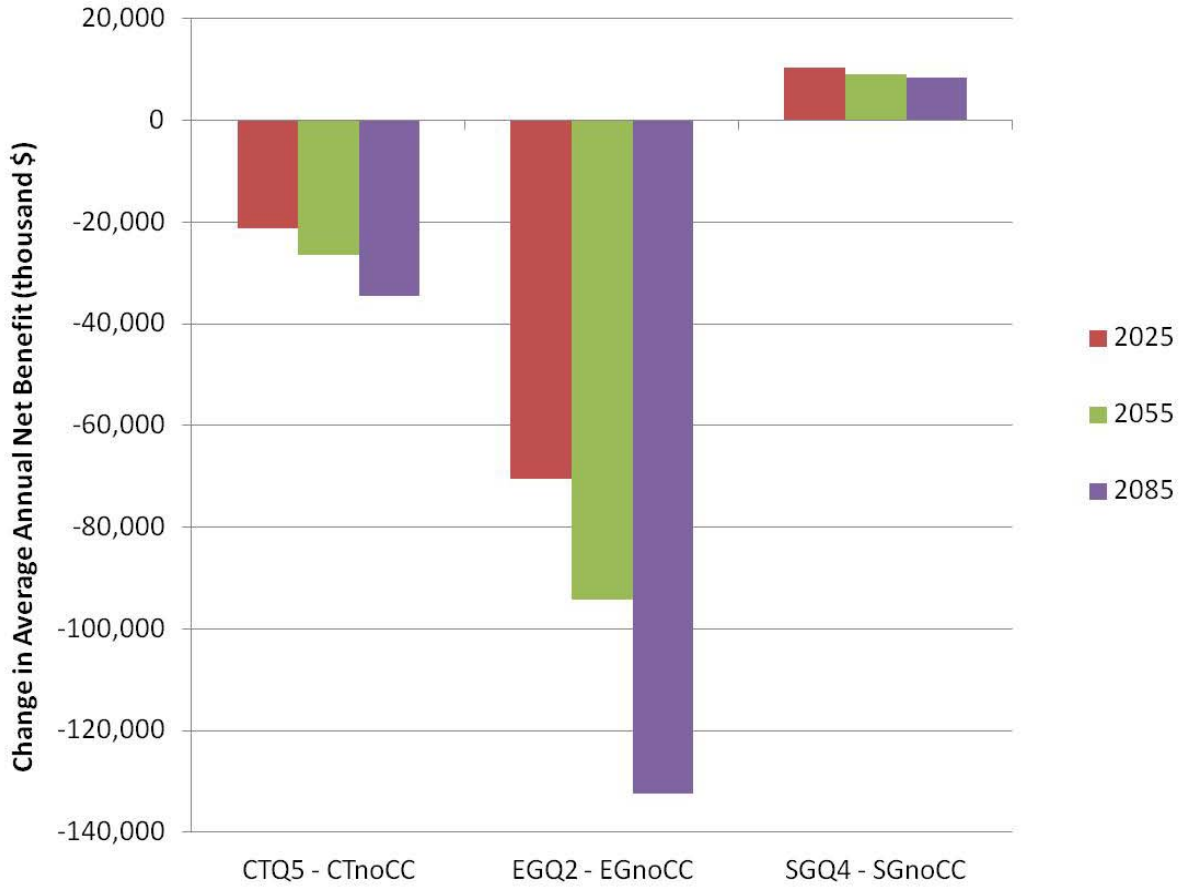
Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

Figure 8-37. Change in Average Annual Net Benefit in Central Valley Urban Areas from OMWEM



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

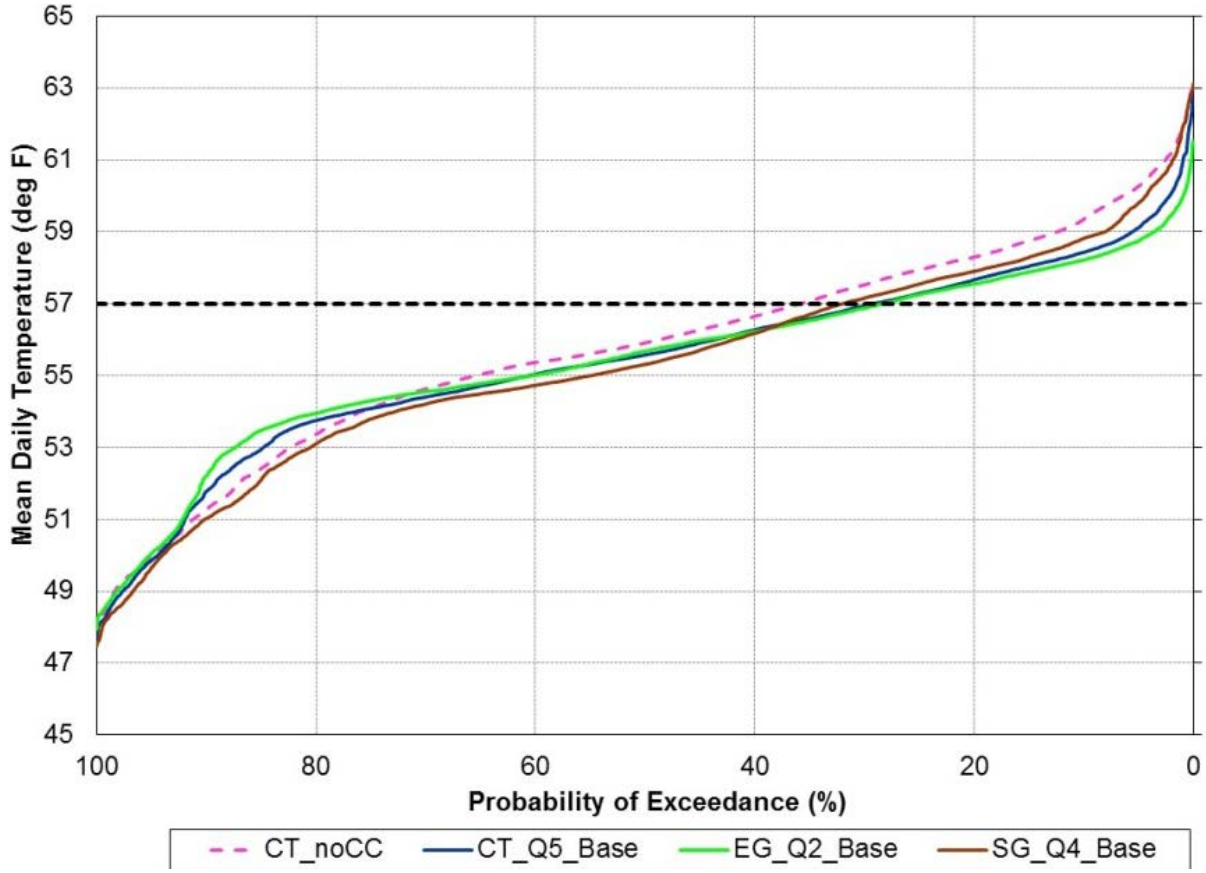
Figure 8-38. Change in Average Annual Net Benefit in South San Francisco Bay Region Salinity Costs from SBWQM



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth thousand acre-feet

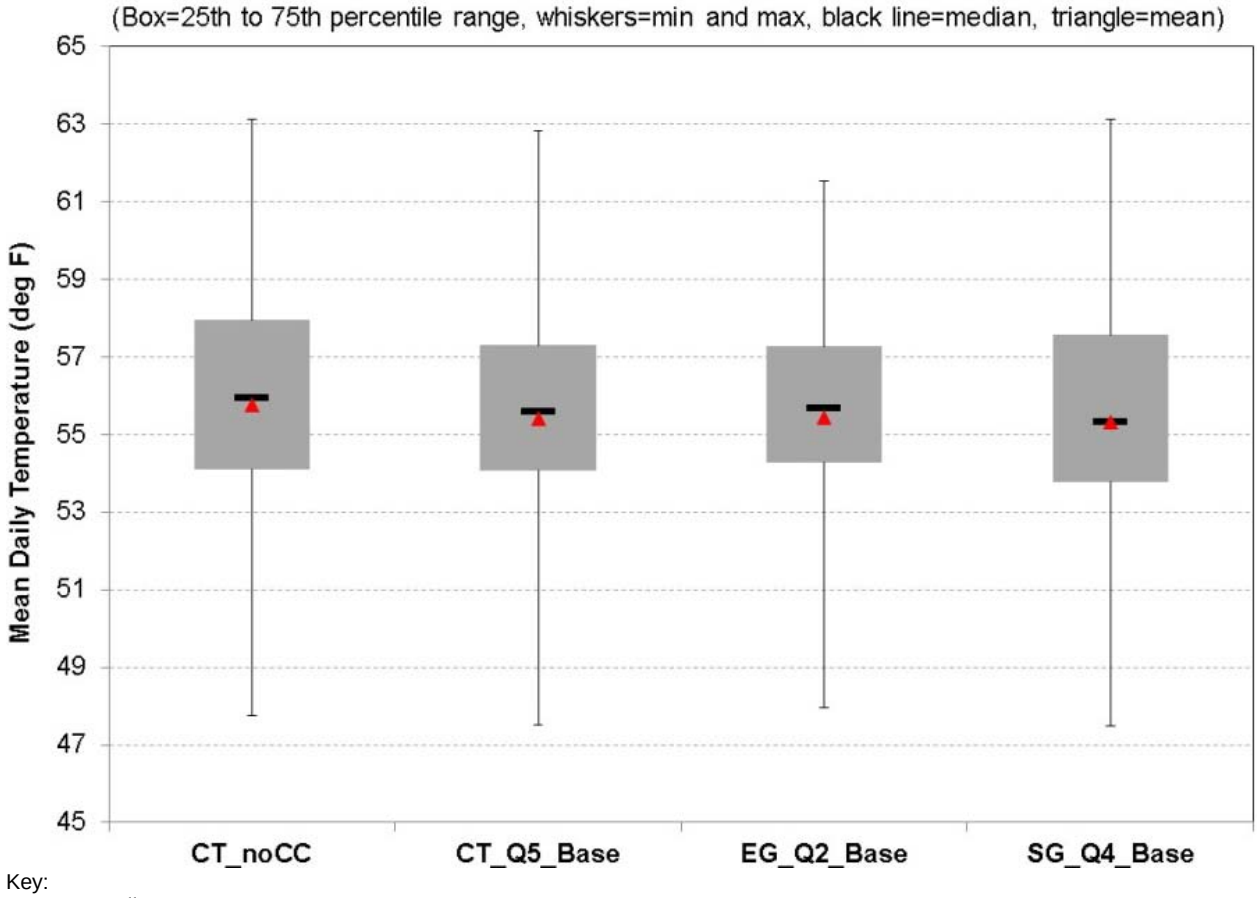
Figure 8-39. Change in Average Annual Net Benefit in Central Valley Agricultural Areas from SWAP

Water Temperature To understand the effects of climate change on river temperatures, the San Joaquin temperature (SJRWQM) models were used to simulate the CT-NoCC scenario as well as the CT-Q5, EG-Q2, and SG-Q4 socioeconomic-climate scenarios. Figure 8-40 through 8-45 provide exceedence plots and box plots of daily temperatures in the San Joaquin River at Lost Lake, Gravelly Ford, and Vernalis locations, from August through November, for these four socioeconomic-climate scenarios. The bold, dashed horizontal lines on the exceedence plots represent desired water temperatures during the period.



Key:
Base = Baseline
CT = current trends
EG= Expansive Growth scenario
No CC = no climate change
TAF = thousand acre-feet

Figure 8-40. Exceedence of Average Daily Water Temperature on San Joaquin River at Lost Lake from August-to-November in Select Socioeconomic-Climate Scenarios



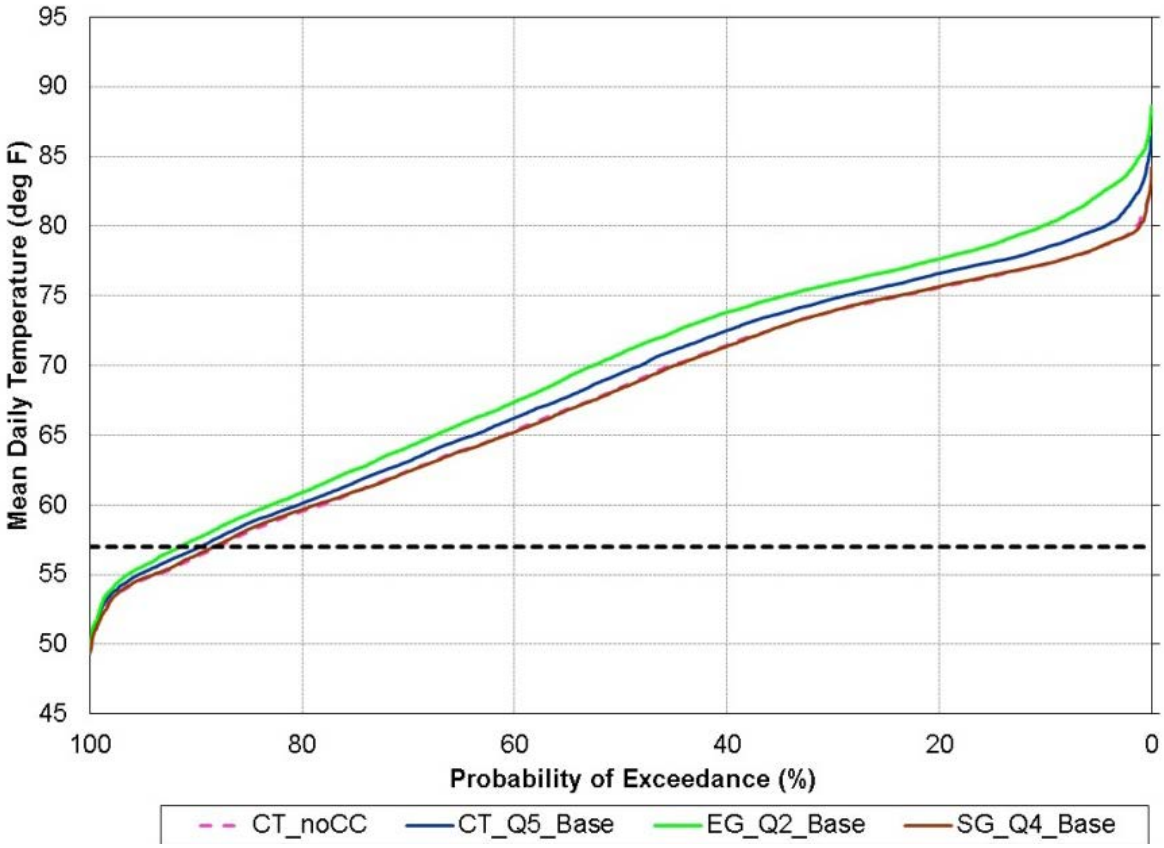
Key:
Base = Baseline
CT = current trends
EG= Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-41. Box Plot of Average Daily Water Temperature on San Joaquin River at Lost Lake from August-to-November in Select Socioeconomic-Climate Scenarios

The mean daily temperatures for the San Joaquin River at Lost Lake (just downstream from Friant Dam) during these months range from 55.3 to 55.8°F across the four scenarios. Scenarios CT-Q5, EG-Q2, and SG-Q4 generally show reduced temperatures at this location relative to the CT-NoCC scenario. The lowest temperatures occur in the SG-Q4 scenario, and the highest temperatures occur in the CT-Q5 and EG-Q2 scenarios. Only minor water temperature cooling occurs under SG-Q4 despite the wetter hydrology because Millerton Lake has limited capacity to hold high flows; when there are higher inflows to Millerton Lake (as occurs more frequently in climate scenario Q4) and the thermocline in the lake is disturbed as high flows flush out any cold water stored in the lake. Similarly, when there are lower inflows into Millerton Lake (as

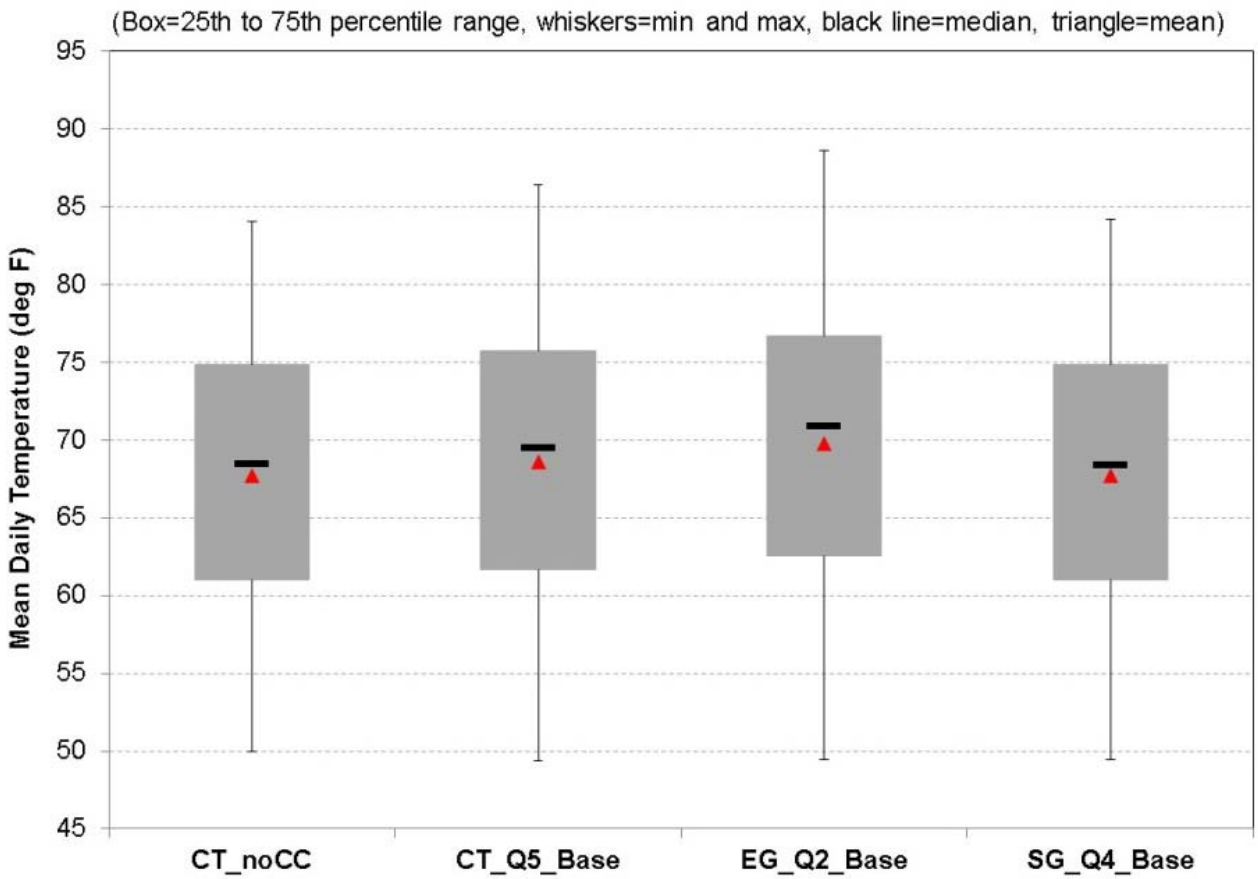
occurs frequently in climate scenario Q2) the thermocline in the Lake is maintained more frequently and the water released from Friant Dam is colder, resulting in cooler temperatures at Lost Lake, as observed in the EG-Q2 scenario.

Farther downstream on the San Joaquin River at Gravelly Ford, the mean daily water temperatures increase under all climate scenarios due to the effects of distance downstream and lower elevation (higher air temperatures). The water temperature increase is greatest in the warmer Q2 scenario and only minimal in less warm Q4 scenario. At Gravelly Ford, the mean daily water temperature during these months ranges from a low of 67.7°F in CT-NoCC and SG-Q4 to a high of 69.7°F in EG-Q2.



Key:
Base = Baseline
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

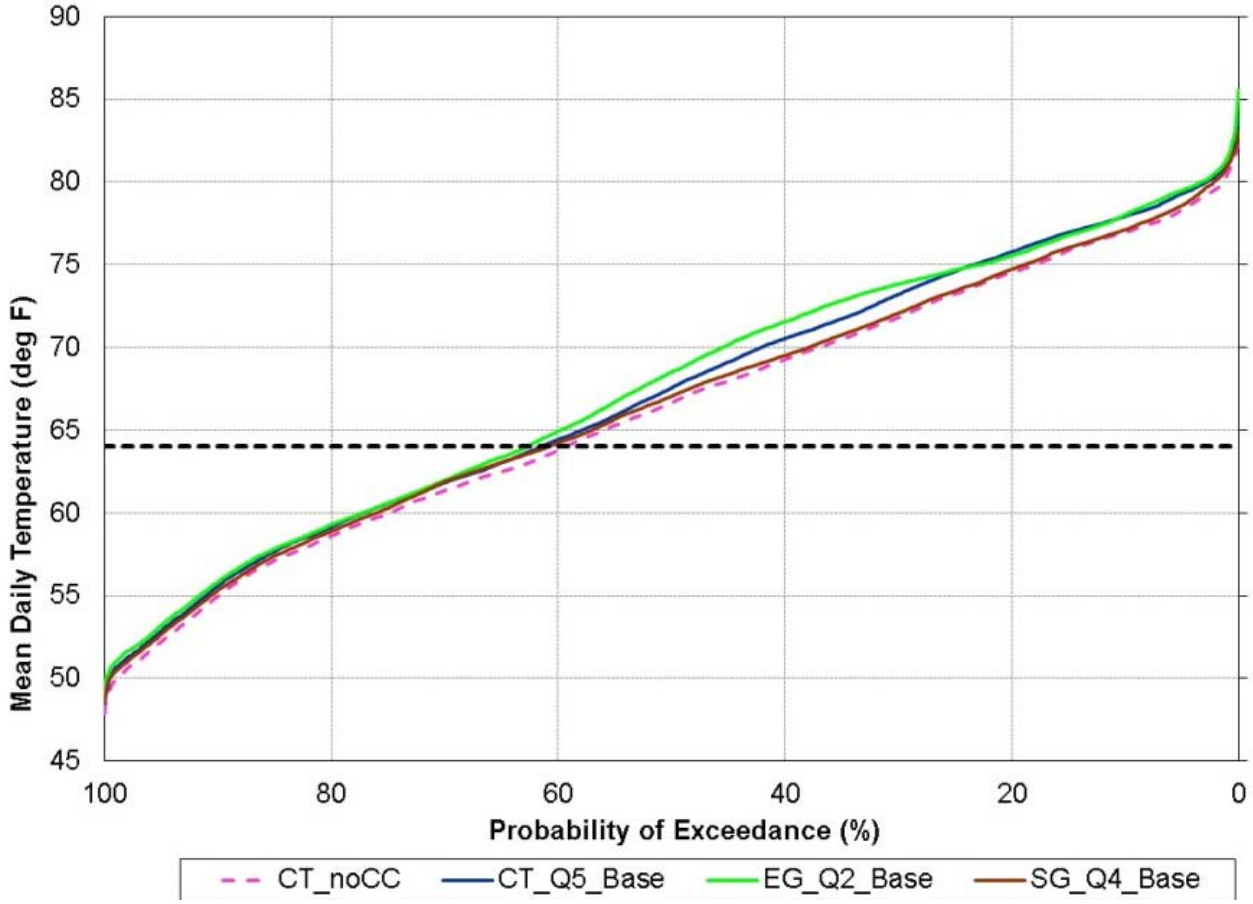
Figure 8-42. Exceedence of Average Daily Water Temperature on San Joaquin River at Gravelly Ford from August-to-November in Select Socioeconomic-Climate Scenarios



Key:
Base = Baseline
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

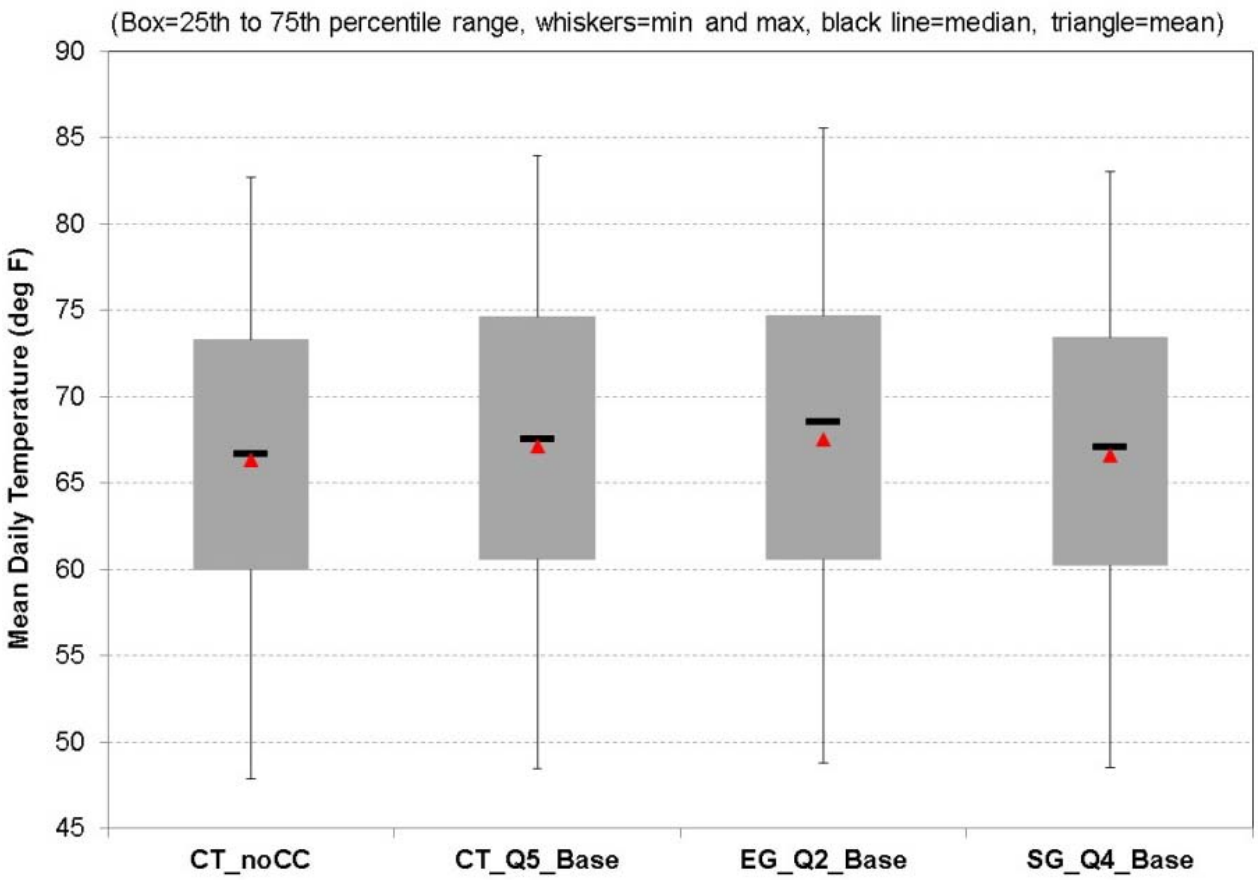
Figure 8-43. Box Plot of Average Daily Water Temperature on San Joaquin River at Gravelly Ford from August-to-November in Select Climate Scenarios

The temperature results for San Joaquin River at Vernalis, which reflect the impacts of all operations in the San Joaquin River system including the upstream tributaries, show warming under all climate scenarios. The mean daily average temperature at Vernalis in the CT-NoCC scenario is 66.3°F. For the three climate scenarios displayed, the mean daily temperatures at Vernalis ranges from 66.6°F to 67.6°F, with lowest in the SG-Q4 scenario and highest in the EG-Q2 scenario.



Key:
Base = Baseline
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

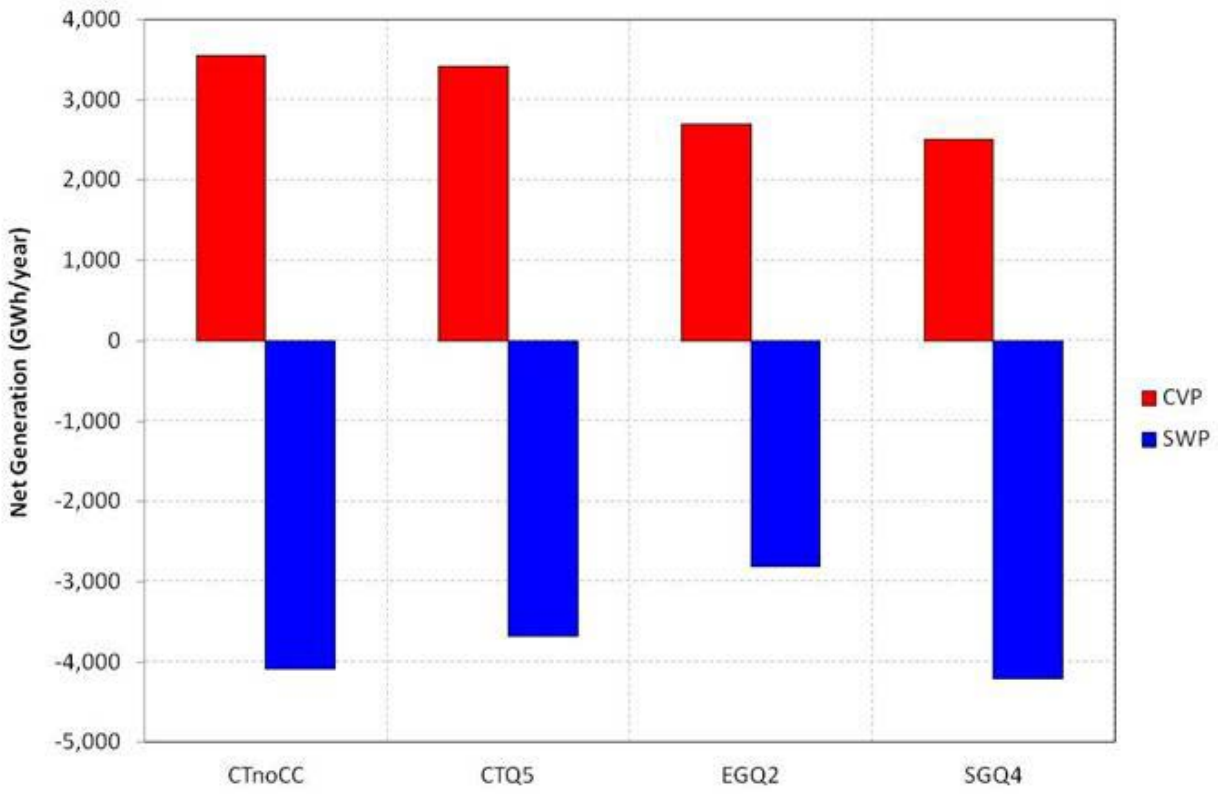
Figure 8-44. Exceedence of Average Daily Water Temperature on San Joaquin River at Vernalis from August-to-November in Select Climate Scenarios



Key:
Base = Baseline
CT = current trends
EG=Expansive Growth scenario
No CC = no climate change
SG = Slow Growth scenario
TAF = thousand acre-feet

Figure 8-45. Box Plot of Average Daily Water Temperature on San Joaquin River at Vernalis from August-to-November in Select Climate Scenarios

Hydropower and Greenhouse Gas Emissions Figure 8-46 shows the average annual net energy generation expressed as GWh/year for the CVP and SWP systems under the CT-NoCC, CT-Q5, EG-Q2, and SG-Q4 scenarios based on the results from the LongTerm_Gen model for the CVP and SWP_Power model for the SWP. Net energy generation is defined as the difference between hydropower production and usage by the CVP and SWP.



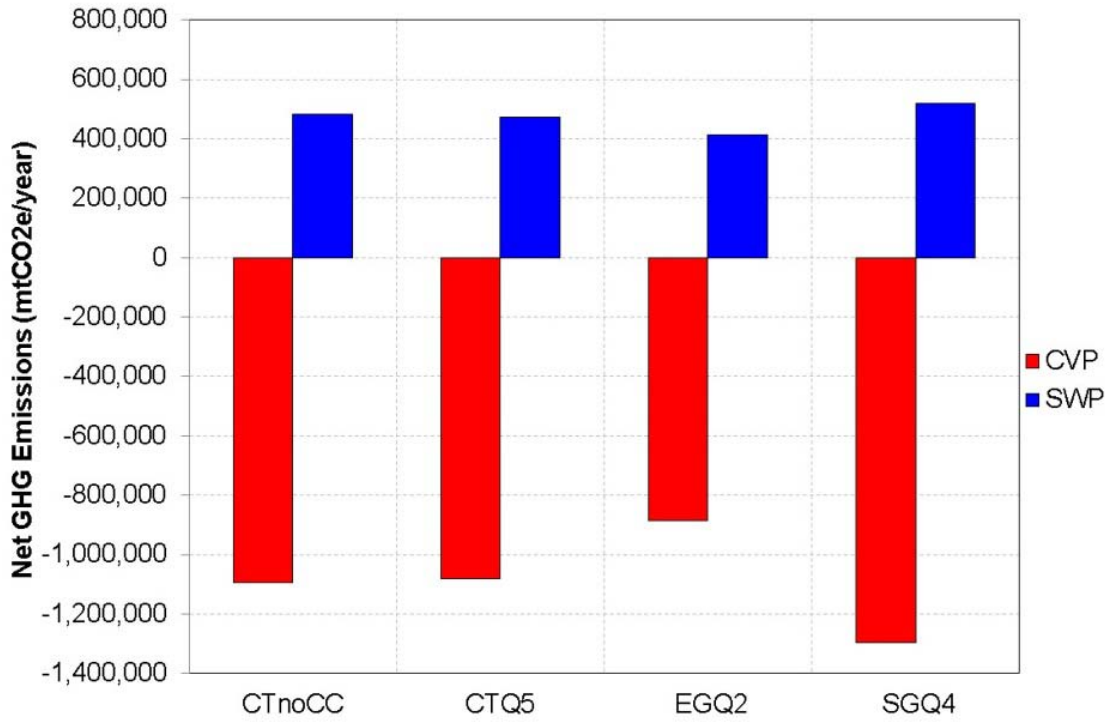
Key:
CT = Current Trends
CVP = Central Valley Project
EG = Expansive Growth
GWh = gigawatt hours
NoCC = No Climate Change
SG = Slow Growth
SWP = State Water Project

Figure 8-46. Average Annual Net Energy Generation for the CVP and SWP Systems in Select Socioeconomic-climate Scenarios

In all four socioeconomic-climate scenarios, the CVP system has more hydropower generation than energy use, while the SWP system has more energy use than hydropower generation. The relative levels of net generation between the four scenarios are consistent with the CVP storage and the SWP Banks pumping results for each scenario. The slightly drier conditions in the CT-Q5 relative to CT-NoCC result in slightly reduced net generation for the CVP and slightly less hydropower usage for the SWP. The wetter SG-Q4 scenario has the highest storage levels in CVP reservoirs for generation but also higher usage for conveyance, resulting in lower net generation. Similarly, SWP Banks pumping and conveyance usage is greatest in the SG-Q4 resulting in its most negative net generation. Conversely, the EG-Q2 scenario has the lowest

storage levels in CVP reservoirs resulting in less power production but also less water supply for exports. Banks pumping is also reduced, therefore the SWP has the least net generation in this scenario, which is drier than CT-NoCC scenario.

Figure 8-47 presents the average annual net GHG emissions from power generation used to pump CVP and SWP supplies, expressed as metric tons of CO_2 equivalents per year (mtCO2e/year) for the CVP and SWP systems under the CT-Q5, EG-Q2 and SG-Q4 scenarios. These results are consistent with the net generation results for the CVP and SWP in each scenario. The CVP system has negative net GHG emissions (i.e., potential GHG offsets) because it has positive net hydropower generation, while the SWP system has positive net GHG emissions because it has negative net hydropower generation. In addition, the net GHG emissions are greatest in SG-Q4 where the net generation results are greatest and lowest in EG-Q2 where the net generation results are lowest.



Key:
CT = Current Trends scenario
CVP = Central Valley Project
EG = Expansive Growth scenario
mtC02e = million tons $C0_2$ equivalent
NoCC = No Climate Change
SG = Slow Growth scenario
SWP = State Water Project

Figure 8-47. Average Annual Net GHG Emissions for the CVP and SWP Systems in Select Climate Scenarios

Climate Change Sensitivity Analysis–Representative Alternative

As described under "Methods and Assumptions," the Representative Alternative was designed to quantitatively investigate the sensitivity of water supply and San Joaquin River temperature benefits from new storage in the Temperance Flat RM 274 Reservoir to future socioeconomic and climate conditions in the 21st century. The sensitivity analysis uses the CVP IRP CalLite model and the same socioeconomic-climate scenarios used in the Baseline conditions analyses. The results of the Representative Alternative simulations can be compared to the corresponding Baseline assessment results to better understand action alternative benefits under potential future conditions.

In the CVP IRP CalLite model, the Representative Alternative is simulated with a maximum storage capacity of 1,331 TAF, and the maximum Millerton Lake storage is reduced by 71 TAF to account for previous storage, which would be within the Temperance Flat RM 274 Reservoir footprint. Restoration Flows are assumed for all simulations. Temperance Flat RM 274 Reservoir operations in the CVPIRP CalLite model are a simplified representation of operations under the action alternatives. These operations, and the differences from the more detailed CalSim II operations, are summarized below.

- **Integration with CVP/SWP System** – The CVP IRP CalLite model does not fully reflect the level of detail of CVP/SWP operations included in the CalSim II model. However, the CVP IRP model was calibrated by comparing its system wide performance characteristics with those of the more detailed CalSim II model.

- **Limitations** – Limitations of the Representative Alternative simulation in CVP IRP CalLite include the following:

  - Simplified model schematic and CVP/SWP operations compared to CalSim II

  - Does not provide a full representation of the extent of potential benefits

  - Only a single simplified representation of Temperance Flat RM 274 Reservoir operations is simulated

- CVPIA (b)(2) requirements are excluded from the simulation

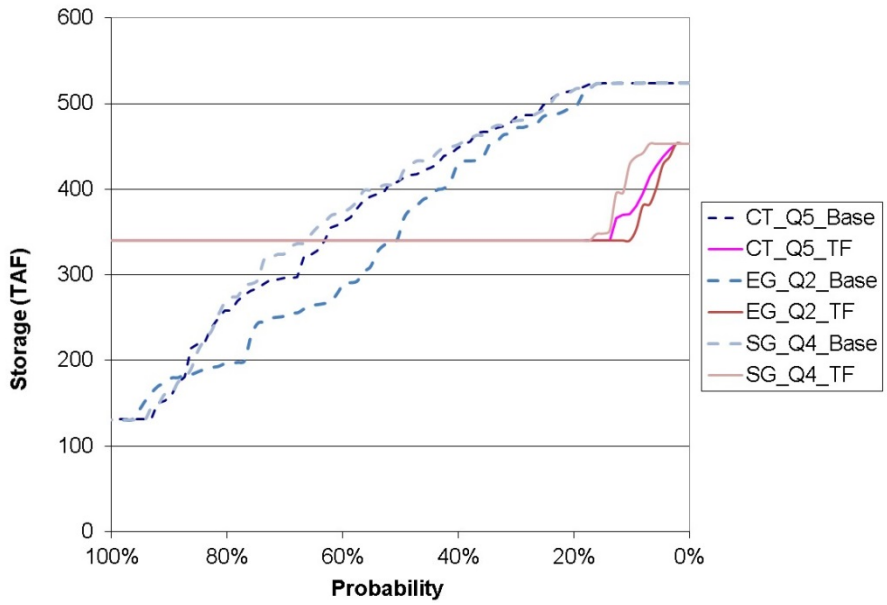
- No explicit delivery of water to Mendota Pool for exchange with other CVP water is simulated

The primary difference between the CVP IRP CalLite and CalSim II representations is that CVP IRP CalLite does not release water for delivery to SWP and CVP contractors at Mendota Pool. Instead, it provides all water delivery benefits from Temperance Flat RM 274 Reservoir via the Friant-Kern and Madera canals. Thus, there is no explicit representation of the various alternative operations simulated by the CalSim II model. In addition, because the CalSim II model has a more detailed representation of Temperance Flat RM 274 Reservoir and Millerton Lake operations, CalSim II results are considered quantitatively more accurate. However, the CVP IRP CalLite model representation provides results useful for evaluating the sensitivity of Temperance Flat RM 274 Reservoir to potential future socioeconomic-climate uncertainties.

CVP and SWP System Operations

The following sections summarize projected storage, Delta export and outflow, Delta salinity, and supply and demand conditions associated with the CVP and SWP under various socioeconomic and climate scenarios for the Representative Alternative.

CVP and SWP Project Storage Figure 8-48 and Figure 8-49 compare exceedence plots over the 21st century under the socioeconomic climate scenarios for the Baseline and Representative Alternative for end-of-May storage available for water supply, and end-of-September carryover storage conditions at Millerton Lake. Conditions are shown for socioeconomic-climate scenarios CT-Q5, EG-Q2, and SG-Q4. As in the Baseline, the highest storage levels occur in the wetter SG-Q4 scenario, and the lowest storage levels occur in the drier EG-Q2 scenario. Changes in Millerton Lake storage are primarily a result of how the Representative Alternative is operated to keep Millerton Lake at an essentially constant level. As can be seen in Figure 8-48 and Figure 8-49, storage in Millerton Lake is relatively constant except in years of exceptionally high precipitation when the reservoir level reaches the flood storage pool, and when there are additional releases to the San Joaquin River from Friant Dam.

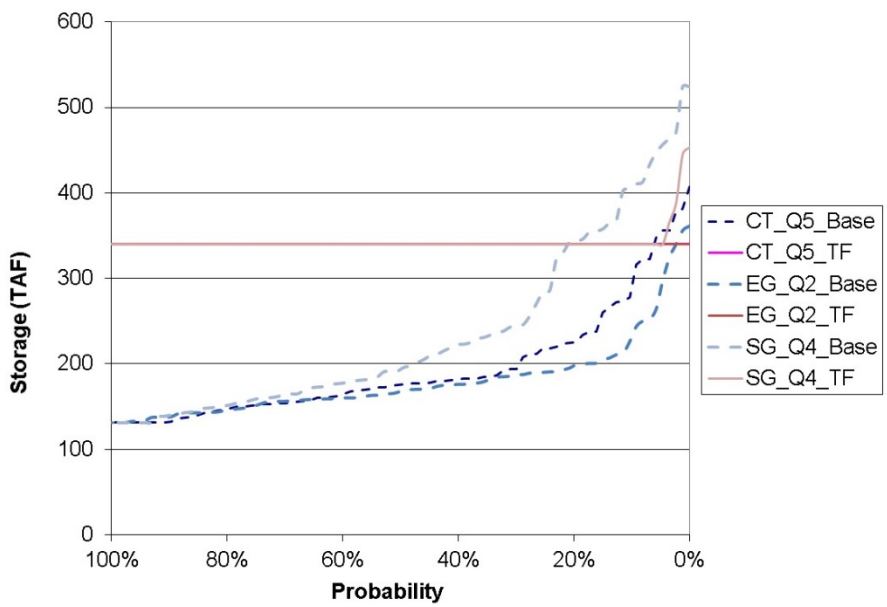


Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.

Key:

Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

Figure 8-48. Exceedence of Millerton Lake End-of-May Storage



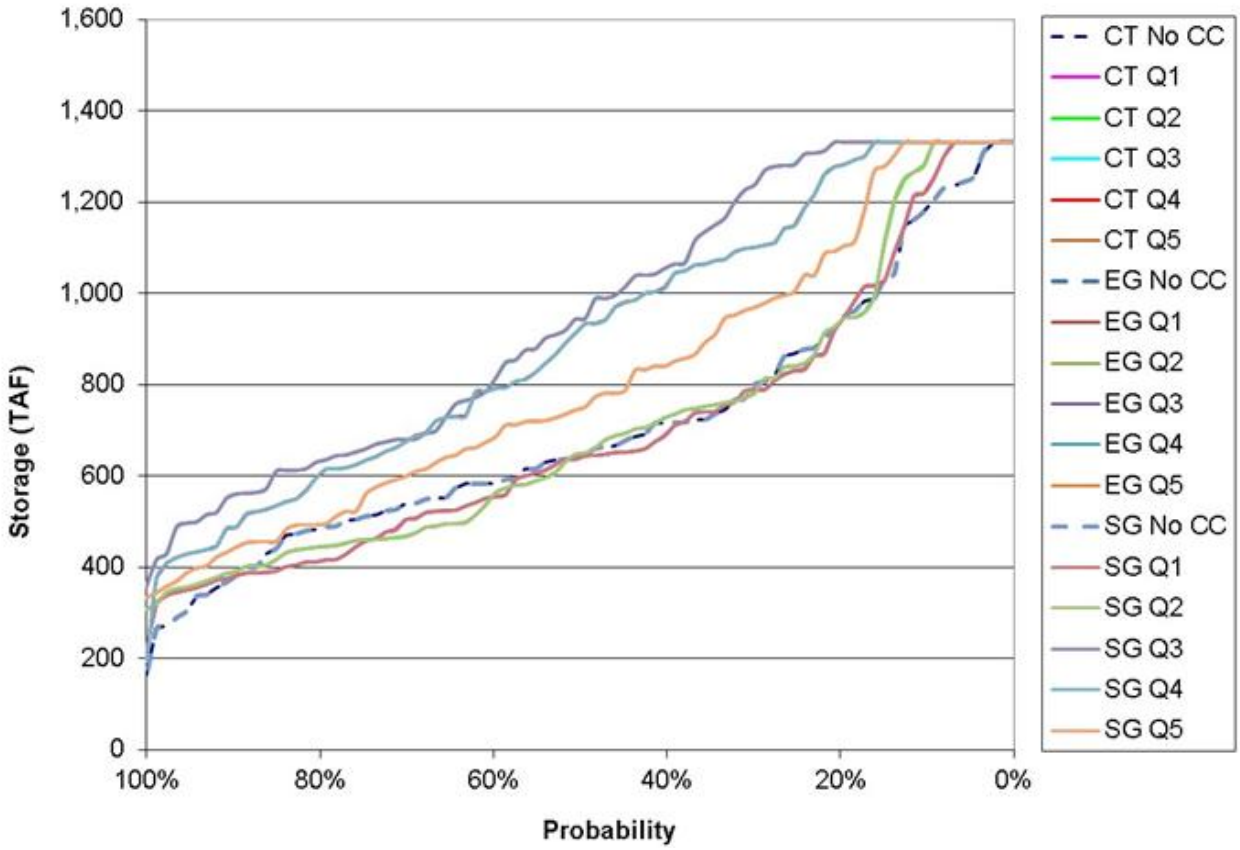
Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.

Key:

Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

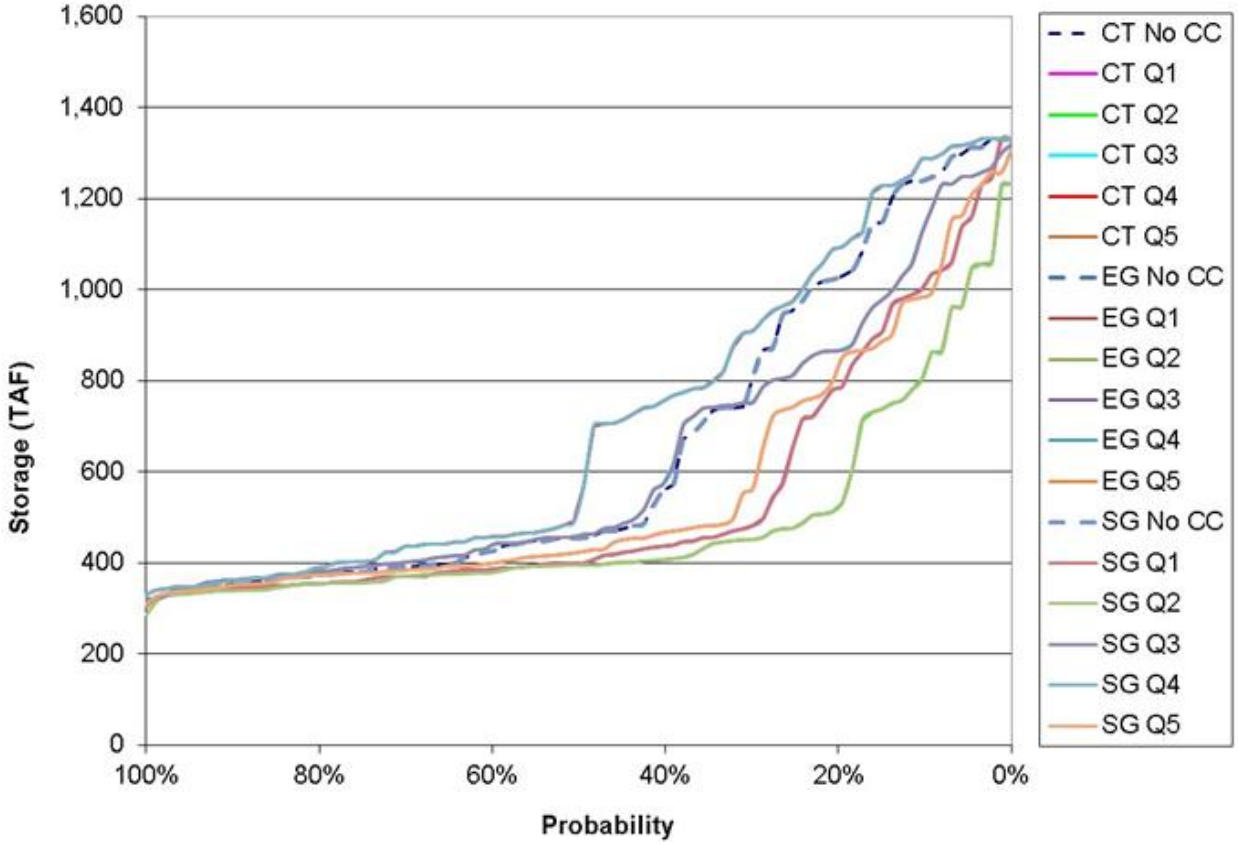
Figure 8-49. Exceedence of Millerton Lake End-of-September Storage

Figure 8-50 and Figure 8-51 show exceedence plots of Temperance Flat RM 274 Reservoir storage at the end-of-May and end-of-September for the Representative Alternative over the range of socioeconomic-climate scenarios. In these figures, only the lines for the slow growth socioeconomic scenario are visible because there is no difference in Millerton Lake, Madera Canal, and Friant-Kern Canal operations between different socioeconomic and climate scenarios. This result occurs because it was assumed that Madera Canal and Friant-Kern Canal deliveries are not constrained by consumptive use demands. In those years when excess water supplies existed, additional deliveries were made to recharge groundwater in the Friant Division of the CVP.



Note: The No Climate Change scenarios (NoCC) are represented by dashed lines, and climate change scenarios by solid lines.
Key:
CT = Current Trends
EG = Expansive Growth
No CC = no climate change
SG = Slow Growth
TAF = thousand acre feet

Figure 8-50. Representative Alternative End-of-May Monthly Storage Exceedence Under Various Climate Change Scenarios



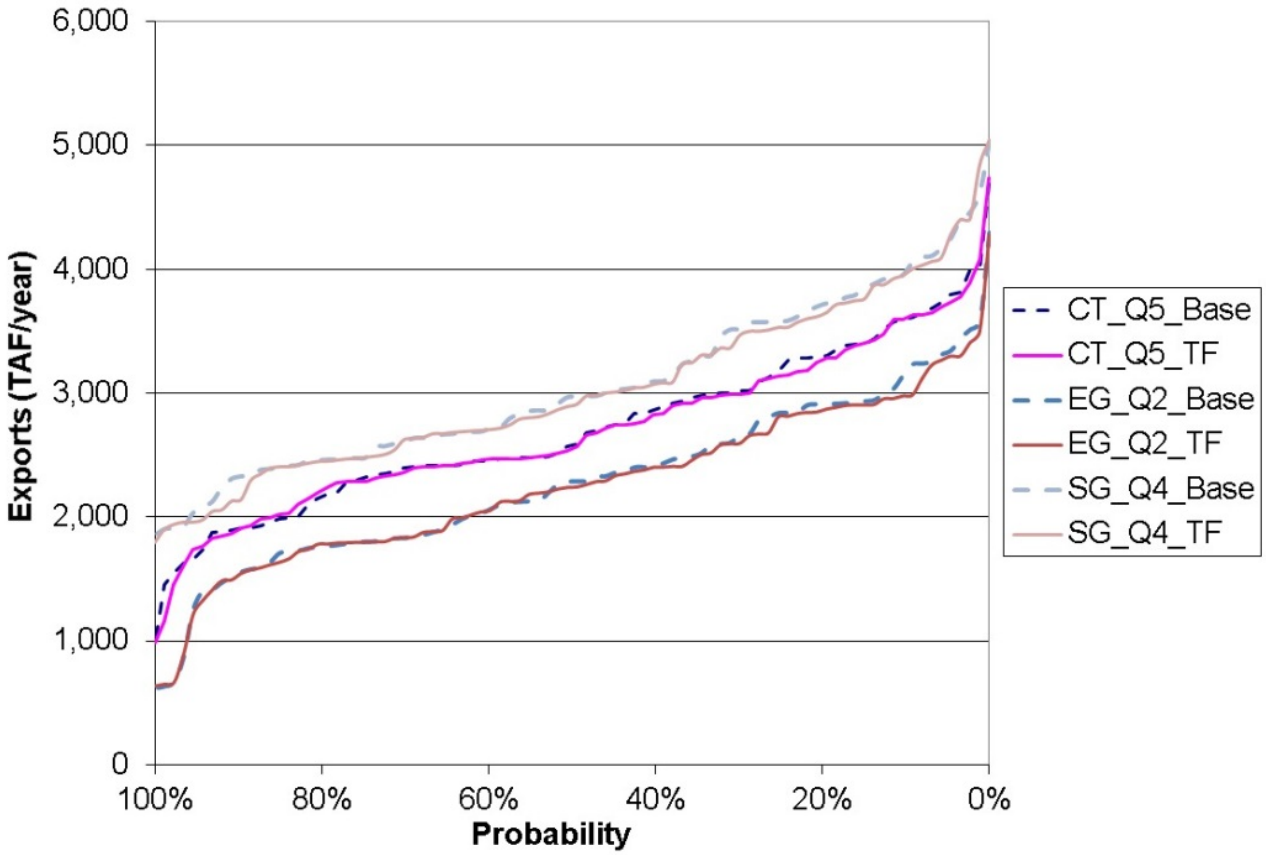
Note: The No Climate Change scenarios (NoCC) are represented by dashed lines, and climate change scenarios by solid lines.
Key:
CT = Current Trends
EG = Expansive Growth
No CC = no climate change
SG = Slow Growth
TAF = thousand acre feet

Figure 8-51. Representative Alternative End-of-September Monthly Storage Exceedence Under Various Climate Change Scenarios

As shown on Figure 8-50 and Figure 8-51, end-of-month storage levels primarily reflect differences in climate projections. At the end of May, the wetter projections (Q3 and Q4) have the largest storage volumes while the drier projections (Q1 and Q2) have storage similar to NoCC. The central tendency Q5 projections are intermediate in volume with an average end-of-May storage of approximately 750 TAF. All climate projections, with the exception of the wetter, less warming projections (Q4), have less carryover storage than the NoCC. The drier projections (Q1 and Q2) have the lowest storage levels and the lowest levels of carryover storage.

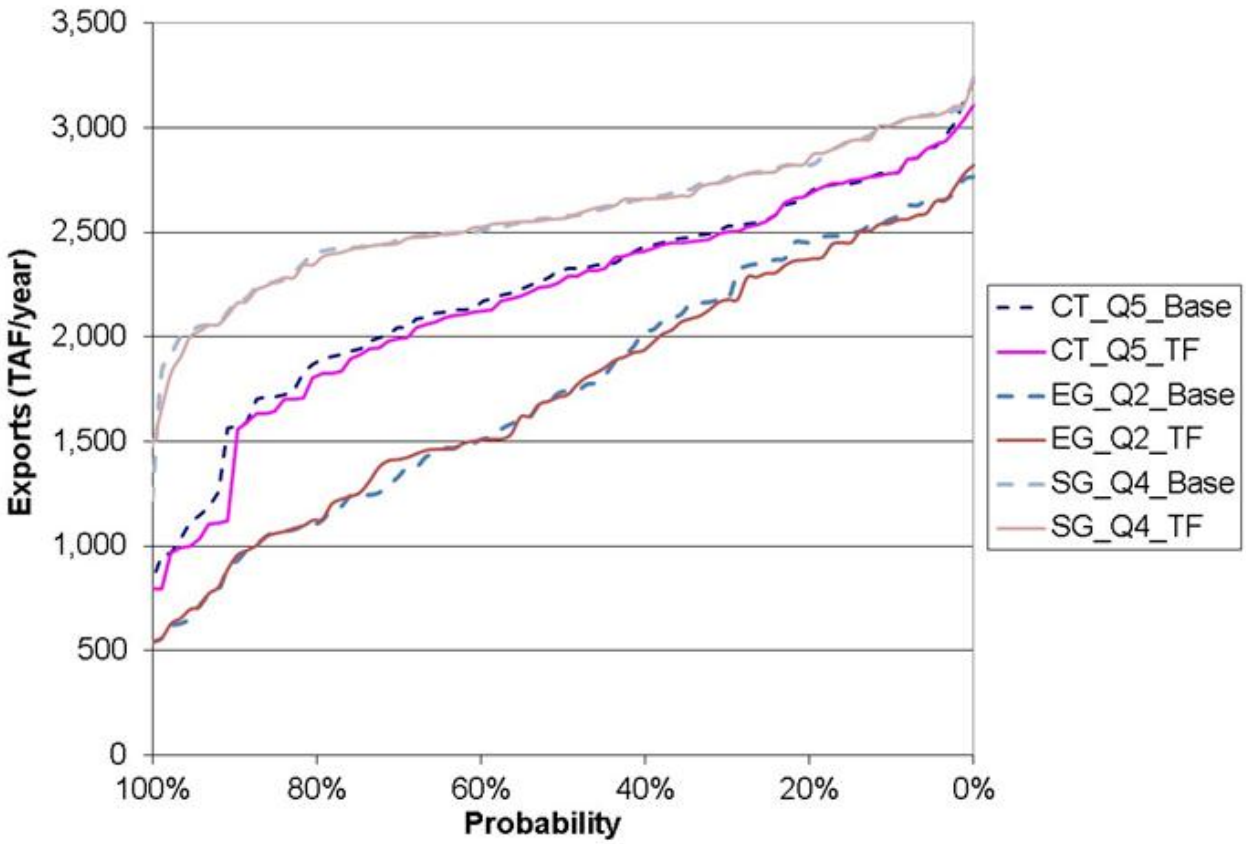
Delta Exports and Delta Outflow Figure 8-52 and Figure 8-53 are annual exceedence plots of Delta exports from Banks

and Jones pumping plants comparing the Representative Alternative to the corresponding Baselines for select socioeconomic-climate scenarios. As shown, Delta export pumping at both the Jones and Banks pumping plants is only slightly affected by the operations of the Representative Alternative. Changes in total Delta exports range from a minimum decrease of 10 TAF/year to maximum decrease of 55 TAF/year.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

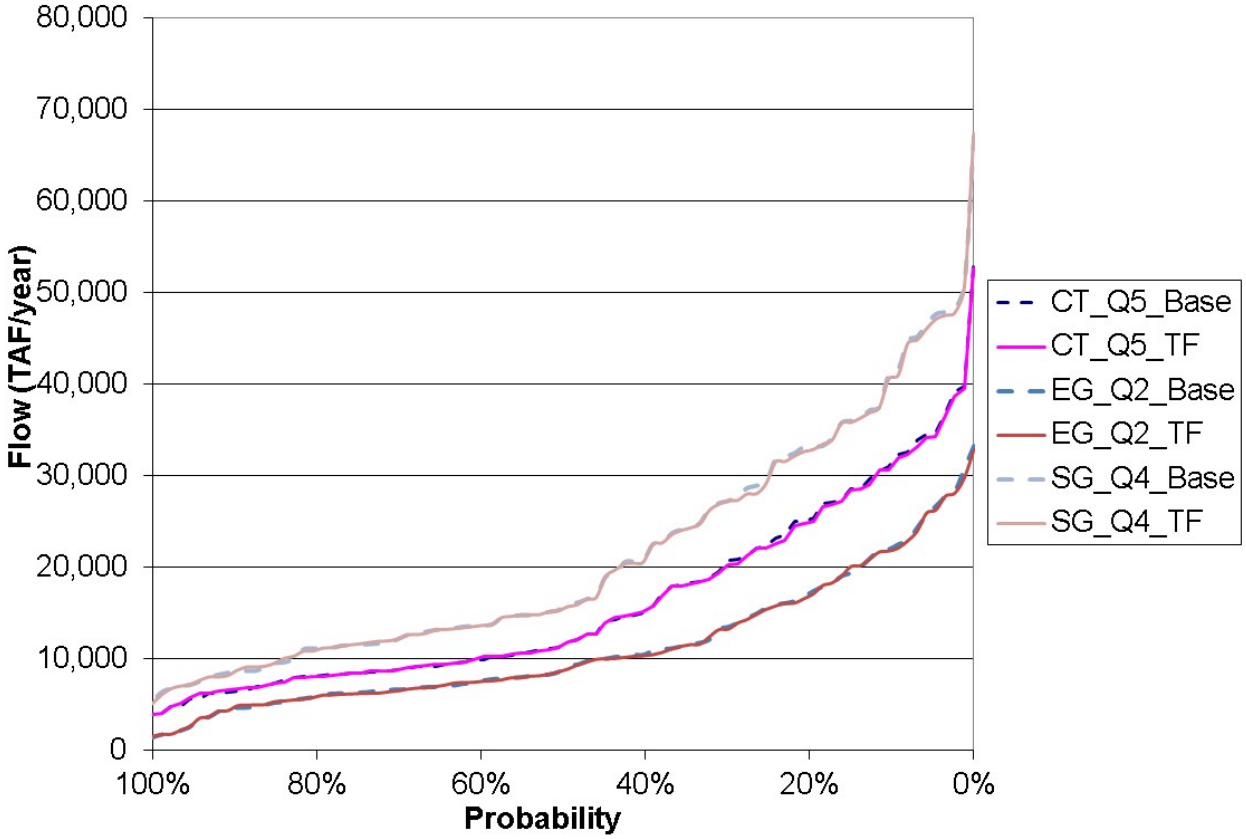
Figure 8-52. Exceedence of Annual Banks Pumping Under Various Climate Change Scenarios



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

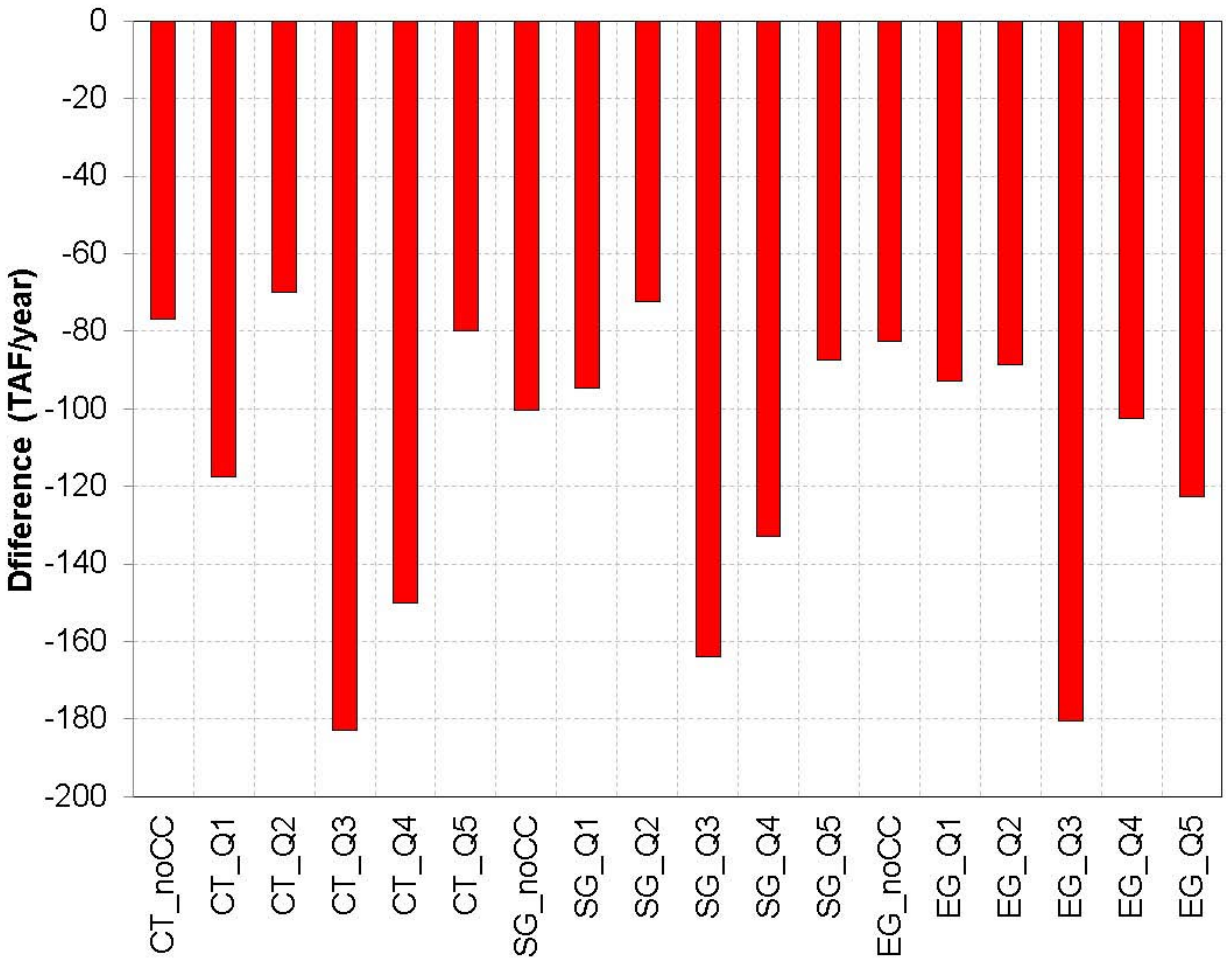
Figure 8-53. Annual Exceedence of Jones Pumping Under Various Climate Change Scenarios

Figure 8-54 is a similar exceedence plot of annual Delta outflows. The Representative Alternative has only slight impacts on Delta outflows. Figure 8-55 shows the magnitude of changes in Delta outflows for all 18 socioeconomic-climate scenarios. Decreases in outflow range from a minimum of 70 TAF/year to a maximum of 180 TAF/year, with the central tendency Q5 projections showing average decreases ranging from approximately 80 to 120 TAF/year.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

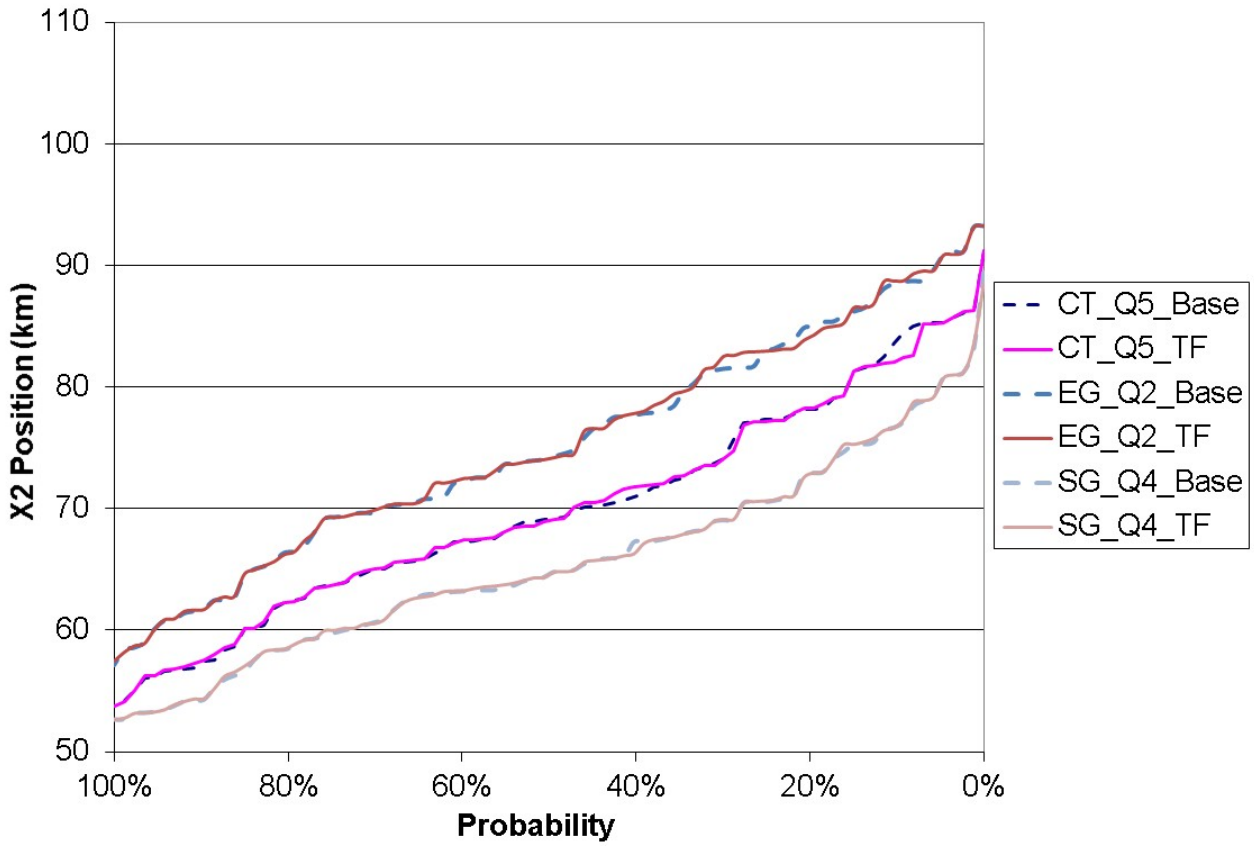
Figure 8-54. Annual Exceedence of Delta Outflow under Various Climate Change Scenarios



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

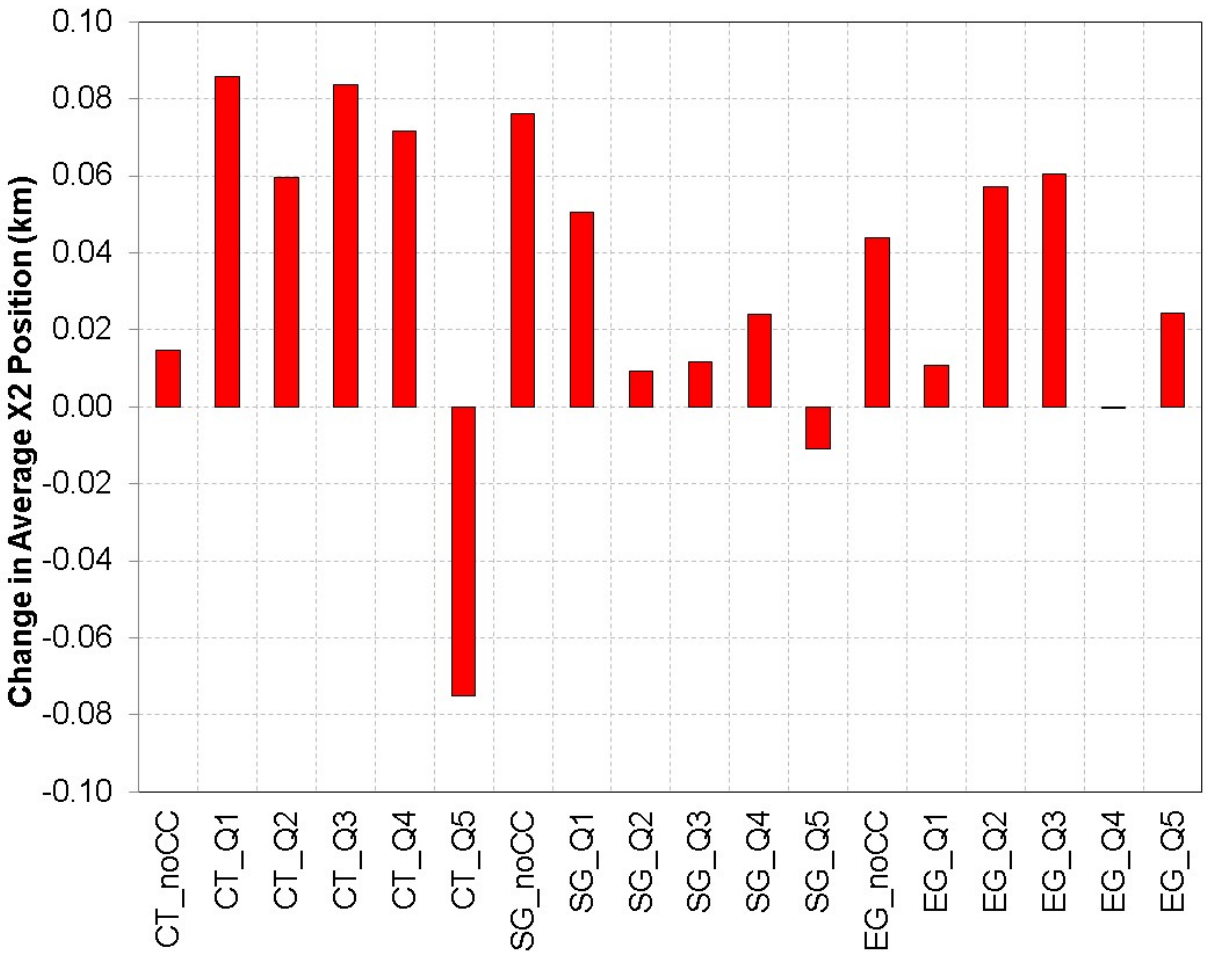
Figure 8-55. Average Annual Change in Delta Outflow for Comparing the Baseline to Representative Alternative in Each Socioeconomic-Climate Scenario

Delta Salinity Figure 8-56 shows exceedence plots of average X2 position during the 21st century from February through June under socioeconomic-climate scenarios CT-Q5, EG-Q2, and SG-Q4. Figure 8-57 shows the change in average X2 position for all 18 socioeconomic-climate scenarios for the months of February through June comparing Representative Alternative to the Baseline simulations. As can be observed from the figure, the Representative Alternative has very little impact on the X2 location. The maximum change is less than 0.1 km either to the east or west.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
km = kilometer
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

Figure 8-56. Exceedence of Average February-to-June X2 Position Under Various Climate Change Scenarios

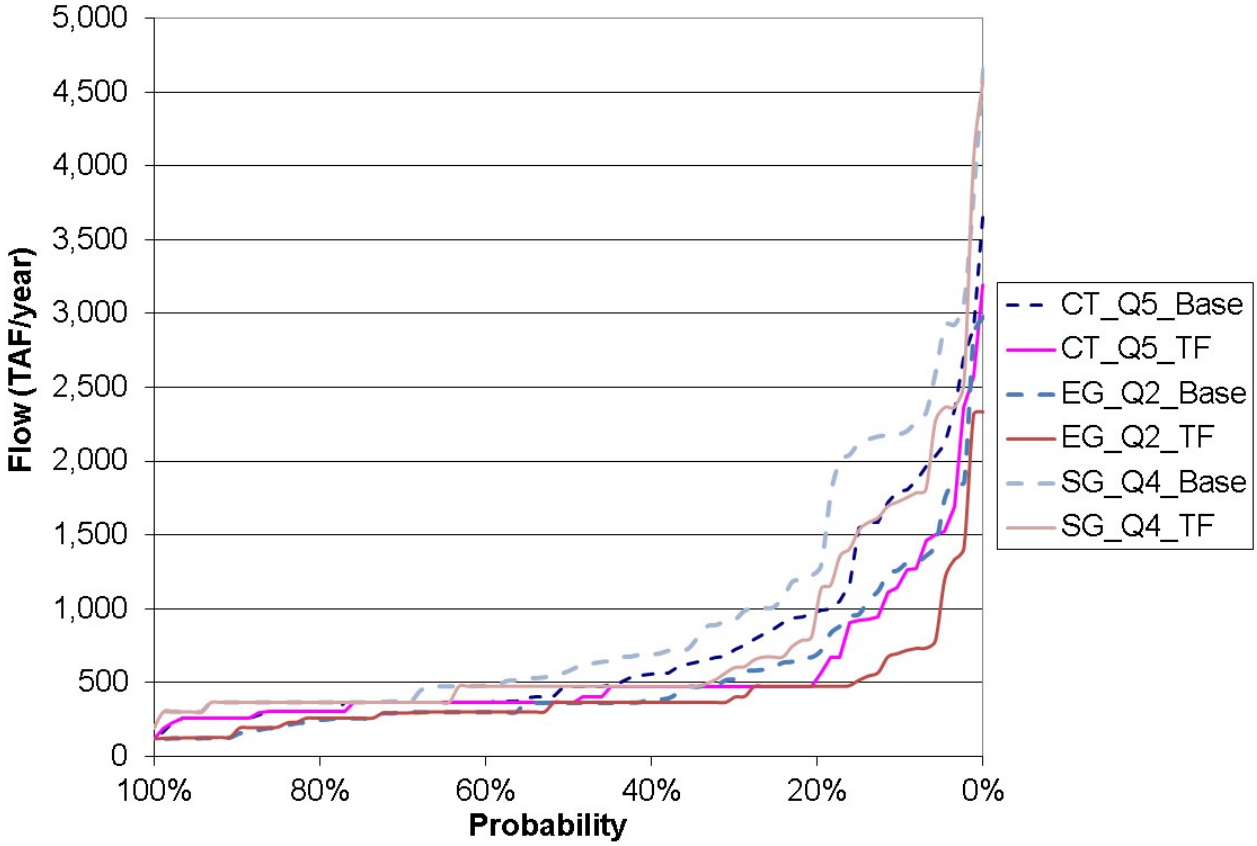


Key:
CT = Current Trends
EG = Expansive Growth
km = kilometer
NoCC = no climate change
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

Figure 8-57. Change in Average February-to-June X2 Position Comparing the Baseline to Representative Alternative in Each Socioeconomic Climate Scenario

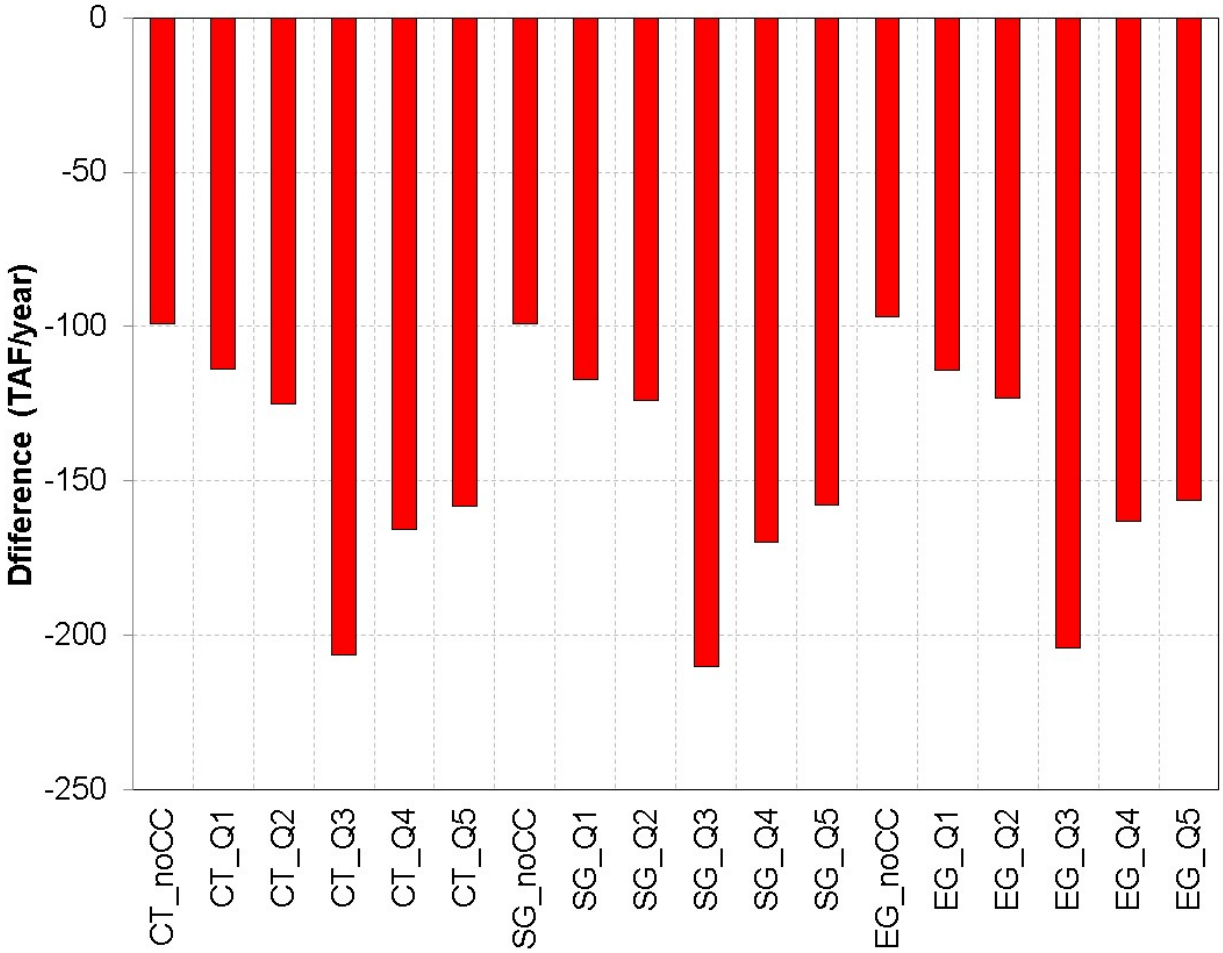
Water Supplies and Demands Figure 8-58 is an exceedence plot of annual releases from Millerton Lake into the San Joaquin River. The figure indicates that Millerton Lake releases under the Representative Alternative are reduced in the highest flow years, reflecting the ability of Temperance Flat RM 274 Reservoir to capture watershed runoff that otherwise would have been released from Millerton Lake for flood control purposes. Figure 8-59 shows the magnitude of these changes for each of the 18 socioeconomic-climate scenarios. Only small differences between the socioeconomic scenarios occur, the largest of which occur in the wetter Q3 and Q4

projections and range from a minimum of approximately 165 TAF to a maximum of 210 TAF. The central tendency Q5 projections result in a reduction of releases of about 155 TAF.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre feet
TF = Temperance Flat (a.k.a. Representative Alternative)

Figure 8-58. Exceedence Annual Releases from Friant Dam Comparing Baseline and Representative Alternative

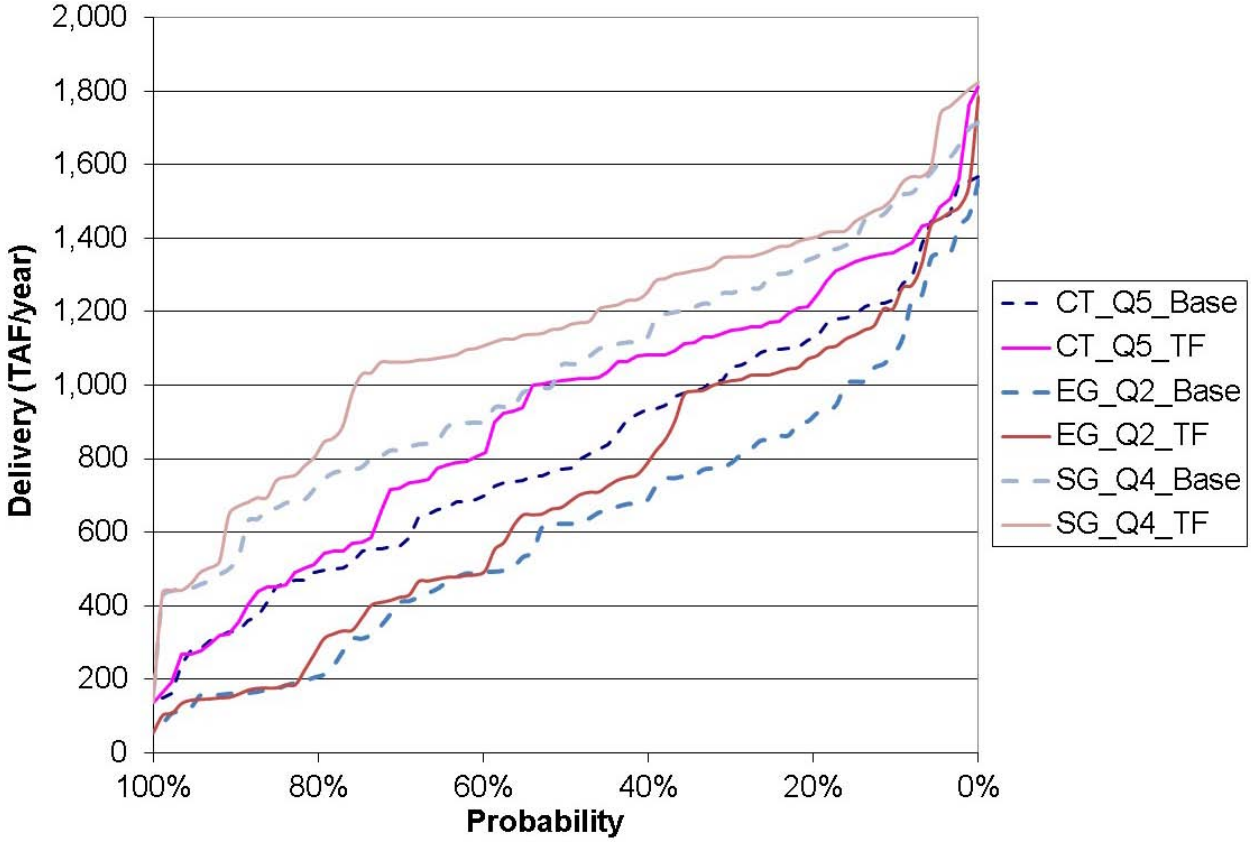


Key:
CT = Current Trends
EG = Expansive Growth
NoCC = no climate change
SG = Slow Growth
TAF = thousand acre feet

Figure 8-59. Average Annual Change in Friant Dam Releases for Comparing the Baseline to Representative Alternative in each Socioeconomic-Climate Scenario

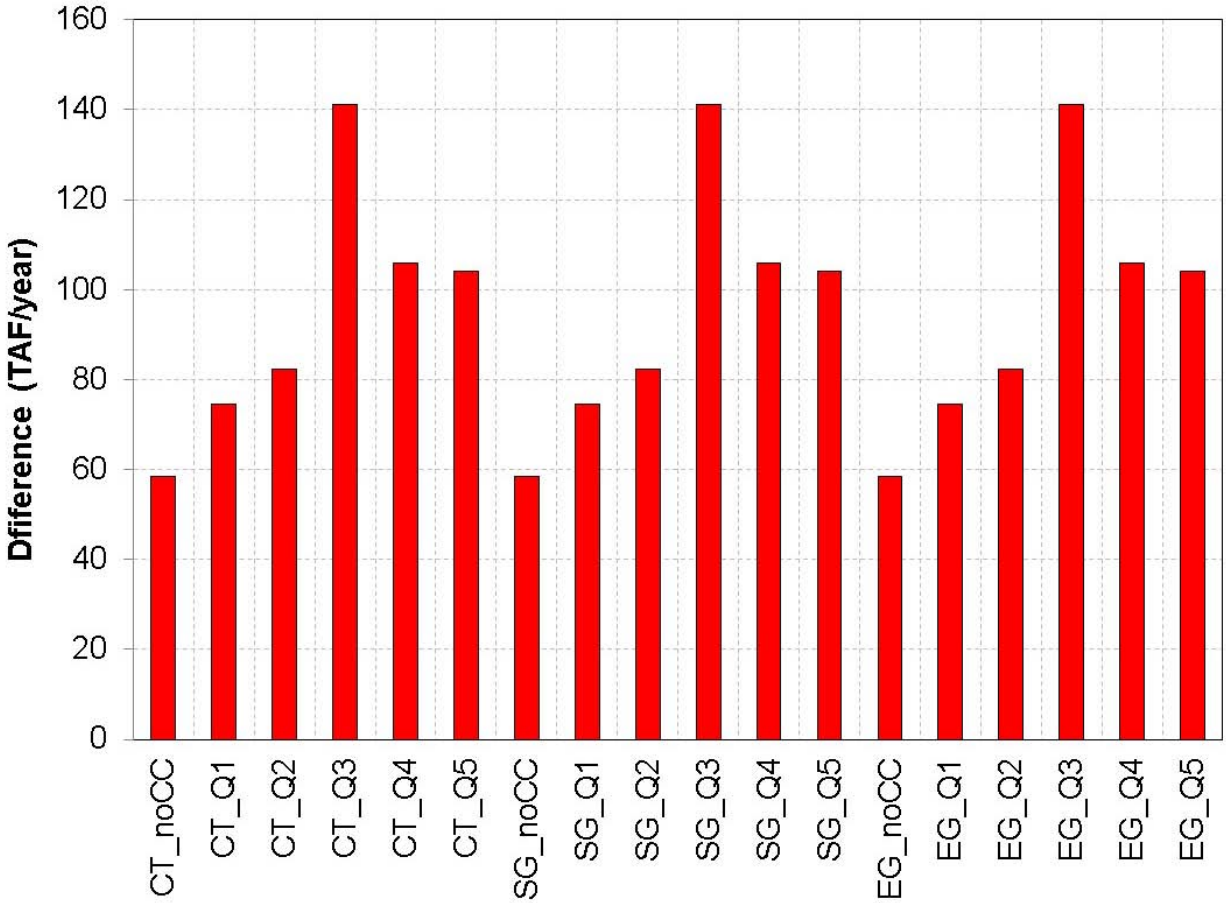
Figure 8-60 through Figure 8-63 show changes in annual exceedence for the Representative Alternative in deliveries from Friant-Kern and Madera canals relative to the Baseline. As shown on Figure 8-60 and 8-62, water supply deliveries in the wettest years are slightly reduced due to Temperance Flat RM 274 Reservoir being used to capture excess runoff for carryover storage; in drier years, canal deliveries with Temperance Flat RM 274 Reservoir are similar to the Baseline results. However, as shown in Figures 8-61 and 8-63, over the 21st century, the operation of the Representative Alternative results in an average increase in deliveries across the range of all 18 socioeconomic-climate scenarios considered.

For the Friant-Kern Canal, increases in deliveries range from a minimum of about 60 TAF/year in the drier Q2 climate scenarios to a maximum of about 140 TAF/year in wetter Q3 climate scenarios. The central tendency Q5 deliveries increase by approximately 100 TAF/year.



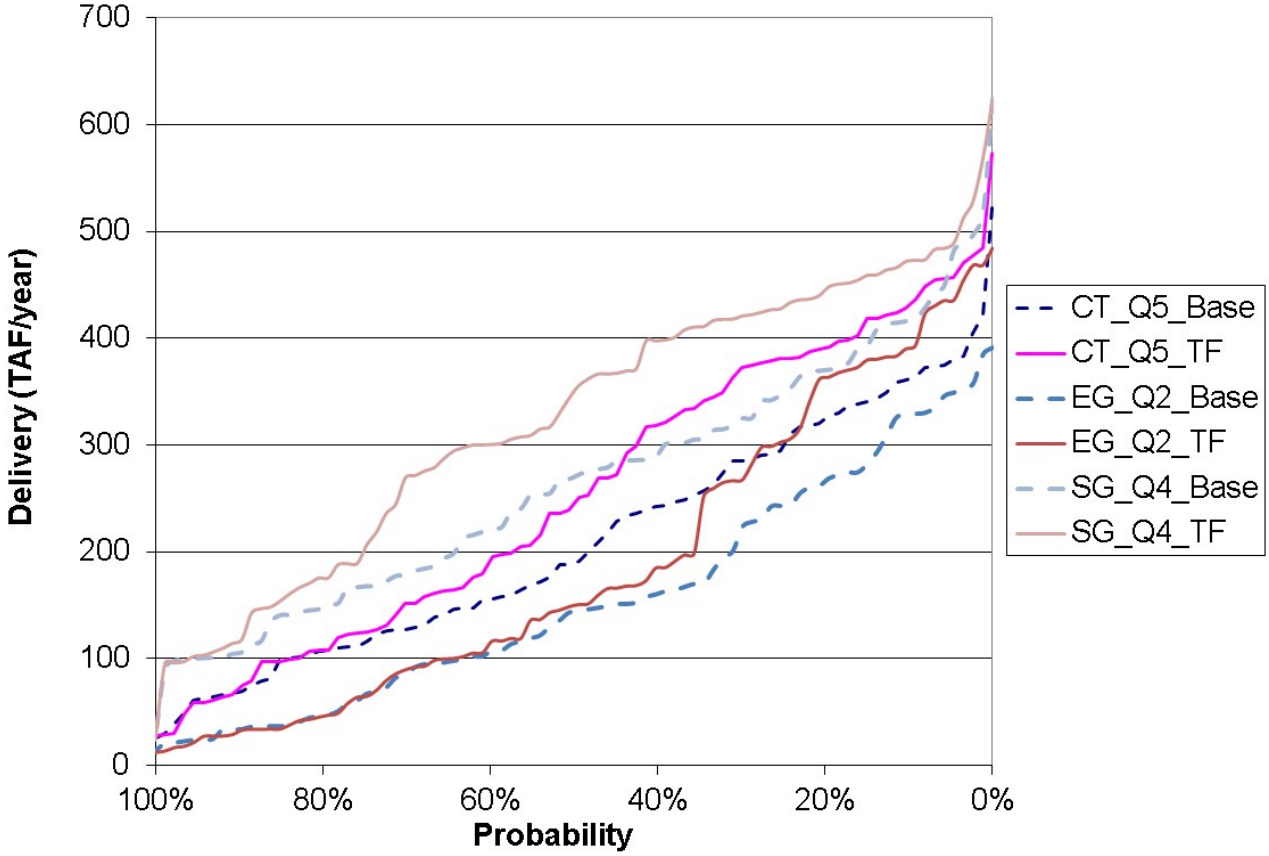
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

Figure 8-60. Exceedence of Annual Friant-Kern Canal Deliveries Comparing Baseline and Representative Alternative



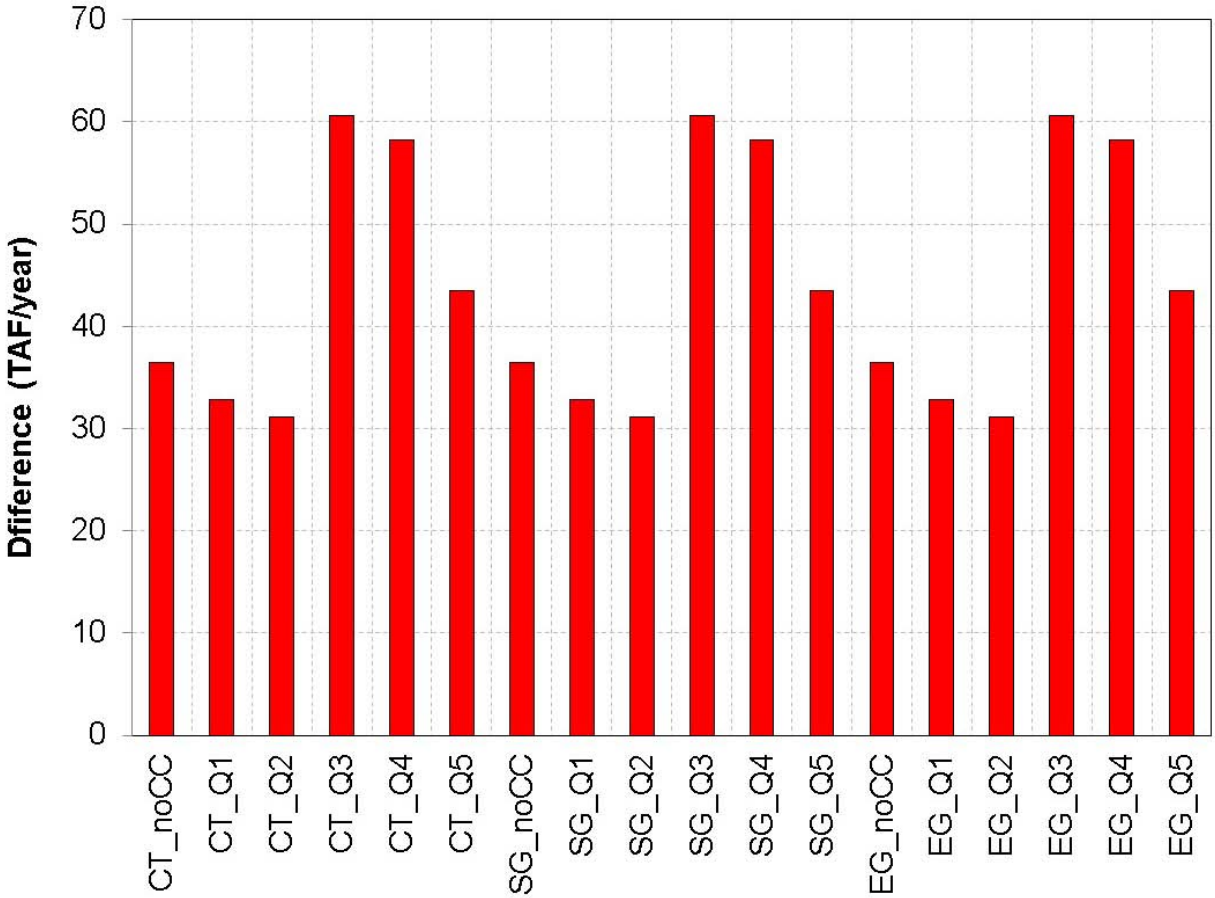
Key:
CT = Current Trends
EG = Expansive Growth
NoCC = No Climate Change
SG = Slow Growth
TAF = thousand acre-feet

Figure 8-61. Average Annual Change in Friant-Kern Canal Deliveries Comparing Baseline and Representative Alternative in Each Socioeconomic-Climate Scenario



Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TAF = thousand acre-feet
TF = Temperance Flat (a.k.a. Representative Alternative)

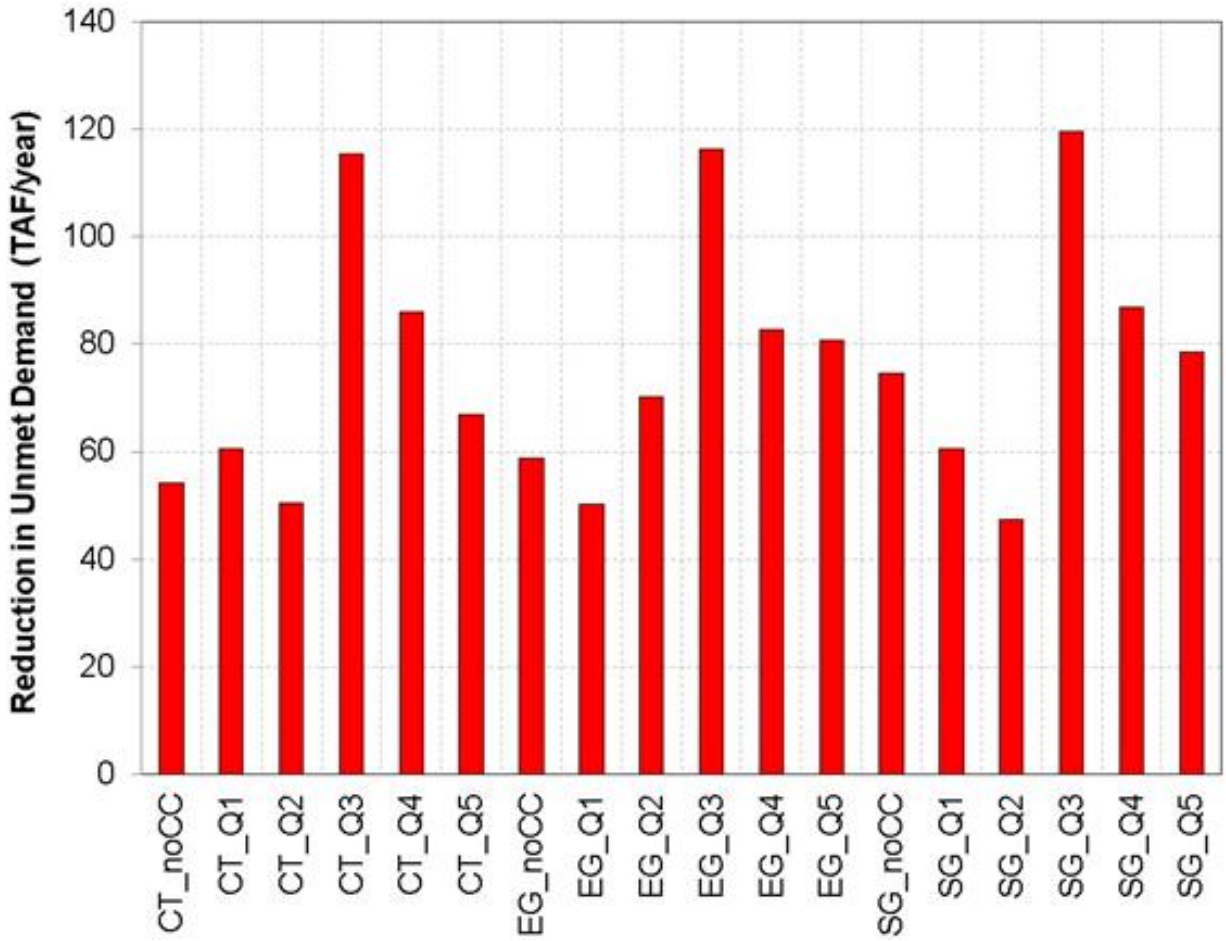
Figure 8-62. Exceedence of Annual Madera Canal Delivery Comparing Baseline and Representative Alternative



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = No Climate Change
SG = Slow Growth
TAF = thousand acre-feet

Figure 8-63. Average Annual Change in Madera Canal Delivery for Comparing Baseline to Representative Alternative in Each Socioeconomic-Climate Scenario

Figure 8-64 shows the change in average annual unmet demands in the CVP water service area with the operation of Temperance Flat RM 274 Reservoir. Overall, with the Representative Alternative, reductions in unmet demands range from a minimum of approximately 50 TAF/year to a maximum of 120 TAF/year. The central tendency Q5 unmet demands decrease by between 70 and 80 TAF/year.



Key:
CT = Current Trends
EG = Expansive Growth
NoCC = No Climate Change
SG = Slow Growth
TAF = thousand acre-feet

Figure 8-64. Average Annual Reduction in Unmet Demand in the CVP Water Service Area Comparing Baseline to Representative Alternative in Each Socioeconomic-Climate Scenario

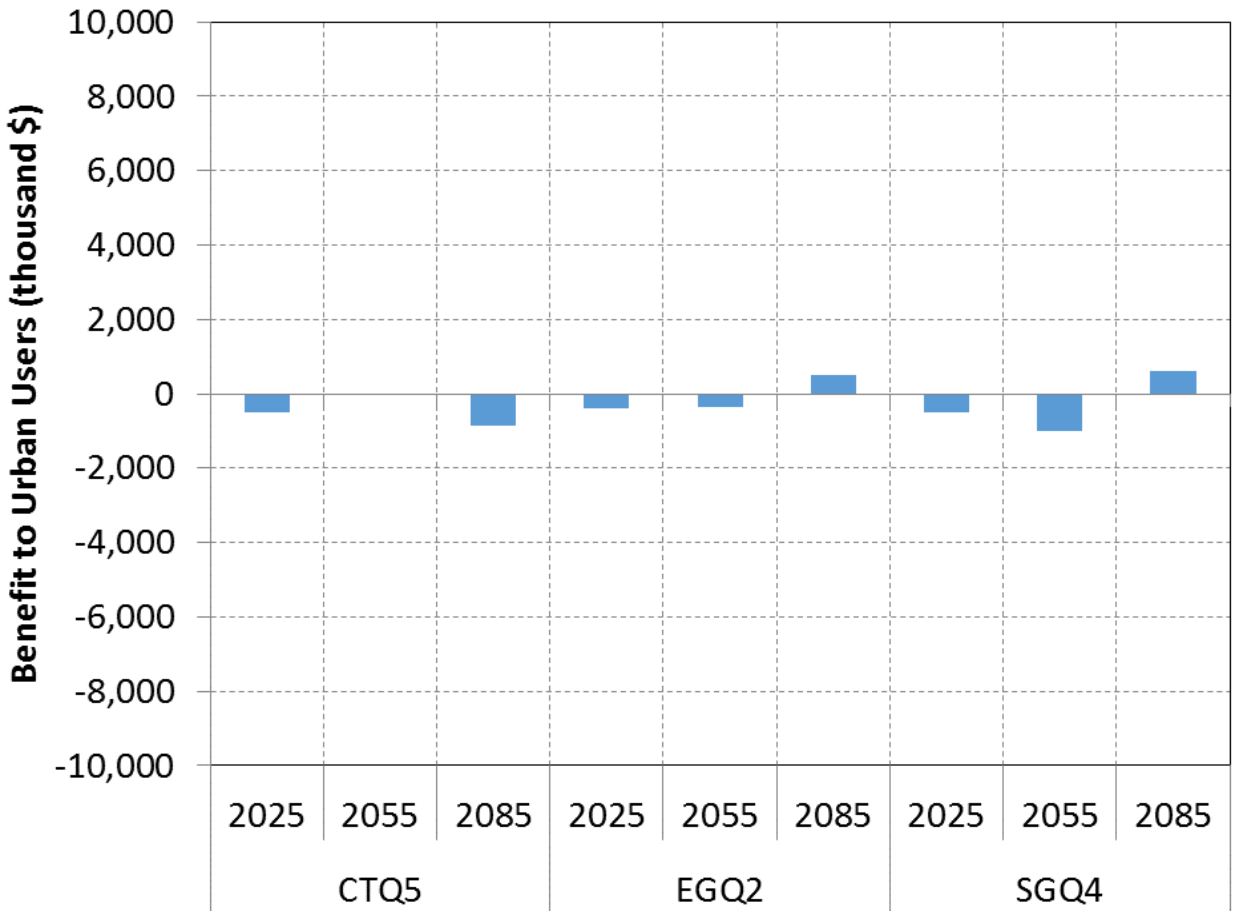
Results of Other Performance-Assessment Tools

Results for the representative alternative relative to other performance tools, including economic, water temperature, and hydropower, are described below.

Economics Figure 8-65 through Figure 8-68 show the net change in water supply system costs from the urban economic models LCPSIM and OMWEM; the net change in avoided cost from the water quality economic model SBWQM; and the change in agricultural net revenue from SWAP for the

Representative Alternative in the CT-Q5, EG-Q2 and SG-Q4 scenarios at the 2025, 2055, and 2085 LODs.

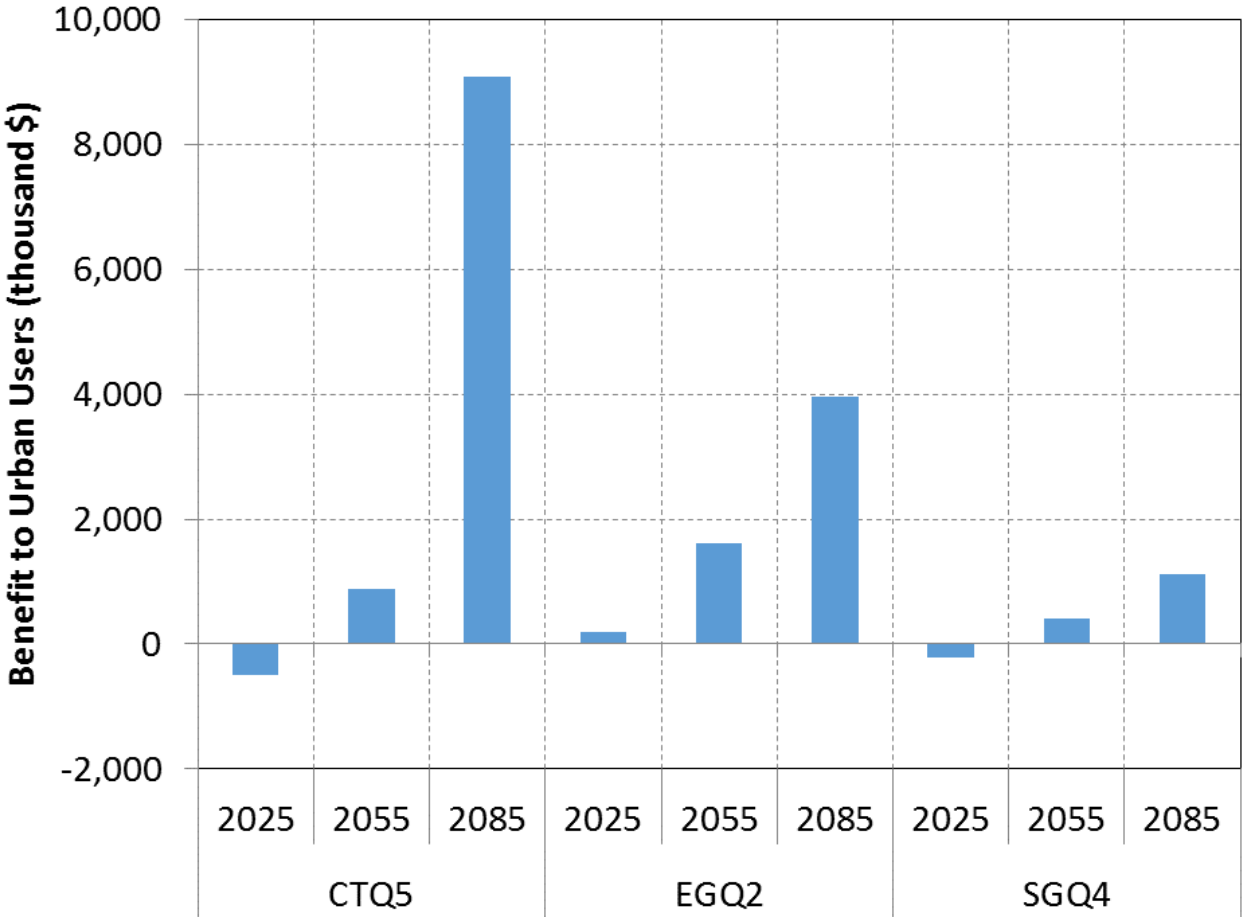
Figure 8-65 shows the change in cost of meeting urban water demand in the South Bay area with the Representative Alternative compared to the Baseline. Positive values indicate that the Representative Alternative provides a cost savings (a benefit) relative to the Baseline, while negative values indicate a cost increase relative to the Baseline. None of the socioeconomic-climate scenarios show an increase or decrease in costs greater than $1M in any year, with most changes much less. These small differences indicate no significant change in the costs of meeting urban water demand in the South Bay Area.



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

Figure 8-65. Difference in Average Annual Costs of Meeting Urban Water Demand in the South Bay Area Region from LCPSIM with the Representative Alternative Relative to the Baseline, for Select Socioeconomic-Climate Scenarios

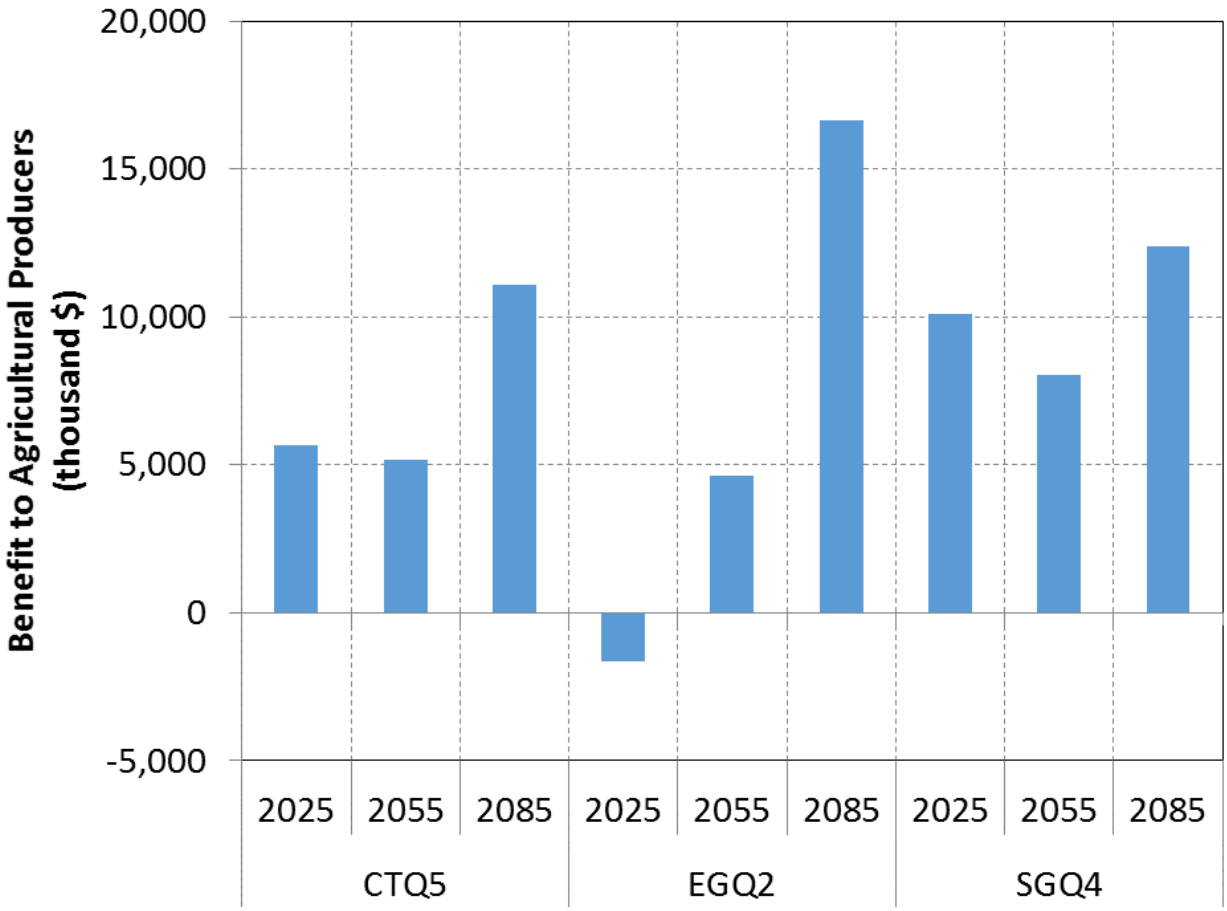
Figure 8-66 shows the cost of meeting urban water demand for CVP and SWP M&I contractors in the Central Valley, Central Coast, and American River Region with the Representative Alternative compared to the Baseline. Positive values indicate that the Representative Alternative provides a cost savings (a benefit) relative to the Baseline, while negative values indicate a cost increase relative to the Baseline. For Friant Division M&I contractors receiving additional CVP delivery, the benefit is the avoided cost of groundwater pumping. All three socioeconomic scenarios show benefits from avoided groundwater pumping costs in 2055 and 2085, with the greatest cost savings in CTQ5 in 2085.



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

Figure 8-66. Difference in Average Annual Costs of Meeting Urban Water Demand in the Central Valley from OMWEM with the Representative Alternative Relative to the Baseline, for Select Socioeconomic-Climate Scenarios

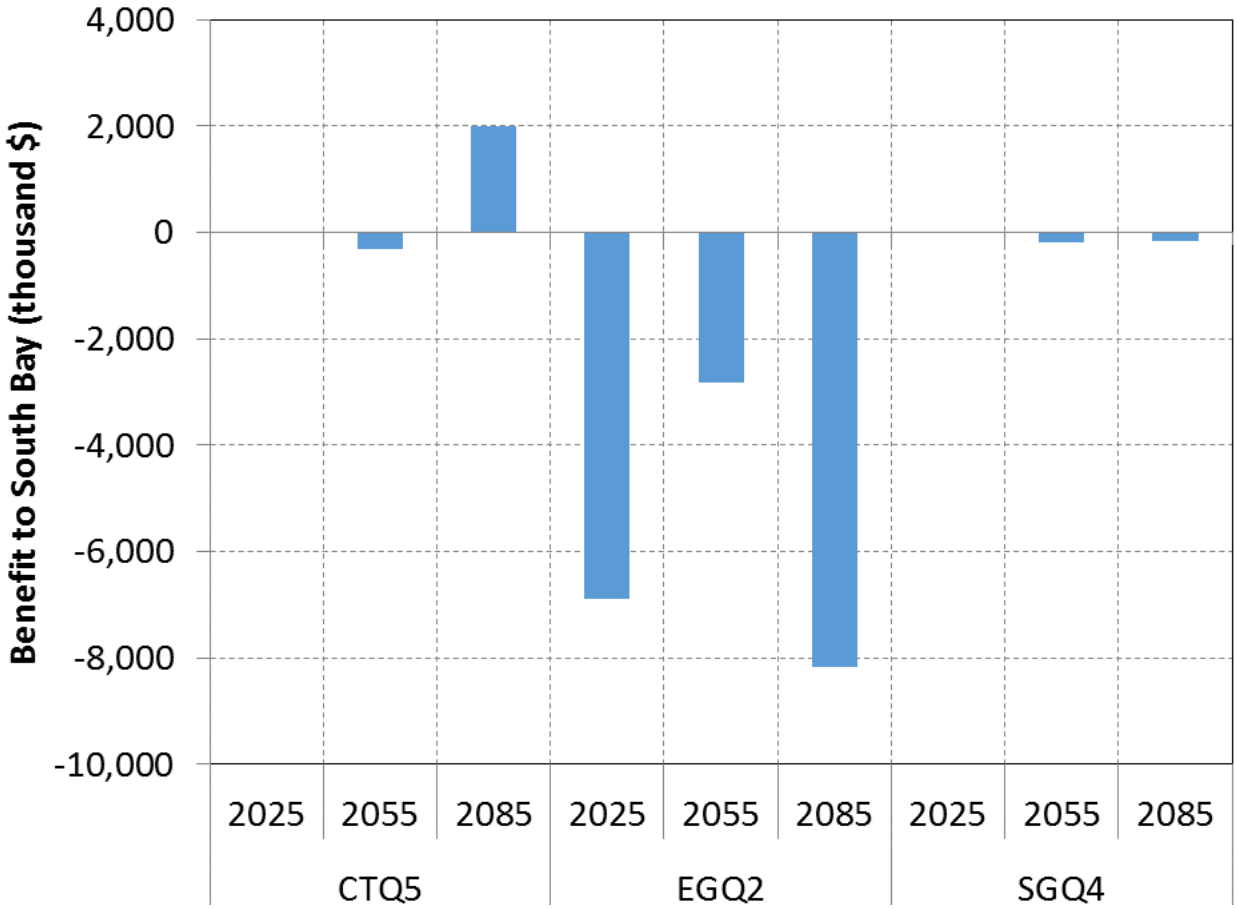
Figure 8-67 shows the change in agricultural net revenues in the Central Valley with the Representative Alternative compared to the Baseline. The values displayed are measured by subtracting average annual net revenue without the Representative Alternative (Baseline) from the average annual net revenue with the Representative Alternative. Positive values indicate higher net revenues with the Representative Alternative than with the Baseline. In scenarios CTQ5, EGQ2, and SGQ4 (all scenario/year combinations but one), Representative Alternative provides an improvement in average annual agricultural net revenues in the Central Valley. EGQ2 2085 shows the largest increase, with $60M in average annual net revenues to agriculture in the Central Valley.



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

Figure 8-67. Change in Average Annual Agricultural Net Revenue in Central Valley from SWAP with the Representative Alternative Relative to the Baseline, for Select Socioeconomic-Climate Scenarios

Figure 8-68 shows the projected change in water quality-related costs for Contra Costa Water District and the South Bay area. In EGQ2, there is an increase in costs of $2 million per year to $8 million per year in all three periods due to higher salinity in the Delta with the Representative Alternative compared to the Baseline. This is caused by reductions in San Joaquin River inflow into the Delta with the Representative Alternative. By contrast, CTQ5 has a cost reduction benefit of about $2 million per year due to a modest improvement in Delta water quality.

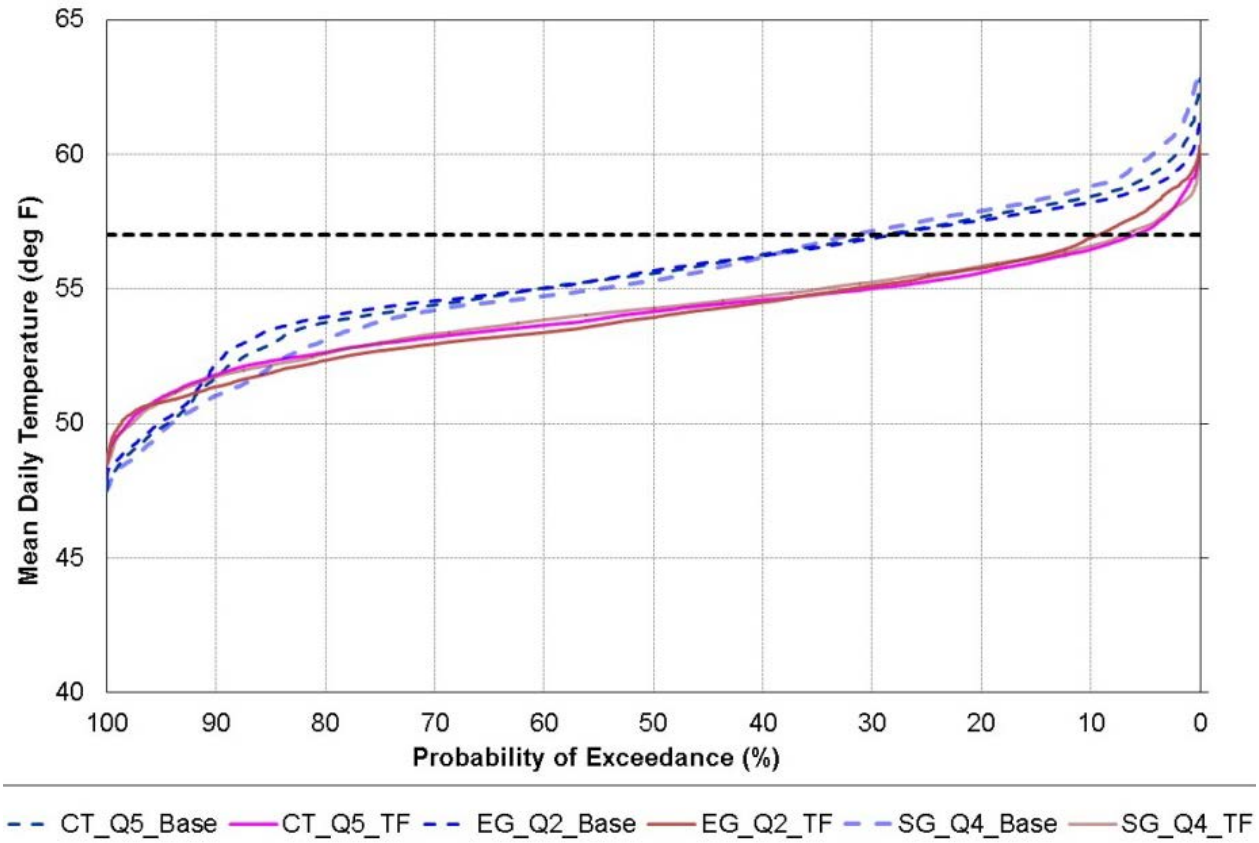


Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

Figure 8-68. Change in Average Annual Avoided Water Quality Costs in South Bay Region from SBWQM with the Representative Alternative Relative to the Baseline, for Select Socioeconomic-Climate Scenarios

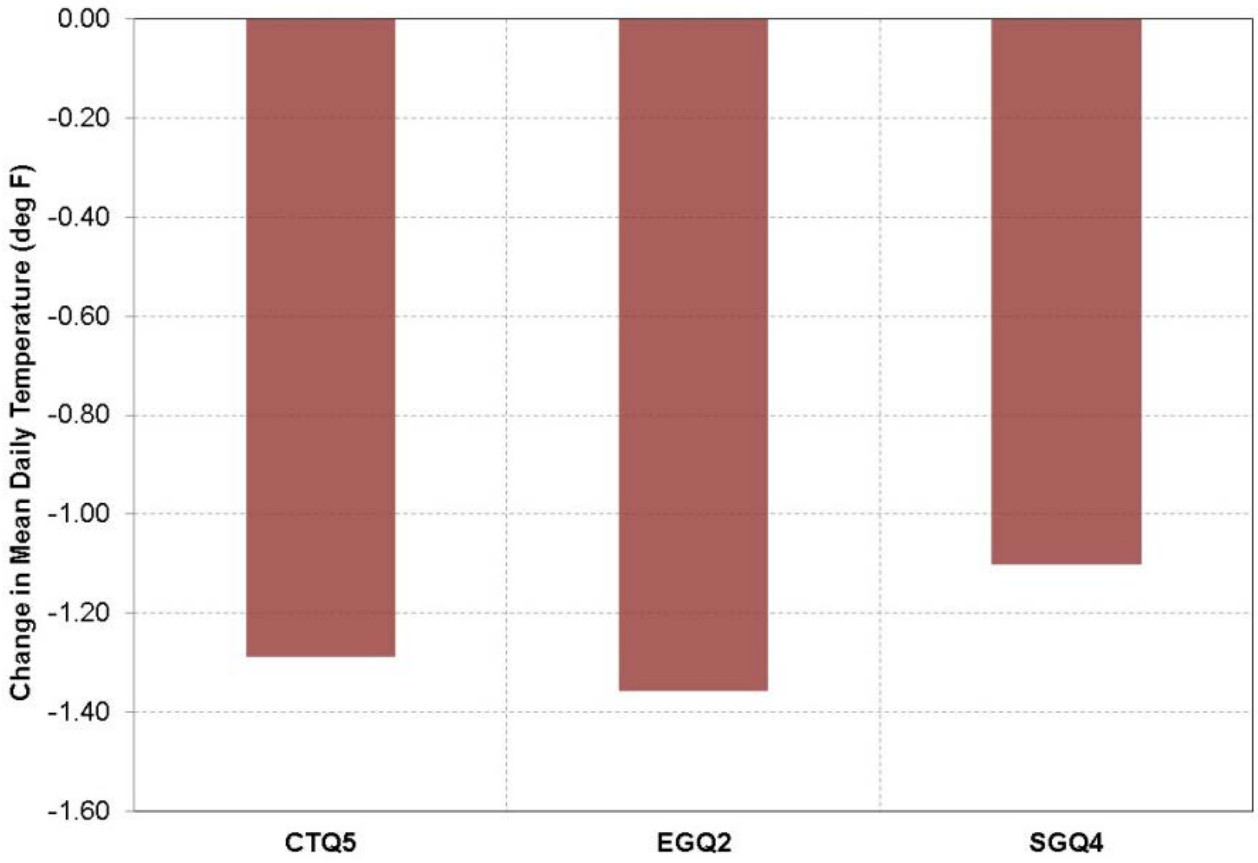
Water Temperature Figure 8-69 through Figure 8-74 are exceedence plots of average changes in mean daily temperatures relative to the Baseline for the CT-Q5, EG-Q2 and SG-Q4 scenarios at the 2025, 2055, and 2085 LODs in the San Joaquin River at Lost Lake, at Gravelly Ford, and at Vernalis.

As can be observed in Figure 8-69 and Figure 8-70, the Representative Alternative provides considerable reductions in water temperatures at Lost Lake relative to the Baselines. The probability of exceeding the 56°F threshold decreases from about 30 percent to 10 percent, with an average reduction of more than 1°F in all socioeconomic-climate scenarios.



Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

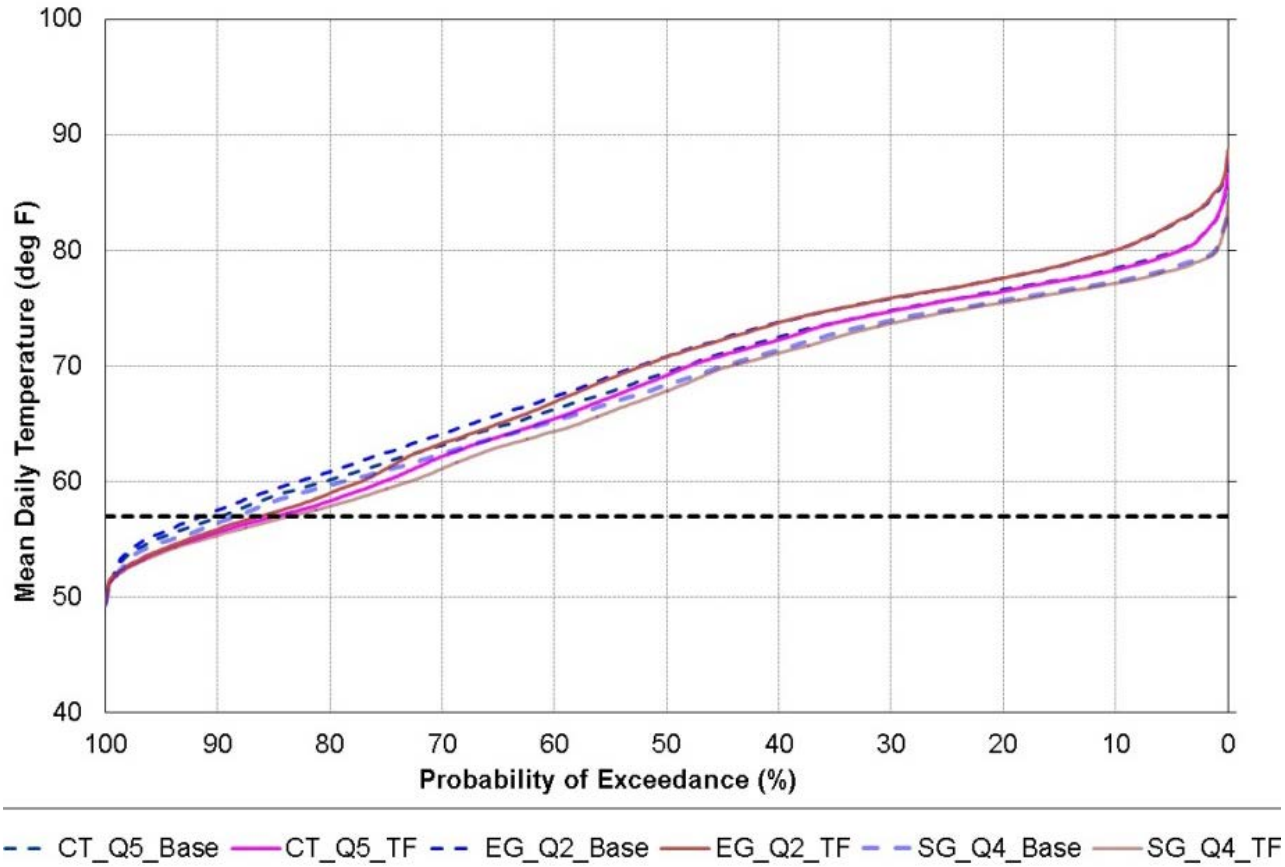
Figure 8-69. Exceedence of Mean Daily Temperature on San Joaquin River at Lost Lake from August-to-November with the Baseline and Representative Alternative



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

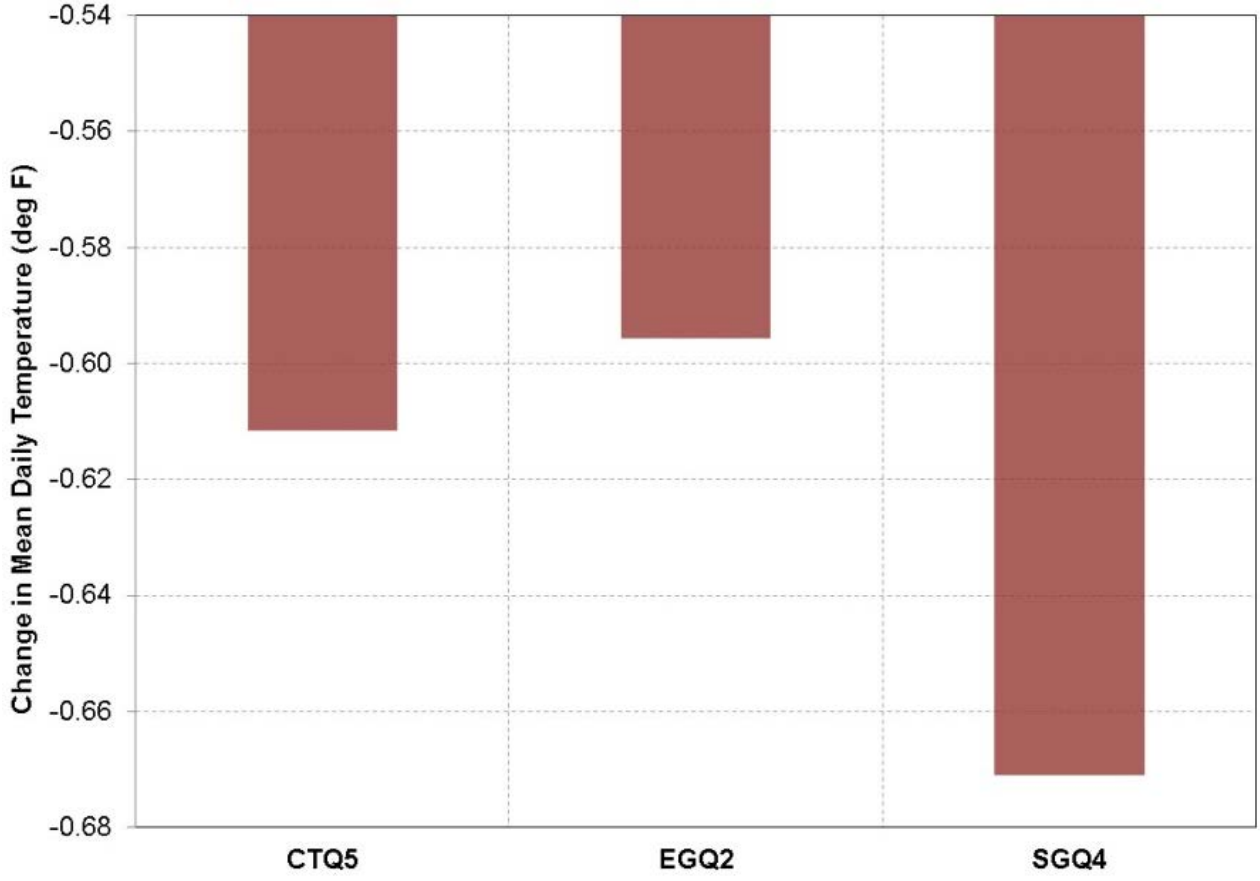
Figure 8-70. Change in Mean Daily Temperature on San Joaquin River at Lost Lake from August-to-November with the Representative Alternative Relative to the Baseline

As shown in Figure 8-71 and Figure 8-72, the results at Gravelly Ford are similar to Lost Lake; however, the changes in exceedance of the 56°F threshold (dashed horizontal line) occur with much higher probability (85 to 90 percent) and with much smaller, but still potentially significant, changes in water temperature (-0.59 to -0.67°F) relative to the Baseline.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

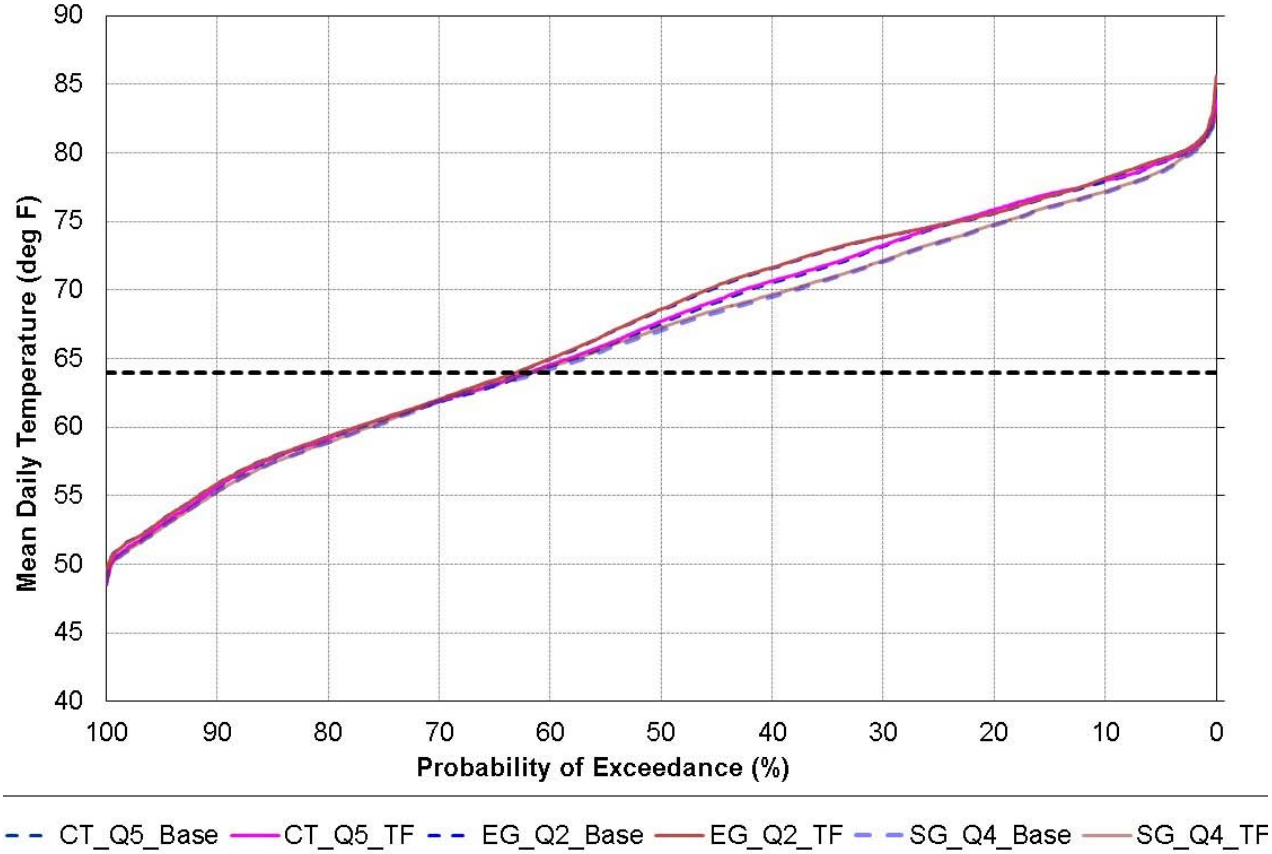
Figure 8-71. Exceedence of Mean Daily Temperature on San Joaquin River at Gravelly Ford from August-to-November with the Baseline and Representative Alternative



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

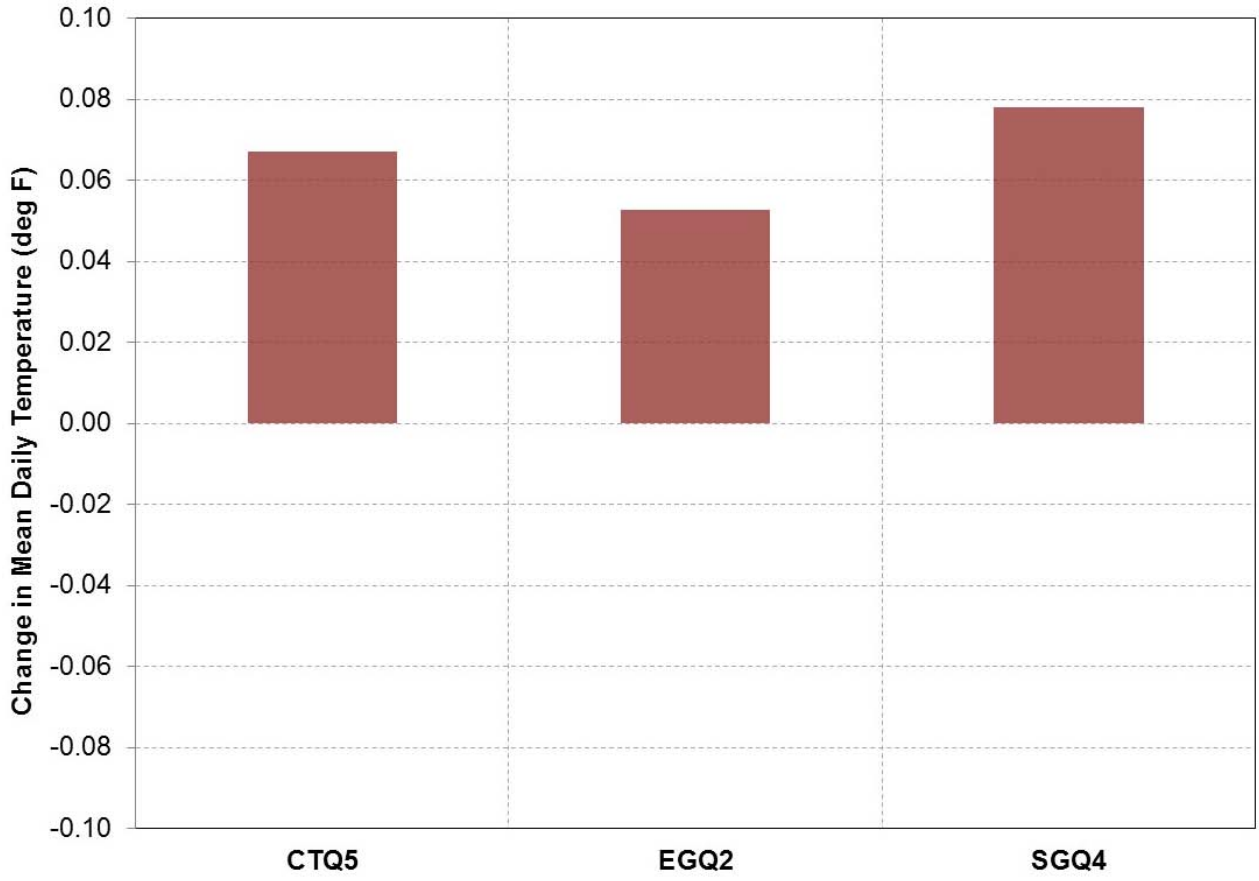
Figure 8-72. Change in Mean Daily Temperature on San Joaquin River at Gravelly Ford from August-to-November with the Representative Alternative Relative to the Baseline

In the San Joaquin River at Vernalis, the effects of socioeconomic and climate changes on the Representative Alternative on water temperatures are projected to be insignificant, because air temperature dominates the equilibrium water temperatures. This is shown in Figure 8-73 and Figure 8-74.



Note: For each scenario, the Baseline is represented by dashed lines and Representative Alternative by solid lines.
Key:
Base = Baseline
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth
TF = Temperance Flat (a.k.a. Representative Alternative)

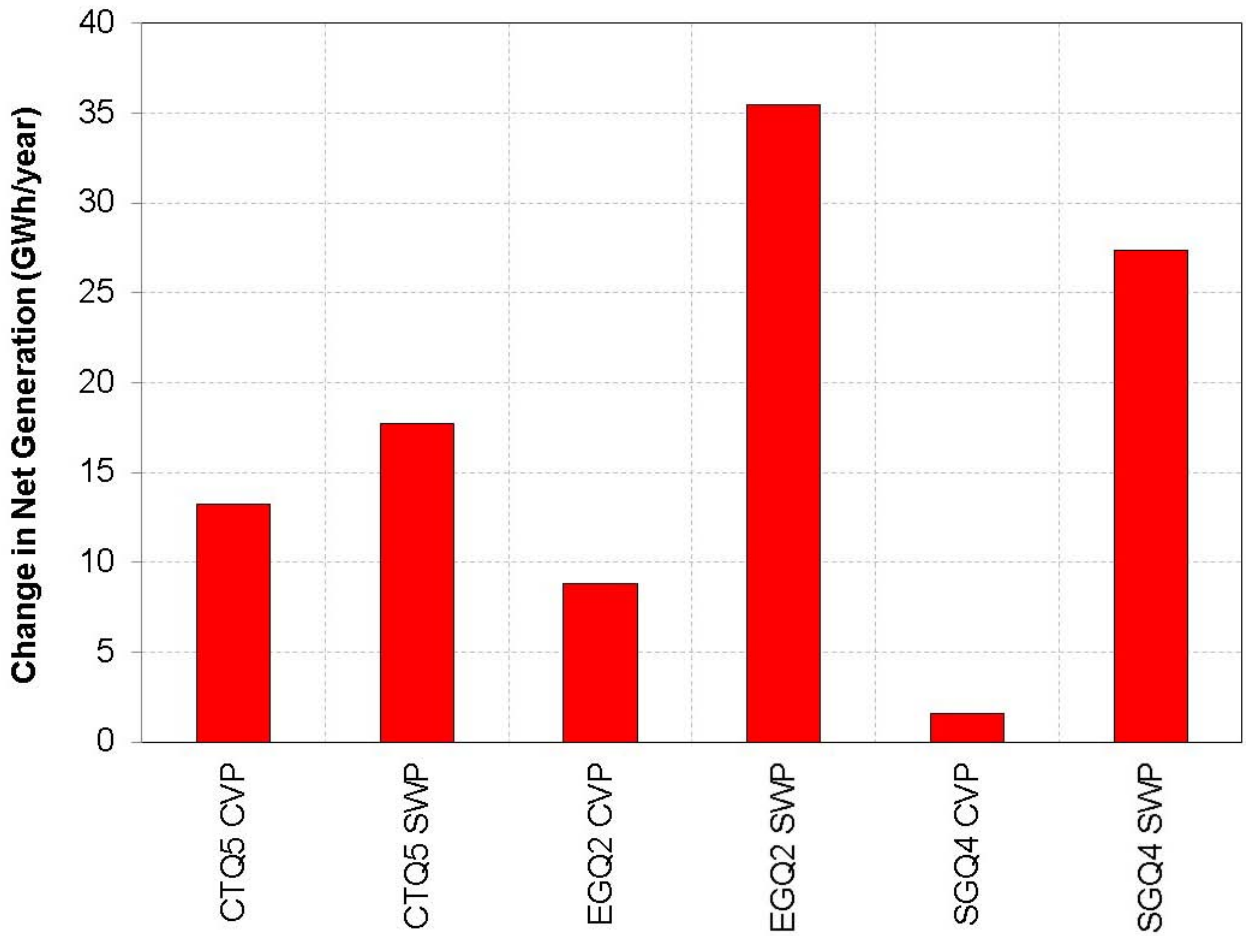
Figure 8-73. Exceedence of Mean Daily Temperature on San Joaquin River at Vernalis from August-to-November with the Baseline and Representative Alternative



Key:
CT = Current Trends
EG = Expansive Growth
SG = Slow Growth

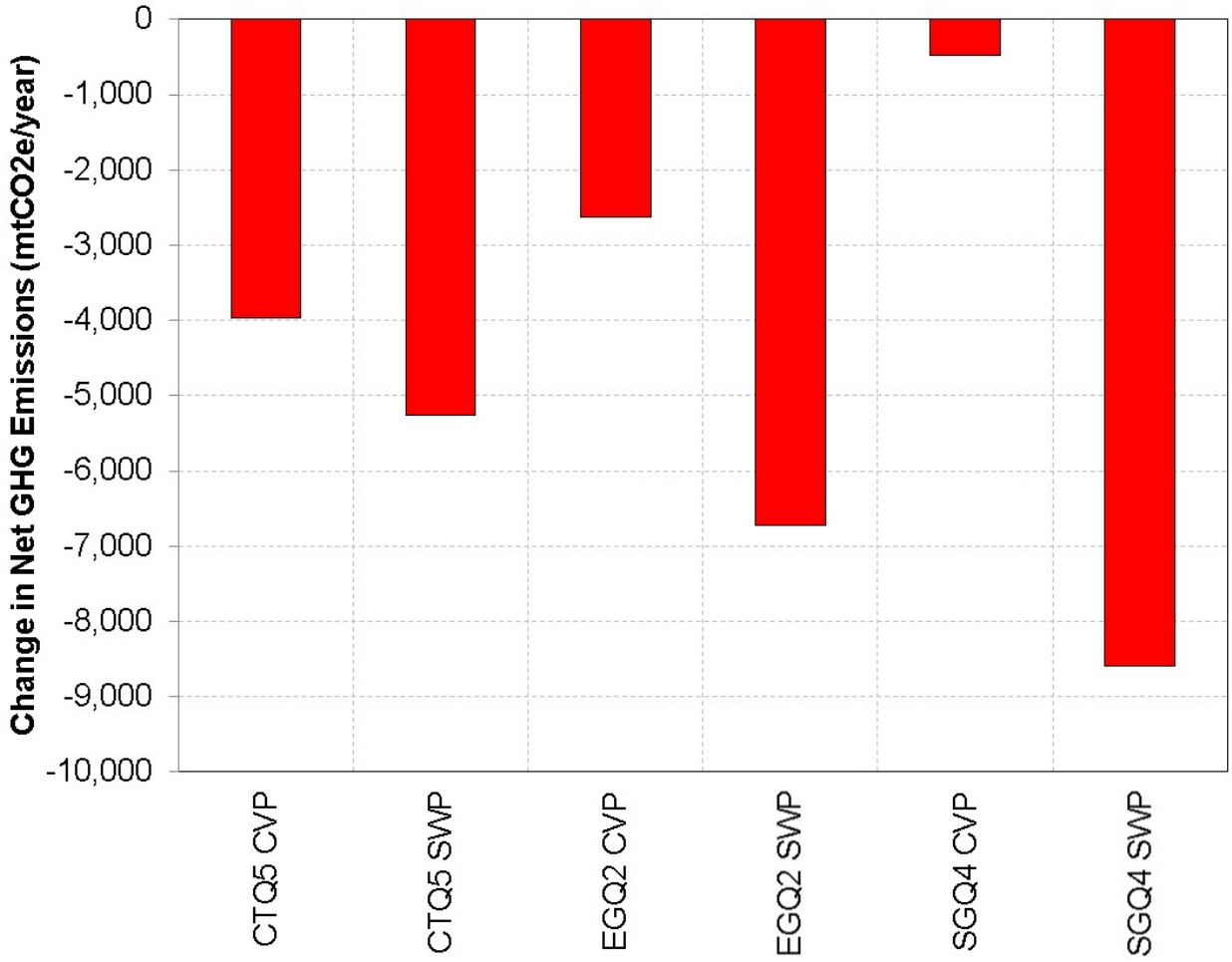
Figure 8-74. Change in Mean Daily Temperature on San Joaquin River at Vernalis from August-to-November with the Representative Alternative Relative to the Baseline

Hydropower and GHG Emissions Figure 8-75 and Figure 8-76 show the changes in net power generation and net GHG emissions in the CVP and SWP systems for the Representative Alternative relative to the Baseline. Across the range of socioeconomic-climate scenarios, the Representative Alternative increases net power generation for both the CVP and SWP systems. As the net power generation increases, the GHG emissions for both the CVP and SWP systems decrease.



Key:
CT = Current Trends
CVP = Central Valley Project
EG = Expansive Growth
GWh = gigawatt hour
SG = Slow Growth
SWP = State Water Project

Figure 8-75. Change in Average Annual Net Energy Generation for the CVP and SWP Systems with the Representative Alternative



Key:
CT = Current Trends
CVP = Central Valley Project
EG = Expansive Growth
GHG = greenhouse gas
mtCO2e = metric tons CO2 equivalent
SG = Slow Growth
SWP = State Water Project

Figure 8-76. Change in Average Annual Net GHG Emissions for the CVP and SWP Systems with the Representative Alternative

Effects of Climate Change on the Impacts Anticipated Under the Action Alternatives

This section examines the relationship of climate change effects to the environmental impacts and mitigation measures presented in Chapters 4 through 7, and 9 through 26, consistent with the guidance provided by CEQ on February 18, 2010, regarding the consideration of the effects of climate change in NEPA documents: "Agencies should consider specific effects of the proposed action (include the proposed actions' effect on

the vulnerability of affected ecosystems), the nexus of those effects with projected climate change effects on the same aspects of our environment, and the implications for the environment to adapt to the projected effects of climate change." This guidance suggests that NEPA documentation should take climate change into account for any and all resources for which the effects of a proposed action might interact with climate changes. This section discusses impacts after implementation of proposed mitigation measures that are anticipated under the action alternatives for a range of possible future socioeconomic-climate scenarios. This discussion relies on information provided previously in this chapter and in greater detail in the Climate Change attachment to the Modeling Appendix.

Resources Eliminated from Further Analysis

The following resources are eliminated from further discussion because the effects of the proposed alternatives are not expected to interact with climate changes: environmental justice; cultural resources; Indian Trust Assets (ITA); noise and vibration; paleontological resources; transportation, circulation and infrastructure; and utilities and service systems. This may be the case either because (1) the action alternatives would have no impact (i.e., cultural resources; ITAs; environmental justice; noise and vibration; and paleontological resources in the extended study area) and, therefore, any climate change effects would be unrelated to the project, or (2) because climate change is not expected to alter the outcome of the impacts from the action alternatives (i.e., noise and vibration in the primary study area; paleontological resources; transportation, circulation and infrastructure in the primary or extended study areas).

Additionally, there would be no effects to air quality aside from GHG emissions, which are addressed in Chapter 4, "Air Quality and Greenhouse Gas Emissions."

Biological Resources – Fisheries and Aquatic Ecosystems

As discussed in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," in the primary study area, the action alternatives could result in impacts related to the following:

- Loss of riverine habitat for lotic fish species (Impact FSH-1, significant and unavoidable)

- Short-term degradation of aquatic habitat from accidental spills or seepage of hazardous materials during construction of Temperance Flat RM 274 Dam and other facilities (Impact FSH-2, less than significant

- Short-term degradation of aquatic habitat from increased turbidity or sedimentation during construction of Temperance Flat RM 274 Dam and other facilities (Impact FSH-3, less than significant)

- Loss of reservoir fish habitat resulting from changes in water temperature (Impact FSH-4, less than significant)

- Changes to reservoir fish habitat caused by turbidity from increased surface area of exposed shoreline (Impact FSH-5, less than significant)

- Loss of reservoir fish caused by entrainment (Impact FSH-6, less than significant)

- Change in shallow-water habitat for largemouth bass, spotted bass, smallmouth bass and other sport fish species (Impact FSH-7, beneficial)

- Change in open-water habitat for striped bass and American shad (Impact FSH-8, beneficial)

- Loss of spawning habitat of American shad and striped bass (Impact FSH-9, significant and unavoidable)

In the extended study area, the action alternatives could result in impacts related to the following:

- Change in habitat potential for spring-run Chinook salmon (Impact FSH-10, less than significant and beneficial for Alternative Plans 1 through 4, potentially significant and unavoidable for Alternative Plan 5)

- Change in water temperature conditions supporting juvenile salmon and steelhead migration (Impact FSH-11, significant and unavoidable)

- Change to habitat for moderately tolerant native fish species from altered water temperatures (Impact FSH-12, less than significant and beneficial)

- Change to habitat for highly tolerant native fish species from altered water temperatures (Impact FSH-13, less than significant and beneficial)
- Changes to spawning and rearing habitat from changes to flood pulses and floodplain connectivity (Impact FSH-14, less than significant)
- Change in fish habitat and migratory behaviors resulting from changes in water temperatures (Impact FSH-15, no impact)
- Change in fish habitat and migratory behaviors resulting from changes in flows (Impact FSH-16, less than significant)
- Loss of fish habitat resulting from changes in tributary flows (Impact FSH-17, no impact)
- Effects on Delta fish habitat from changes in water temperatures and DO concentrations (Impact FSH-18, potentially significant and unavoidable)
- Loss of suitable fish habitat from salinity changes in the Delta (Impact FSH-19, less than significant)
- Loss of suitable fish habitat from change in flow patterns in the south Delta (Impact FSH-20, less than significant)
- Reduction in fish abundance from changes in exports and entrainment in the south Delta (Impact FSH-21, less than significant and beneficial)
- Loss of suitable fish habitat resulting from changes in X2 (Impact FSH-22, less than significant)

Primary Study Area

Climate change could result in Millerton Lake receiving more inflow from precipitation than from snowmelt, as compared to the NoCC scenarios. Inflows would also occur earlier in the year, as shown in Figure 8-4. This change could result in higher releases from Millerton Lake in the winter and spring to maintain flood control space given the earlier timing of snowmelt and increased percentage of precipitation occurring as rainfall (and potentially more intense storms), as compared to the action alternatives without climate change.

Further, increases in water temperature would occur in Millerton Lake overall, particularly later in the year as water levels decrease. Other water quality changes may also occur, as described in Chapter 15, "Hydrology – Surface Water Quality." It is expected that under climate change water temperatures would increase downstream from Friant Dam, as shown in Figure 8-69.

As stated in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," black bass spawning production could benefit from increasing rates of egg and larval development at warmer water temperatures. However, spotted bass and largemouth bass cease spawning when water temperatures exceed about 72°F (Moyle 2002) and 76°F (Mitchell 1982), respectively, and these water temperatures are exceeded more frequently under the action alternatives, although to a less than significant level. Sufficient data are not available to determine if increasing water temperatures resulting from climate change would alter the overall survival for reservoir fish species under the action alternatives. However, because increased water temperatures would have both beneficial (creating conditions for increased rates of egg and larval development) and detrimental effects (once temperatures exceed suitable conditions) on reservoir fishes, it is assumed that the impact conclusions would not be substantially different with or without climate change.

High turbidity and sedimentation have a number of potentially adverse effects on fish, including smothering eggs, injury to gills, impairment of visual feeding, and reducing food web production (Kerr 1995). Increased turbidity under the action alternatives would potentially suppress fish production in the proposed Temperance Flat RM 274 Reservoir. Any such suppression under the action alternatives would be offset by improved habitat conditions in Millerton Lake and an overall increase in habitat availability by the addition of Temperance Flat RM 274 Reservoir. Erosion and sedimentation are expected to be similar with and without climate change (see the Geology and Soils section).

The increases in spawning production of largemouth bass and spotted bass due to reservoir habitat changes under the action alternatives (an increase in shallow water habitat and less water level fluctuation) would be beneficial. Effects of the action alternatives on production of smallmouth bass and other warm-water sport fishes (e.g., crappie and sunfish) would be similar to the results predicted by the Black Bass Spawning Production

model simulations for largemouth and spotted bass. Under climate change, runoff would occur earlier in the water year than without climate change, and reservoir elevation could be low for a longer period of time. This could attenuate some benefits of increases in shallow water habitat for reservoir fish realized under the action alternatives. Because of the variability and uncertainty associated with potential climate change effects in conjunction with the action alternatives, it is unknown to what degree climate change would alter the outcome of the action alternatives in the respect. However, the overall significance conclusions presented in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," would not be expected to change.

Extended Study Area

Impacts relating to temperature and habitat changes (Impact FSH-11 and Impact FSH-18) were determined to be significant in the extended study area. The remaining impacts were determined to be beneficial, less than significant, or have no impact. In the extended study area, the action alternatives each have small beneficial but variable effects on spring-run Chinook salmon habitat potential (Impact FSH-10), with the effects varying by water year type and SAR scenario. Beneficial effects in Alternative Plans 1 through 4 are the result of decreases in water temperature conditions in Reaches 1 and 2; whereas these beneficial effects are absent in Alternative Plan 5.

Comparing Figure 8-40 and Figure 8-69, under climate change the Representative Alternative provides for lower water temperature releases from Millerton Lake under a wide range of potential future climate changes.

Impact FSH-14 addresses changes to spawning and rearing habitat from changes to flood pulses and floodplain connectivity. As stated in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," 10-year and more frequent flood pulses are strongly linked to floodplain habitat formation processes that are beneficial to native fish species. The action alternatives would have a less than significant impact on species like splittail and Chinook salmon that require or rely strongly on functional floodplain habitats (Matella and Merenlender 2014, Sommer et al. 1997). It is unknown how changes in flow regime under climate change, and associated changes in facility operation would change the outcome of this result; however, it is expected that the impact conclusions would not differ substantially with or without climate change.

Climate change is expected to result in sea-level rise during this century, which would have effects on Delta salinity levels due to greater tidal excursion. This, in turn, would affect the location of X2 from February through June, moving X2 upstream. This general trend is shown on Figure 8-19 (Baseline) and Figure 8-56 and Figure 8-57 (Representative Alternative) and would have adverse effects to native species in the Delta under both the No Action Alternative and action alternatives.

It is unknown how changes in flow regime would affect Delta hydrodynamics under climate change, or how associated changes in facility operation would change the outcome of this result, but it is expected that the impact conclusions would not differ substantially with or without climate change.

The degree that climate change would alter the outcome of the action alternatives is unknown because of the variability and uncertainty associated with potential climate change. The negative effects of climate change on water temperature, Delta salinity, and changes in flow regimes have the potential to be greater than the benefits realized from the action alternatives (Impact FSH-10) or to change some impacts from less than significant or no impact to significant.

Biological Resources – Botanical and Wetlands

As discussed in Chapter 6, “Biological Resources – Botanical and Wetlands,” implementing any action alternative would result in the following impacts on botanical resources and wetlands in the primary study area:

- Loss of special-status plants and loss or degradation of special-status plant habitat (Impact BOT-1, less than significant)
- Loss or riparian habitat and other sensitive communities (Impact BOT-2, significant and unavoidable)
- Loss or degradation of waters of the United States, including wetlands, and waters of the state (Impact BOT-3, less than significant)
- Introduction and spread of invasive plants (Impact BOT-4, less than significant)
- Elimination of a plant community or substantial reduction in the number of or restriction of the range of

an endangered, rare, or threatened plant species (Impact BOT-5, less than significant)

- Conflict with local or regional policies and plans protecting wetland or botanical resources (Impact BOT-6, less than significant)

- Conflict with provisions of an adopted habitat conservation plan protecting wetland or botanical resources (Impact BOT-7, no impact)

In the extended study area, the action alternatives could result in impacts related to the following:

- Loss of special-status plants and loss or degradation of special-status plant habitat (Impact BOT-1, less than significant)

- Loss or riparian habitat and other sensitive communities (Impact BOT-2, less than significant)

- Introduction and spread of invasive plants (Impact BOT-4, less than significant)

Primary Study Area

Under climate change, terrestrial habitats could be negatively affected by increased spread of invasive species (EPA and DWR 2011). Increased temperatures and variations in precipitation (shown in the Climate Change attachment to the Modeling Appendix) may also displace some native species that may not compete well under changing conditions. Optimal climate conditions for native species may move to higher elevations; however, these areas may not always be available or suitable for colonization of plant species, depending on land use and other physical conditions, such as substrate characteristics. Climate change is expected to stress forested areas, making them more susceptible to pests and disease, which would further alter species composition. It is also projected that climate change would increase the frequency and intensity of wildfires (EPA and DWR 2011). Changes in the distribution of native plant species and habitats under climate change would exacerbate negative impacts on plant species and habitats from implementation of the action alternatives.

Regardless of whether an action alternative is implemented, climate change is likely to place additional stress on the botanical and wetlands resources within the primary study area,

which have been and continue to be adversely affected by past, present, and reasonably foreseeable actions. Significant effects from the action alternatives, however, are not expected except for riparian habitat. Because the impacts on botanical and wetland resources within the primary study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Extended Study Area

Climate change effects on habitats and species in the extended study area would generally be the same as in the primary study area. However, significant effects from the action alternatives are not expected. Because the impacts on botanical and wetland resources within the extended study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Biological Resources – Wildlife

As described in Chapter 7, "Biological Resources – Wildlife," the action alternatives may affect various wildlife species in the primary study area related to the following:

- Substantial impact on special-status invertebrates (Impact WLD-1, less than significant)
- Substantial impact on special-status amphibians and reptiles (Impact WLD-2, less than significant)
- Substantial impacts on special-status raptors (Impact WLD-3, significant and unavoidable)
- Substantial impact on special-status passerines of birds protected by the Migratory Bird Treaty Act (Impact WLD-4, less than significant)
- Substantial impact on ringtail (Impact WLD-5, less than significant)
- Substantial impact on American badger (Impact WLD-6, less than significant)
- Substantial impact on San Joaquin Pocket Mouse (Impact WLD-7, less than significant)

- Substantial impact on special-status bat species (Impact WLD-8, less than significant)
- Substantial impact on migratory and wintering deer herds (Impact WLD-9, less than significant)
- Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines (Impact WLD-10, significant and unavoidable)
- Conflict with local or regional policies protecting wildlife resources (Impact WLD-17, no impact)
- Potential Conflict with adopted conservation plans (Impact WLD-18, no impact)

In the extended study area, the action alternatives could result in impacts related to the following:

- Potential reduction in habitat or populations of special-status invertebrates (Impact WLD-11, less than significant)
- Potential reduction in habitat or populations of special-status amphibians and reptiles (Impact WLD-12, less than significant)
- Potential reduction in habitat or populations of special-status bird species (Impact WLD-13, less than significant)
- Potential reduction in habitat or populations of special-status mammal species (Impact WLD-14, less than significant)
- Potential interference with migratory corridors or nursery sites (Impact WLD-15, less than significant)
- Potential impact on riparian habitat for special-status bird species (Impact WLD-16, less than significant)
- Conflict with local or regional policies protecting wildlife resources (Impact WLD-17, no impact)
- Potential Conflict with adopted conservation plans (Impact WLD-18, no impact)

Primary Study Area

Few impacts on wildlife would occur under the action alternatives after mitigation. Climate change would not change these impact conclusions. As stated in the Biological Resources – Botanical and Wetlands section of this chapter, climate change may affect species and habitat composition due to changes in temperature and precipitation. Therefore, although the impact conclusions would not change, climate change has the potential to cause negative impacts on wildlife due to detrimental effects on habitat.

Extended Study Area

In the extended study area, the action alternatives were determined to have no impact or less-than-significant impacts for all wildlife resources evaluated. Although climate change would have negative effects on species and habitat, as discussed above, these effects are not expected to change the impact conclusions for action alternatives.

Geology and Soils

As discussed in Chapter 11, "Geology and Soils," the action alternatives could result in local impacts in the primary study area related to the following:

- Exposure of structures and people to geologic hazards resulting from seismic conditions and slope instability (Impact GEO-1, less than significant)
- Alteration of fluvial geomorphology and hydrology that would adversely affect aquatic habitat (Impact GEO-2, significant and unavoidable)
- Loss or diminished availability of known mineral resources that would be of future value to the region or State (Impact GEO-3, less than significant)
- Substantial soil erosion or loss of topsoil due to construction and operations (Impact GEO-4, potentially significant and unavoidable)
- Failure of septic tanks or alternative wastewater disposal systems due to soils that are unsuited to land application of waste (Impact GEO-5, less than significant)

In the extended study area, the action alternatives could result in impacts related to the following:

- Alteration of fluvial geomorphology and hydrology of aquatic habitats (Impact GEO-2, less than significant)
- Loss or diminished availability of known mineral resources that would be of future value to the region (Impact GEO-3, less than significant)
- Substantial soil erosion or loss of topsoil due to construction and operations (Impact GEO-4, less than significant)

Primary Study Area

Under the action alternatives, alteration of fluvial geomorphology and hydrology of aquatic habitats would occur related to formation of the proposed Temperance Flat RM 274 Reservoir. As discussed in Chapter 11, "Geology and Soils," when the reservoir is high and regional flooding occurs, sediment transported from the uplands would be deposited as deltas at the confluence of the streams and lake. When the lake level is low, stream channels within the inundation zone are likely to be channelized as streamflows downcut into delta deposits.

Under climate change, inflow peaks would occur earlier in the water year (Figure 8-4) and, therefore, delta formation at the confluence of lakes and streams would occur earlier in the water year; further, more channelization could occur from downcutting into the delta deposits during the remainder of the year. Certain climate change scenarios could also result in greater inflows to Temperance Flat RM 274 Reservoir (Figure 8-4). Erosion along the shorelines of Millerton Lake and Temperance Flat RM 274 Reservoir would be similar with or without climate change, but would reflect the change in the zone of fluctuation (i.e., occurring at higher elevations during the winter months, and lower elevations during the remainder of the water year).

Because the impacts on geology and soils within the primary study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Extended Study Area

As previously mentioned and shown in Figure 8-4, climate change could result in an increase in winter inflow into the upper San Joaquin River Basin, necessitating higher reservoir releases from Millerton Lake during these periods to maintain

flood storage space and manage resulting flood events. The potential increase in releases from the reservoir could lead to long-term changes in downstream channel equilibrium. Although the action alternatives would potentially diminish these effects by increasing storage capacity, as described in Chapter 11, "Geology and Soils," the action alternatives are not expected to result in long-term changes to channel equilibrium or shoreline erosion downstream from Friant Dam either with or without climate change.

Because the impacts on geology and soils within the extended study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Hydrology – Flood Management

As discussed in Chapter 12, "Hydrology – Flood Management," the action alternatives could result in impacts in the primary study area related to the following:

- Exposure of people or structures to a significant risk or loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam (Impact FLD-1, less than significant)

- Substantially alter the existing drainage pattern of the site or area, including alternating the course of a stream or river, or substantially increasing the rate or amount of surface runoff in a manner that would result in onsite or offsite flooding (Impact FLD-2, less than significant)

- Place within a 100-year flood hazard area structure which would impede or redirect flood flows (Impact FLD-3, no impact)

In the extended study area, the action alternatives could result in impacts related to the following:

- Exposure of people or structures to a significant risk or loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam (Impact FLD-1, less than significant and beneficial)

- Substantially alter the existing drainage pattern of the site or area, including through the alternation of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which

would result in onsite or offsite flooding (Impact FLD-2, less than significant)

- Place within a 100-year flood hazard area structure which would impede or redirect flood flows (Impact FLD-3, no impact)

Primary Study Area

The action alternatives would increase local runoff to San Joaquin RM 274 from construction-related activities and from permanent structures near Temperance Flat RM 274 Reservoir (Impact FLD-2, less than significant). However, implementation of BMPs would minimize runoff from permanent facilities. Climate change effects of runoff occurring earlier in the year (Figure 8-4) are not expected to result in significant changes to the effects from the action alternatives. The action alternatives would have no impact related to impeding or redirecting flood flows in the primary study area; this result would not change when considered in the context of climate change, and the impact significance conclusions for this resource topic are not expected to change.

Extended Study Area

Under the action alternatives, the additional storage provided by Temperance Flat RM 274 Reservoir would reduce the magnitude and frequency of flood releases from Friant Dam and therefore lower the potential for loss, injury, or death involving flooding in the extended study area. As previously mentioned, climate change could result in earlier inflow into the upper San Joaquin River Basin, necessitating higher reservoir releases from Millerton Lake during these periods to maintain the flood pool and manage resulting flood events. The action alternatives would potentially diminish these climate-related effects by increasing storage capacity; therefore, no long-term changes are expected for the exposure of people or structures to a significant risk of loss, injury, or death involving flooding with or without climate change.

The action alternatives would not alter the course of the San Joaquin River or alter the rate or amount of surface runoff downstream from Friant Dam, and are expected to have only residual impacts in the extended study area, due to the use of BMPs in the primary study area. Climate change would result in runoff occurring earlier in the year (Figure 8-4) and could result in greater flood peaks, especially under the wetter Q4 climate change scenarios (Figure 8-23 and Figure 8-24). However, the action alternatives would have no impact related

to impeding or redirecting flood flows in the extended study area, and this result would not change when considered in the context of climate change.

Because the impacts on flood management within the extended study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Hydrology – Groundwater

As discussed in Chapter 13, "Hydrology - Groundwater," because of the speculative nature of impacts on groundwater resources in the primary study area, only impacts in the extended study area were identified, and would be related to the following:

- Change in groundwater levels (Impact GRW-1, less than significant [Alternative Plans 1 and 5], less than significant and beneficial [Alternative Plans 2, 3, and 4])

- Change in groundwater quality (Impact GRW-2, less than significant [Alternative Plans 1 and 5], less than significant and beneficial [Alternative Plans 2, 3, and 4])

Primary Study Area

The action alternatives would have no impact on groundwater in the primary study area. No additional impacts would be anticipated when climate change is considered.

Extended Study Area

Impacts GRW-1 and GRW-2 are linked, in that increased pumping would both decrease groundwater levels and could degrade groundwater quality. Alternative Plan 1 could slightly increase reliance on groundwater pumping in the CVP SOD water service area because of a small reduction in surface water deliveries relative to the No Action Alternative. Several future reasonably foreseeable actions (e.g., groundwater recharge/banking projects, increased regulation of groundwater by the State) could affect groundwater pumping in the extended study area. However, the action alternatives would have either a less-than-significant (Alternative Plans 1 and 5) or less-than-significant and beneficial (Alternative Plans 2 through 4) impact on groundwater resources.

In the climate change impact assessment, groundwater levels in all socioeconomic-climate scenarios were constrained to not exceed historical minimum groundwater levels. It is possible that the effects of reduced inflows into Millerton Lake, as shown in Figure 8-5, could initially cause increases in groundwater pumping; however, long-term reduction in inflows could discourage planting of annual crops and, thereby, reduce groundwater demand and pumping. Figure 8-64 suggests that the Representative Alternative may reduce unmet demand under climate change and likely reduce groundwater pumping. Therefore, there would be no change in impact significance conclusions for this topic under climate change.

Hydrology – Surface Water Supplies and Facilities Operations

The action alternatives would not impact surface water supplies and facilities in the primary study area. In the extended study area, the action alternatives could result in impacts related to the following:

- Change in water levels in the Old River near the Tracy Road Bridge (Impact SWS-3, less than significant)
- Change in water levels in the Grant Line Canal above the Grant Line Canal barrier (Impact SWS-4, less than significant)
- Change in water levels in the Middle River near the Howard Road Bridge (Impact SWS-5, less than significant)

Primary Study Area

Under climate change, runoff would occur earlier in the water year than without climate change, as shown in Figure 8-4, and reservoir elevation could be low for a longer period under drier climate change scenarios, as shown in Figure 8-14 and Figure 8-51. With the implementation of the action alternatives, changes in Millerton Lake volumes and surface water elevations would be within typical historical ranges and would not impede existing diversion facilities at Friant Dam. That is, Millerton Lake would not fall below the diversion points for the Friant-Kern and Madera Canals and the outlet to the San Joaquin River. Climate change may result in lower reservoir elevations for a longer period, as shown in Figure 8-14, but the impact on existing diversion facilities would not change and the storage in Millerton Lake would not fall below 130 TAF (Figure 8-48 and Figure 8-49). The impacts on surface water

supplies and facility operations within the primary study area are not expected to differ greatly with or without climate change; therefore, there would be no change to the impact significant conclusions.

Extended Study Area

Under the action alternatives, changes in San Joaquin River flow volumes and timing would be within typical historical ranges, and Reclamation would continue to release sufficient flow to the San Joaquin River to maintain at least 5 cfs past the last diversion near Gravelly Ford, to satisfy Holding Contract diversions in Reach 1. This diversion would continue to operate and is not expected to be affected by climate change in the future.

The action alternatives would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of reducing infrequent flood flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, as shown by the increase in X2 position and decrease in Delta exports under the Representative Alternative; although this could impact south Delta water levels, the impact would be less than significant. The impacts of water level decreases downstream from Friant Dam under the action alternatives would also be less than significant because decreases would not adversely impact agricultural users' ability to divert irrigation water. The effects of climate change could result in earlier releases of flood flows (Figure 8-4) and increase the X2 position (Figure 8-19). However, the construction of Temperance Flat RM 274 Reservoir is expected to have little change to the X2 position under climate change (Figure 8-57).

Because the impacts on surface water supplies and operations within the extended study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Hydrology – Surface Water Quality

As discussed in Chapter 15, "Hydrology – Surface Water Quality," the action alternatives could result in impacts in the primary study area related to the following:

- Temporary construction-related sediment effects the would violated water quality standards or adversely

affect beneficial uses (Impact SWQ-1, less than significant)

- Temporary construction-related water temperature effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-2, less than significant)
- Temporary construction-related metal effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-3, less than significant)
- Long-term water quality effects that would violate water quality standards of adversely affect beneficial uses with in the primary study area and San Joaquin River (Impact SWQ-4, less than significant)
- Long-term water temperature effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-5, less than significant and beneficial)

In the extended study area, the action alternatives could result in impacts related to the following:

- Temporary construction-related sediment effects the would violated water quality standards or adversely affect beneficial uses (Impact SWQ-1, less than significant)
- Temporary construction-related water temperature effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-2, less than significant)
- Temporary construction-related metal effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-3, less than significant)
- Long-term water quality effects that would violate water quality standards of adversely affect beneficial uses with in the primary study area and San Joaquin River (Impact SWQ-4, less than significant)

- Long-term water temperature effects that would violate water quality standards or adversely affect beneficial uses (Impact SWQ-5, less than significant and beneficial)

- Long-term effects on Delta salinity that would violate D-1641 salinity objectives (Impact SWQ-6 less than significant)

- Long-term effects on Delta Salinity that would violated the X2 Standard (Impact SWQ-7, less than significant)

- Long-term effects on water quality that would violate existing water quality standards or adversely affect beneficial uses in the CVP/SWP water service areas (Impact SWQ-8, less than significant)

Primary Study Area

Surface water quality effects from the action alternatives in the primary study area related to short-term construction impacts would not be affected by longer-term impacts from climate change.

After construction is complete, all action alternatives would increase the total combined volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in action alternatives and higher carryover storage in most months.

As described previously, climate change could result in Millerton Lake receiving more inflow from precipitation than from snowmelt, as compared to the no climate change scenarios. These inflows would also occur earlier in the year (Figure 8-4). This change could result in higher releases from Millerton Lake in the winter and spring to manage the increased potential for flood events, as compared to the action alternatives without climate change, with subsequent increases in water temperature later in the year as water levels decrease. Increased surface water temperatures could result in greater eutrophication (EPA and DWR 2011). Climate change temperature increases and associated eutrophication would be offset to some degree by expected water temperature decreases under the action alternatives.

Suspended sediment levels from erosion along the shorelines of Millerton Lake and Temperance Flat RM 274 Reservoir are expected to be similar with or without climate change (see

Section 8.5.6 above). However, high turbidity could occur with climate change as storm severity increases and wildfires become more frequent (DWR 2008 as cited in EPA and DWR 2011).

Other water quality issues that could result from climate change include more frequent spikes in *E. coli* or Cryptosporidium, which typically accompany severe storms (Bates et al 2008 as cited in EPA and DWR 2011). Pollutant loads may also increase as more extreme rain events occur (DWR 2008 as cited in EPA and DWR 2011).

Significant impacts on surface water quality within the primary study area are not expected from implementation of the action alternatives. Climate change may result in significant surface water quality impacts in the primary study area, but these are not directly related to implementation of the action alternatives; consequently, there would be no changes to the impact conclusions for surface water quality in the primary study area.

Extended Study Area

The action alternatives would improve San Joaquin River release temperatures from September through December, but releases would be slightly warmer in winter than under the No Action Alternative. However, in the winter months, the temperature of released water would still be cooler than needed for anadromous fish. It is expected that the effects of climate change on water temperature downstream from Friant Dam would somewhat offset temperature benefits from increased storage in the San Joaquin River watershed under the action alternatives, as shown in Figure 8-69.

Under the action alternatives, changes in the operation of Friant Dam would not introduce new contaminants to the San Joaquin River system. However, by changing the timing and location of flows, changes in operation would change the relative concentrations of constituents in various segments of the river. Increased flows would increase dilution of constituents and result in improved water quality. Because some reaches would experience increased flows and some decreased flows at different times of the year under the action alternatives, some reaches are expected to see improvements in water quality, including salinity, while others would experience declines. These changes are expected to be less than significant. Additional changes in the timing of flow releases under climate change (earlier releases) may increase this variation; however, the magnitude is not expected to be substantially greater.

Significant impacts on surface water quality within the extended study area are not expected from implementation of the action alternatives. Climate change may result in significant surface water quality impacts in the extended study area, similar to those discussed above in the primary study area section, but these are not directly related to implementation of the action alternatives. Consequently, there would be no changes to the impact conclusions for surface water quality in the extended study area.

Land Use Planning and Agricultural Resources

As described in Chapter 17, "Land Use Planning and Agricultural Resources," implementing any action alternative would only result impacts on land use and agricultural resources in the primary study area. These would be related to the following:

- Disruption of existing land uses (LUP-1, potentially significant and unavoidable)
- Conflict with adopted plans (LUP-2, potentially significant and unavoidable)
- Conversion of farmland to nonagricultural uses and cancellation of Williamson Act contracts (LUP-3, potentially significant and unavoidable)
- Conversion of forest land (LUP-4, potentially significant and unavoidable)

Primary Study Area

Climate change could alter agricultural practices because of its influence on a number of factors related to water demand and crop performance. Increased air temperatures may increase crop evapotranspiration, but when a crop's optimum temperature range is exceeded growth and water demand would decrease. Higher levels of carbon dioxide can stimulate crop growth but can also reduce transpiration, resulting in lower water demand. Changes in crop growth rates and the timing of crop planting and harvesting due to higher early- and late-season temperatures could result in lower water demand for annuals but higher water demand for perennial crops, as discussed in the climate change chapter of the Modeling Appendix.

Implementing any action alternative would result in inundation of agricultural and forest lands. The effects of climate change

would alter native forest composition, as discussed above (see the Biological Resources – Botanical and Wetlands section). Climate change effects on watershed evapotranspiration and crop water requirements and growth may also result in different crops being farmed in the region, or conversion of more land to other uses. It is unknown to what degree climate change may affect land uses, but it has potential to further increase impacts from land use changes associated with the action alternatives.

Extended Study Area

None of the action alternatives would impact land use planning or agricultural resources in the extended study area; therefore, there would be no change in the impact significance conclusions for this resource topic when climate change is considered.

Power and Energy

As described in Chapter 20, "Power and Energy," the action alternatives could result in impacts in the primary study area related to the following:

- Decrease in Kerckhoff Hydroelectric Project energy generation and ancillary services (PWR-1, significant and unavoidable)
- Change in energy generation at Friant Dam powerhouses (PWR-2, beneficial)

In the extended study area, the action alternatives could result in impacts related to the following:

- Change in energy generation and use within the Friant Division of the CVP Water Service Area (PWR-3, less than significant and beneficial)
- Decrease in CVP system energy generation (PWR-4, less than significant)
- Decrease in SWP system energy generation (PWR-5, less than significant)
- Increase in CVP system pumping energy use (PWR-6, less than significant)
- Increase in SWP system pumping energy use (PWR-7, less than significant)

Primary Study Area

All action alternatives would increase the Friant Dam powerhouses' average annual generation by 16 GWh (25 percent) compared to the No Action Alternative. Higher reservoir storage volumes at Friant Dam would cause these energy generation increases. As discussed above, climate change is expected to result in earlier reservoir inflows (Figure 8-4) and likely earlier releases. Lower releases would occur in the summer with climate change, as compared to no climate change. These changes in flow timing could have an adverse impact on hydropower generation at times when demand is high.

The degree of impact from climate change is dependent on many factors and is uncertain. However, Figure 8-75 suggests that the Representative Alternative could provide a small increase in hydropower generation under different socioeconomic-climate scenarios.

Extended Study Area

Implementing the action alternatives would likely increase diversions from Millerton Lake to the Madera Canal, and likely improve energy generation at powerhouses along the Madera Canal. As shown in Figure 8-60 and Figure 8-62, deliveries to the Friant-Kern and Madera canals increase because of the construction of Temperance Flat RM 274 Reservoir in all but the wettest years. Additionally, increased diversions from Millerton Lake to the Friant-Kern and Madera canals would likely improve groundwater conditions and groundwater pumping energy use. Implementation of the action alternatives is also expected to result in benefits to CVP and SWP system energy generation.

As shown in Figure 8-46, hydropower generation will be impacted under climate change; in general, as seasonal river flows shift, hydropower may become less reliable in the future (EPA and DWR 2011). Increasing temperatures are also expected to result in increased energy demands, especially during peak demand times, i.e., summer (DWR 2008 as cited in EPA and DWR 2011).

The degree of impact from climate change on energy generation is dependent on many factors and is not known at this time. However, the effects of climate change (more energy demand and lower flows during high energy demand times) could increase impacts from the action alternatives in the extended study area.

Public Health and Hazardous Materials

As described in Chapter 21, "Public Health and Hazards," the action alternatives would only have public health and hazards impacts in the primary study area. These would be related to the following:

- Potential for exposure to hazardous materials (Impact HAZ-1, less than significant)
- Potential emission of hazardous materials within 0.25 mile of a school (Impact HAZ-2, less than significant)
- Hazards from known hazardous materials contamination site (Impact HAZ-3, less than significant)
- Interfere with evacuation routes and emergency vehicle access (Impact HAZ-4, less than significant)
- Locate electrical transmission facilities near a school (Impact HAZ-5, no impact)
- Hazards of wildland fires (Impact HAZ-6, less than significant)
- Hazards of West Nile Virus (Impact HAZ-7, less than significant)
- Hazards of Valley Fever (Impact HAZ-8, less than significant)
- Exposure to damage from acts of terrorism (Impact HAZ-9, less than significant)
- Exposure to hazards associated with abandoned mine sites (Impact HAZ-10, less than significant)
- Increase Potential for blast-related injury during construction (Impact HAZ-11, less than significant)

Primary Study Area

Most impacts identified on public health and hazards under the action alternatives are related to project construction. Therefore, climate change in the longer term would not change the effects evaluations or conclusions. Significant impacts on health and hazards within the primary study area are also not expected from implementation of the action alternatives after

mitigation. Although, as stated above (see the Biological Resources – Botanical and Wetlands section), climate change has the potential to increase the frequency and intensity of wildfire, impacts from the action alternatives associated with wildfires (HAZ-6) are related to construction only, and mitigation measures would minimize these risks.

The action alternatives would not result in significant impacts from increased habitat that could contribute to the spread of and/or increase existing mosquito populations (HAZ-7). Warming temperatures, however, are likely to further increase the abundance and active period of mosquitos and could further increase the potential for negative impacts from WNV (OEHHA 2013).

Climate change effects on health and hazards would be not directly related to implementation of the action alternatives; consequently, there would be no changes to the impact conclusions for health and hazards in the primary study area.

Extended Study Area

None of the action alternatives would impact public health or hazardous materials in the extended study area; therefore, there would be no change in the impact significance conclusions for this resource topic when climate change is considered.

Recreation

As described in Chapter 22, “Recreation,” implementing any action alternative would result in the following impacts on recreation in the primary study area related to the following:

- Permanent loss or closure of a recreation facility (Impact REC-1, less than significant)
- Permanent loss of a resource used for recreation (Impact REC-2, significant and unavoidable)
- Substantial or long-term reduction or elimination of recreation opportunities or experiences (Impact REC-3, significant and unavoidable)
- Loss of access to a locally important recreation site or area (Impact REC-4, significant and unavoidable)
- Increased use of existing neighborhood and regional parks or other recreation facilities such that substantial

physical deterioration of the facilities would occur or be accelerated (Impact REC-5, less than significant)

- Impacts associated with new or expanded recreation facilities (Impact REC-6, beneficial)

The action alternatives would result in the following impacts on recreation in the extended study area related to the following:

- Permanent loss or closure of a recreation facility (Impact REC-1, less than significant)
- Permanent loss of a resource used for recreation (Impact REC-2, less than significant)
- Substantial or long-term reduction or elimination of recreation opportunities or experiences (Impact REC-3, less than significant)
- Loss of access to a locally important recreation site or area (Impact REC-4, less than significant)
- Increased use of existing neighborhood and regional parks or other recreation facilities such that substantial physical deterioration of the facilities would occur or be accelerated (Impact REC-5, less than significant)

No impacts associated with new or expanded recreation facilities would occur in the primary or extended study areas.

Primary Study Area

Most effects on recreational resources from the action alternatives relate to inundation of such resources, which would not change when considered in the context of climate change. However, the effects of climate change on operations at Millerton Lake could potentially affect water-based recreation opportunities both at the lake and downstream. Potentially lower inflows under climate change, as shown in Figure 8-4 and Figure 8-5, could result in reservoir levels being lower or higher for longer periods of time, which could affect the availability and quality of recreation activities and experiences throughout the year. Conversely, climate change could result in warmer air temperatures, increasing demand for recreational activities associated with reservoir use.

Extended Study Area

The action alternatives would have no impact or less-than-significant impacts on recreation in the extended study area. The impact significance conclusions are not expected to change when climate change is considered.

Socioeconomics, Population, and Housing

As described in Chapter 23, "Socioeconomics, Population, and Housing," the action alternatives could result in impacts in the primary study area related to the following:

- Temporary increases in employment and personal income resulting from construction (Impact SOC-1, less than significant and beneficial)
- Temporary increases in population and housing demand resulting from construction (Impact SOC-2, less than significant)
- Temporary increase in business income and local sales tax revenue resulting from construction (Impact SOC-3, less than significant and beneficial)
- Increases in employment and personal; income resulting from operations and maintenance (Impact SOC-4, less than significant)
- Increases in spending, employment and personal income from increased recreational visitation (SOC-5, less than significant and beneficial)
- Increases in population and housing demand resulting from operations and maintenance (SOC-6, less than significant)
- Increases in business income and local sales tax revenue associate with O&M and recreation visitation (Impact SOC-7, less than significant and beneficial)
- Decreases in property tax revenue from acquisition of privately owned land (Impact SOC-8, less than significant)

The action alternatives could result in impacts in the extended study area related to the following:

- Impacts on agricultural economics in the CVP and SWP water service areas (Impact SOC-9, less than significant and beneficial)

- Increase in population and housing demand within the CVP and SWP service areas (Impact SOC-10, less than significant)

- Increases in business income and local sales tax revenue within the CVP and SWP water service areas (Impact SOC-11, less than significant and beneficial)

Primary Study Area

Implementing any action alternative would result in construction-related and O&M-related socioeconomic (Impact SOC-1, SOC-3, SOC-4, SOC-6, SOC-7, SOC-8), population, and housing (Impact SOC-2) impacts in Fresno and Madera counties. These short-term, less than significantimpacts would not differ when considered in the context of climate change.

Extended Study Area

The action alternatives are expected to have less-than-significant but beneficial impacts on agriculture in the extended study area. As discussed above (see Land Use Planning and Agricultural Resources section), climate change is likely to affect agricultural practices; however, the specific nature (type of crops grown) and magnitude of these effects is unknown. Consequently, the potential effects of climate change on the impacts identified in the extended study area cannot be determined.

Visual Resources

As discussed in Chapter 26, “Visual Resources,” each action alternative would only impact the primary study area. These would be related to the following:

- Consistency with applicable plans (VIS-1, significant and unavoidable)

- Degradation and/or obstruction of a scenic view (VIS-2, significant and unavoidable)

- Generation of increased daytime glare and/or nighttime lighting (VIS-3, significant and unavoidable)

- Impacts on a designated scenic highway (VIS-4, no impact)

Primary Study Area

Construction and operation of the proposed Temperance Flat RM 274 Dam combined with the existing water surface of Millerton Lake would transform the riverine visual character to a reservoir, resulting in a substantial visual modification. Implementing any action alternative would stabilize the Millerton Lake water surface elevation, minimize reservoir drawdown, and reduce the exposure of barren side slopes. This reduction would enhance the visual appearance associated with the bathtub ring common to reservoirs in the western United States. Potentially lower inflows under climate change, as shown in Figure 8-4 and Figure 8-5, could result in reservoir levels being lower for longer periods of time, which could affect recreational activities. Conversely, climate change could result in warmer air temperatures, increasing demand for recreational activities associated with reservoir use.

Because the impacts on visual resources within the primary study area are not expected to differ greatly with or without climate change, there would be no change in the impact significance conclusions for this resource topic.

Extended Study Area

None of the action alternatives would have a visual impact in the extended study area; therefore, there would be no change in the impact significance conclusions for this resource topic when climate change is considered.

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Chapter 9
Cultural Resources

This chapter describes the affected environment for cultural resources, and potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Additional detailed description and discussion of cultural resources is presented in *Cultural Resources Analysis in Support of the EIS/EIR, Upper San Joaquin River Basin Storage Investigation, Fresno and Madera Counties, California* (Rich et al. 2014). This technical report will not be publically distributed due to the sensitive nature of the resource type and the requirement to protect these resources under the Archaeological Resources Protection Act of 1979 (16 USC 470).

Cultural resources are defined as prehistoric and historic-era archaeological sites, Traditional Cultural Properties, sites of religious and cultural significance, and architectural properties (e.g., buildings, bridges, and structures). This definition includes historic properties as defined by the National Historic Preservation Act (NHPA).

If cultural resources may be adversely affected by a Congressionally-authorized alternative, Reclamation will prepare, in coordination with affected and interested parties, agreements on the treatment of cultural resources during future planning phases. Reclamation has initiated a preliminary effort to identify archaeological resources which is used to infer potential effects on resources not yet discovered within the primary study area. These preliminary studies will help shape the Section 106 process in the event that Congress and the President authorize and fund the Investigation.

Affected Environment

This section provides a regional setting of cultural resources in the Study Area and includes sections on the prehistoric, ethnohistorical, and historical context of the primary study area. This discussion provides a general context within which the significance of cultural resources will be evaluated. Determinations of eligibility will be made during future planning phases of the project, once a preferred alternative is selected and authorized by the President and Congress.

To provide context for evaluating the potential effects that alternatives may have on cultural resources within the primary study area, archival and records searches were conducted. Information concerning potential Native American concerns within the primary study area was gathered from historic and ethnographic literature and consultation with individuals and representatives of local Native American tribes. The results of these efforts are summarized below, following a brief discussion of the regional context. The area analyzed for cultural resources comprises the primary study area, as defined in Chapter 1, “Introduction.”

Regional Setting

The following section provides a temporally organized discussion of the regional archaeological record. The study area lies at the interface of the Central Valley and the Sierra Nevada, although this lower foothill region is generally discussed with respect to the archaeology of the Sierra Nevada (Moratto 1984). As no construction activities or changes in the landscape would occur in the Delta or SWP/CVP service areas under the action alternatives, these geographic areas are not considered further in this analysis.

Prehistoric Context

Native American prehistoric occupation of the region began near the end of Pleistocene (circa 13,500 years ago) and continued until Spanish contact (in the late 1700s) (Rosenthal et al. 2007). Terminal Pleistocene (13,500 to 11,600 years ago) occupation in the region is represented by wide-ranging, mobile hunters and gatherers who periodically exploited large game. Throughout California, the prehistoric conditions of the Terminal Pleistocene are minimally represented and poorly understood.

Evidence of early Holocene (11,600 to 7,700 years ago) human settlement is only rarely encountered in the Central Valley

(Rosenthal et al. 2007). Infrequent early Holocene sites in the foothills appear to have been seasonally occupied and include a robust ground stone assemblage focused on the processing of nuts. The lack of documented Central Valley early and middle Holocene sites is due in large part to sedimentation that has buried surfaces of the time period (Rosenthal and Meyer 2004). Well-dated sites of this age in the Central Valley are typically in buried contexts. In the foothills, middle Holocene (7,700 to 3,800 years ago) sites are dominated by expedient cobble tools for various purposes including grinding, chopping, and pounding, and preserved plant remains are mainly represented by acorns and pine nuts.

By 4,500 years ago, distinctive lowland and upland adaptive patterns emerged in the region (Rosenthal et al. 2007). Throughout the late Holocene (after 3,800 years ago) the Central Valley was characterized by a complex socioeconomic strategy focused on riverine and marsh resources and extremely elaborate material culture (Moratto 1984). Notable attributes included dart points, mortars and pestles; use of acorns and pine nuts; new fishing technologies and numerous fish remains; basketry and cordage; ceramic items; diverse personal accoutrements of stone, bone and shell; and large, formal cemeteries.

Around 2,300 years ago, large populations were concentrated in major settlements along the San Joaquin River. Material culture included large dart points, mortars and pestles, milling stones, and bone spear points. Subsistence was concentrated on hunting and fishing and, based on secondary evidence, included hard seeds, with more limited use of acorns. Wide-ranging trade networks are documented and a non-egalitarian social organization and ascribed status may have emerged. With extended occupation at key settlements, large mounded villages were created. Trade items included obsidian from the Great Basin, and other items from the Central Valley and coastal southern California.

The Madera Phase (500-100 cal BP) represents the last 400 years of the prehistoric record. During this time, populations were much higher than they previously had been, and settlement patterns shifted dramatically (Moratto 1984). This new “village community pattern” included large residential sites along the Chowchilla River, with smaller residential settlements along nearby secondary drainages. Trade in brown ware pottery is well-documented. Overall, Moratto (1972, 1984) interprets this time period as a cultural florescence and

sees direct continuity with Native Americans groups documented in the historic period (namely the Southern Sierra Miwok for the Chowchilla River).

Ethnohistorical Context

The San Joaquin River defines a topographic, political, and cultural frontier in the primary study area, where a variety of religious, economic, historic, and other values can be identified for Native American groups. Tribal use in this area is both historic and ongoing, and has been in flux since the post-contact-era. This ethnohistorical context attempts to capture through records analysis the variety of ways in which the primary study area has been used by numerous Native American groups.

Ethnohistorical investigations indicate that at the end of the prehistoric era and into the historic era, the primary study area was at the territorial boundary, or within a zone of overlapping use, for several Native American populations. Principal among these are various tribes of Foothill Yokuts (Spier R. 1954; Spier R. 1978a) and bands of Nim or Western Mono (Gayton, 1948; Spier R. 1978b). Other groups who may have used this area include Valley Yokutsan tribelets (Wallace 1978) and the Southern Sierra Me-Wuk (Smith 1978).

Traditionally, these four Native American groups, most easily distinguished by linguistic differences, were hunter-gatherers, focusing on locally available plant and animal resources with varied reliance on riverine resources. The primary study area appears to be more central to Foothill Yokuts territory, and Spier (1978) defines the area upstream from Friant Dam and along the lower reaches of Fine Gold Creek as being the tribal territory of the Dumna (related to the surrounding Monache tribes (Dumna 2014)). In general, Valley Yokuts populations were considered to have been complexly organized and resided in larger settlements than Foothill Yokuts groups (Kroeber 1925; Spier R. 1978a; Wallace 1978). The territories of the Nim/Western Mono and the Southern Sierra Me-Wuk were primarily at higher elevations within the Sierra Nevada. They correspondingly lived in smaller residential groups and had a more generalized subsistence strategy.

At the time of contact with European settlers, the study area was occupied by the Northern Valley Yokuts, who had lived in the region for some 4,500 years (Kroeber 1925; Latta 1949, 1977; Powers 1877; Wallace 1978). The Yokuts were hunter-gatherers who divided themselves into named tribes, each with

a dialect, territory, and discrete settlements. Each tribe was politically autonomous and occupied a permanent area, usually on high ground along a major drainage course. The San Joaquin River and its main eastern tributaries formed the core of the Northern Valley Yokuts' homeland. Yokut populations at the time of European contact have been estimated to be about 41,000, with perhaps 5,000 living along the east side of the valley between the Merced and Kings rivers (Cook 1955). Overall, the primary study area was a very important and heavily used region for several Native American groups. As such, it was a contested landscape when Euro-Americans poured into the area during the latter half of the nineteenth century (Stammerjohan 1988).

Historical Context

The 200-year-long historic-era in the lower foothills began in the early 1800s with initial contact between Native Americans and Europeans (first the Spanish and then other European explorers). For some time only sporadic interaction took place between Native Californians and Europeans (Beck and Haase 1974, Clough and Secrest 1984, Hayes 2007). The first Spanish expedition into the San Joaquin Valley was led by Pedro Fages in 1772 who sought a new route between San Diego and Monterey. In the 1820s, the objective of inland expeditions had changed from scouting new mission sites to punitive forays against the San Joaquin Valley Indians, both Yokuts and Miwoks.

During the summer of 1851, gold was discovered in Coarse Gold Gulch north of the San Joaquin River. Shortly thereafter, prospectors made their way south from Coarse Gold Gulch along Fine Gold Creek and other tributaries of the San Joaquin River, as well as along the main stem itself from the mountains and down into the foothill woodlands. As a result, the native populations dropped drastically primarily due to exposure to European and Euro-American diseases brought into the area by the tremendous influx of nonnative people leading up to and during the gold rush (Wallace 1978). Today there are still several bands of Yokuts Indians living in the San Joaquin Valley, and many tribal members from Yokuts as well as Western Mono groups still gather extensively in the area for both food and materials used for traditional purposes.

In 1851, the United States chose to establish Fort Miller as a solution to conflicts with native peoples. The Fort Miller location was a couple of miles upstream from the current location of Friant Dam (old Fort Miller was subsequently

inundated by Millerton Lake). This effort displaced local Native Americans (Latta 1977).

The town of Rootville became one of the early important relay points for supplies distributed to outlying mining communities on the southern fringe of the Sierra mining districts. Established in 1852, Rootville was situated near the left bank of the San Joaquin River, and just west of Fort Miller. Two years later, the name of this frontier town was changed to Millerton (Thompson 1891). Small communities such as Millerton,Texas Flat, Hildreth, and Fine Gold became local supply points in the expanding network of towns that served the surrounding mines in what became known as the Coarse Gold, Fine Gold, Temperance Flat, and Hildreth mining districts (Clark 1970).

Vast numbers of livestock were introduced into the Central Valley to feed the miners. By 1862 there were about three million cattle and nine million sheep grazing on the grasses on an open range where much of the land was unreserved public domain from the Sierra Nevada Foothills to the Coast Range. Two successive years of drought in the early 1860s, however, reduced the Central Valley to a dust bowl, and by the time normal precipitation returned to the Valley in 1864-1865, the numbers of livestock had declined markedly. Damage to the rangelands was so complete that the native grasslands never recovered (Burcham 1956).

During the 1870s, the Central Pacific Railroad, and later the Southern Pacific Railroad, spawned a network of some 50 railroad stations, of which 24 became railroad town sites. About eight of these town sites became strategic trading centers stretching from Stockton south to Bakersfield.

In 1873, the California State Legislature passed a “No Fence Law,” which established agriculture’s dominance over ranching. The need for water to irrigate the arid San Joaquin Valley became a priority for the economic development of Central Valley towns, especially those laid out along Southern Pacific’s railroad track. By the late 1880s small-scale irrigated agriculture was in the ascendancy and irrigation companies, colonies, and districts were formed to help promote agriculture, for which the first canals were completed in the 1870s. Passage of the Wright Act in 1887 provided a legal mechanism for landowners to create public irrigation districts and finance major irrigation works to divert water from the major streams flowing west from the Sierra.

The CVP was devised by the State, and ultimately built by the Federal government, to resolve California's chronic water shortage problem. Studies undertaken between 1927 and 1931 resulted in a plan calling for a vast system of canals, massive dams, and reservoirs throughout the state, including most of what became the CVP (Hundley 1992).

Reclamation designed the CVP as five fundamental units, operating as an integrated system: Shasta Dam, the Delta-Mendota Canal, Friant Dam, the Madera and Friant-Kern canals, and the Contra Costa Canal. The core of the system involved the coordinated operation of the other four units for the purpose of delivering Sacramento River water to the arid San Joaquin Valley. In 1935, Reclamation was charged with construction of the CVP, which was completed in the early 1950s (Cooper 1968, Hundley 1992).

Completed in 1942, Friant Dam was the first major engineering structure constructed for the Friant Division of the CVP. The dam controls San Joaquin River flows and provides storage for water diversions into Friant-Kern Canal and Madera Canal, which convey irrigation water to a million acres of agricultural land in Fresno, Kern, Madera, and Tulare counties in the San Joaquin Valley. Based on U.S. Geological Survey (USGS) mapping from 1945, there were only a few scattered buildings along the margins of Millerton Lake, along Fine Gold Creek and its tributaries, or along the upper San Joaquin River, despite the fact that these lands had been claimed and patented as homesteads decades earlier (California Highways and Public Works 1939, 1942; Harding 1960; Reclamation 1958).

The upper San Joaquin River watershed was also used for generation of hydroelectric power, beginning during the 1890s. In 1920 the San Joaquin Power Company (later San Joaquin Light & Power which was later absorbed by PG&E) completed Kerckhoff reservoir and powerhouse, located on the San Joaquin River, about ten miles (16 kilometers) northeast of Friant. The Kerckhoff plant was supplied with water diverted from the Kerckhoff Dam via pressure tunnel. The Kerckhoff Powerhouse supplied power to two transmission lines—one running 39 miles (63 kilometers) south to a substation at Sanger, the other running 64 miles (103 kilometers) west to Merced.

Archaeological Resources and Historical Structures

This section discusses known archaeological resources and historic structures within the primary study area.

Data Collection

Cultural resources were identified for this analysis via examination of the results of previously conducted fieldwork, as well as archival documentation. No new fieldwork was conducted to confirm the presence or absence of prehistoric or historic era archaeological sites, multi-component sites, or historic era structures, nor has any new survey evaluation work been done to assess significance of historic-era architectural resources within the primary study area.

Because this Investigation has multiple, ongoing phases, there are several stages of progress to report in regard to the sources consulted. On November 7, 2001, Reclamation initiated a records search of the Southern San Joaquin Valley Information Center (SSJVIC), California State University, Bakersfield. This entailed obtaining all State Parks site records and copies of the cover pages for archaeological reports within the action alternatives as they were defined in 2001. On February 10, 2006, a records search update was requested to identify any new sites and studies completed since 2001 within the primary study area as it was defined in the plan formulation phase of the Investigation, and included the Temperance Flat RM 274 Dam and Reservoir area (Byrd and Wee 2008). The update also included obtaining copies of all reports dealing with the primary study area.

The SSJVIC examined relevant portions of the following 7.5-minute USGS quadrangles: Friant, Millerton Lake East, Millerton Lake West, North Fork, and ONeals; Fresno and Madera Counties, California. Searches for both archaeological and non-archaeological resources were requested, and in regard to the Office of Historic Preservation's (OHP) Property Directory, the SSJVIC stipulates that this reference includes, but is not limited to, information regarding National Register of Historic Places (NRHP), California Register of Historical Resources, California Inventory of Historic Resources, California State Historic Landmarks, California State Points of Historical Interest, NRHP Index of Determined Eligible Properties, OHP's Archaeological Determinations, and OHP's Historical Property Data File.

In 2006, inquiries were also made with BLM's Bakersfield Field Office; the State Parks, Millerton Lake SRA; and the

NRHP Keeper's Office, to determine if any newly recorded sites or substantive surveys had taken place in recent years, or if any recent cultural resources investigations had been undertaken that may not have been submitted to the Information Center. Recent reports, updated site records, and information from the Squaw Leap Archaeological District paperwork were reviewed as part of this analysis. Additionally, historical research was conducted by examining various journals, government publications, historical USGS topographic maps; BLM (General Land Office) plat maps, master title plats, and mining index sheets; historical official county maps; and maps appearing in various primary and secondary sources. This research focused on localities related primarily to gold mining, mining towns, frontier military forts, homesteading, agriculture, the CVP (Friant Dam), and hydroelectric power development.

These data were again brought up to date in a records search update submitted on August 22, 2013, to identify any newly recorded sites and studies completed since 2006. Along with this update, a new search request was initiated for previously unsearched portions of the primary study area, as well as a 1/4-mile buffer zone around the unsearched portions. A new records search request to the SSJVIC was made on February 13, 2014 to encompass several additional small areas newly incorporated into the primary study area, and then again in June 2014.

Based on the combined records search results, 33 cultural resources studies have been undertaken within the primary study area. These studies consist of one overview, one historical resources report, 28 survey reports, one combined survey/testing report, and two eligibility-related documents. The boundary of each of these surveys was digitized and integrated into a GIS database. In all, 38.3 percent (2,867.9 acres) of the 7,480.9-acre area has been surveyed. The surveys were compiled during the Plan Formulation Phase of the Investigation (Byrd and Wee 2008). Additionally, there are six reports in areas adjacent to the Investigation's primary study area, including one ethnographic overview, one survey, and four excavation reports.

Only one historic-era building inventory project has been undertaken near Friant Dam (JRP 2003), but not all resources have been evaluated for eligibility. To contrast, archaeological survey has covered approximately one-third of the primary study area. Notably, few low-density prehistoric artifact

scatters and no buried sites have been recorded, and historic-era sites were often not recorded. As such, archaeological inventory is not fully representative of all resources categories, and it appears that only prehistoric residential settlements and bedrock milling localities have been systematically discovered and recorded. Ultimately, only a full-coverage cultural resources survey across the primary study area will serve to securely identify the actual quantity and full breadth of archaeological and historic-era resources within the proposed Temperance Flat River Mile 274 Dam and Reservoir area.

Primary Study Area

Within the primary study area, 52 archaeological sites and seven historic-era architectural resources were identified. The archaeological sites include 41 prehistoric sites, one archaeological district (Squaw Leap Archaeological District), which encompasses multiple sites counted among the 40, six historic-era sites, and four sites with both historic-era and prehistoric components. In addition, three isolates have been recorded across the primary study area; all are historic-era stone walls. The results of this research for archaeological sites within the primary study area, as well as the historic architectural resources, are summarized in Table 9-1.

Table 9-1. Summary of Known Cultural Resources in the Primary Study Area

Category	Number of Sites
Archaeological Sites	
Prehistoric	41
Historic-era	6
Prehistoric/Historic-era	4
Archaeological District (Squaw Leap)	1
Subtotal	52
Historic Architectural Resources	
Hydroelectric	4
Roads	1
Buildings/Structures	2
Subtotal	7
Total Documented Cultural Resources	59

The 41 prehistoric sites account for 79 percent of the known archaeological sites. These include 28 bedrock milling localities, 10 residential sites (defined by the presence of midden deposits), two lithic scatter/bedrock milling localities, and one lithic scatter. Many of the residential sites have surface evidence of house pits as well as bedrock milling features, while bedrock milling sites typically contain numerous milling

elements on multiple outcrops. The six historic-era archaeological sites comprise 9.5 percent of the sample, and include two mining sites, one location with two ore crushers, and a series of 13 rock cairns, some of which are located outside of the primary study area boundary. The four multi-component sites include some combination of bedrock milling loci, prehistoric or historic artifact scatters, and prehistoric or historic Native American residential evidence, and make up 9.5 percent of the sample. None of these previously recorded historic-era sites has intact standing structures.

Portions of the Squaw Leap Archaeological District are located within the primary study area. This district was determined eligible for the NRHP by the Keeper on May 5, 1980, and is on the California Register of Historic Resources. The final district boundaries included two discontiguous areas: an upland meadow area on the Madera County side of the San Joaquin River and a plateau area on the Fresno County side. The district was defined based on its ability to contribute to prehistoric research questions; it includes 20 sites, mainly bedrock milling locations, along with some residential sites. This area is currently within the BLM SJRG SRMA. As mapped, the Squaw Leap Archaeological District encompasses a total of 700 acres. The portion encompassed within the primary study area includes about 499 acres. Fourteen Squaw Leap Archaeological District sites are situated within the primary study area.

Historic-era architectural (built environment) resources include all aspects of the built environment. The site records from the Information Center records search were produced as a result of archaeological surveys, and the sample is likely biased toward archaeological sites, as opposed to the built environment. Yet some historic-era structures exist within the survey area, and this study has identified seven localities where known historical sites, buildings or structures intersect the primary study area. In general, locations of historic-era architectural resources are generally distributed throughout the primary study area; however, few resources are identified at the northeastern most portion of the primary study area, northeast of the area historically known Temperance Flat, where the rugged landscape of the river canyon restricted settlement and permanent occupation of the land.

The seven known historic-era structures include four hydroelectric resources, two structures, and one road. Hydroelectric power resources make up 57 percent of known

resources in the primary study area. These four resources consist of the Kerckhoff Powerhouse and its associated resources including the Kerckhoff Dam and Tunnel, which date to the early 1920s; and the Friant Dam (and its power plant), completed in the mid-1940s. However, in a filing to FERC dated March 8, 2013, PG&E submitted a letter from the SHPO stating that the Kerckhoff Hydroelectric Project is not eligible for listing on the NRHP (FERC 2013). Buildings and structures account for 28.6 percent of all known historic resources found within the primary study area, consisting of a boat ramp and a gaging station. Only one known transportation infrastructure feature is located within the primary study area: Sky Harbour Road dates to 1965 or before. The results of this research for known archaeological sites and historic-era architectural resources within the primary study area are summarized in Table 9-1.

The only known resources within the study area that have been identified as a historic property are related to Friant Dam, one of the key water storage structures built by Reclamation as part of the CVP. As a result of a study conducted in the Millerton Lake SRA by JRP (2003), Reclamation determined Friant Dam and its contributing features (spillway, canal outlets, four gantry cranes, and three small dikes used to contain Millerton Lake) as individually eligible for the NRHP (Reclamation 2005, 2006). Further, Reclamation has also preliminarily identified Friant Dam as a contributor to a larger discontiguous Central Valley Project Historic District (Reclamation 2005, 2007).

Sensitivity analyses indicate the potential to find more historic-era resources in the primary study area. Well-preserved historic-era resources related to late-nineteenth- and early-twentieth-century homesteading and ranching would have a high potential to address important research questions. Similarly, resources related to mining activities in the Temperance Flat Mining District, because of the high concentration of mining activities dating from the 1850s through the early decades of the twentieth century, also have a high potential to address research questions related to the gold rush, mining technologies, and the ethnic and cultural groups associated with early mining in Fresno and Madera counties. Given the distribution of historic-era activities, there appears to be potentially more significant historic-era resources in the upper reaches of the primary study area, particularly in the Temperance Flat region.

No historic-era Native American villages are depicted on the General Land Office (GLO) plat maps for the portions of five townships that are located within the primary study area. A strong likelihood exists that other important Native American heritage locations are present within the primary study area, based on ethnohistoric data and initial discussions with Native Americans that have included early written communication and meetings with tribal members. The Study Area was the focus of intensive Native American occupation during historic times, with a variety of religious, economic, historic, and other values identified by Native American groups and is currently used by these groups. Sixteen groups, including those listed by the NAHC, represent Native American interests in the study area: the Big Sandy Rancheria of Western Mono Indians; Choinumni Tribe; Cold Springs Rancheria of Mono Indians; Dumna Tribal Government; the Dumna Wo-Wah Tribal Government; Dunlap Band of Mono Indians; North Fork Mono Tribe; North Fork Rancheria; Nototonme/North Valley Yokut Tribe, Inc.; Picayune Rancheria of the Chukchansi Indians; Tachi-Yokut Tribe (Santa Rosa Rancheria); Sierra Nevada Native American Coalition; Southern Sierra Miwuk Nation; Table Mountain Rancheria; Tule River Tribe; and the Traditional Choinumni Tribe.

Traditional Cultural Properties

Federal regulation defines Traditional Cultural Properties as properties that have “association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (Parker and King 1998). Examples of Traditional Cultural Properties include: a location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world; a location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice.

The records search at the Information Center revealed that no Traditional Cultural Properties have been formally recorded in the primary study area. However, there is a possibility that Traditional Cultural Properties, and/or viewsheds associated with Traditional Cultural Properties, exist within the primary study area. Should Congress authorize and fund implementation of an action alternative, additional information about Traditional Cultural Properties in the primary study area will be sought by Reclamation.

Indian Sacred Sites

Executive Order No. 13007 defines a sacred site as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." Reclamation will continue to provide updates about the project to tribal members and solicit input from the tribes on known resources within the Study Area that may be affected by the action alternatives.

Executive Order 13007 pertains only to Federally recognized tribes and Federally managed lands. For groups that are not formally recognized, sacred areas may be listed in the Sacred Lands files of the California Native American Heritage Commission. This commission has reviewed its files and identified sacred lands within the study area. Their locations are confidential.

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on cultural resources that could result from the No Action Alternative and from implementing any of the action alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on cultural resources. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on cultural resources and associated mitigation measures are summarized in Table 9-2.

Table 9-2. Summary of Impacts and Mitigation Measures for Cultural Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL-1:Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL 2: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 9-2. Summary of Impacts and Mitigation Measures for Cultural Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	CUL 3: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
CUL-4 Destruction or Damage to Traditional Cultural Properties	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	CUL 4: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 9-2. Summary of Impacts and Mitigation Measures for Cultural Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
CUL-5 Destruction or Damage to Indian Sacred Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	CUL 5: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

The environmental setting for this chapter includes only the primary study area, which includes the proposed Temperance Flat River Mile 274 Dam and Reservoir and is defined as the San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the reservoir, which encompasses the proposed temporary and permanent facilities upstream from Friant Dam, such as the dam and appurtenant structures, power generation features including transmission facilities, and other construction areas. Together these areas comprise the focus of this cultural resources analysis. No potential impacts to cultural resources are expected in the extended study area as no construction or other physical disturbance would occur there. Therefore, the extended study area is not discussed further in this section.

Impact Assessment Methods and Assumptions

The standard Section 106 process of the NHPA follows a series of steps that are described in the 36 CFR Part 800 regulations that implement the NHPA. These steps are as follows:

- Initiate Section 106 Process, 36 CFR Part 800.3
- Identify Historic Properties, 36 CFR Part 800.4
- Assess Adverse Effects, 36 CFR Part 800.5
- Resolve Adverse Effects, 36 CFR Part 800.6

“Adverse Effects” are defined below. In the event that historic properties within the APE for an undertaking would be subject to adverse effects, the lead Federal agency would consider ways to minimize or mitigate (“resolve”) such effects, in consultation with the SHPO and other signatories and consulting parties. This often requires a memorandum of agreement or programmatic agreement among the consulting parties (Part 800.6).

Section 106 regulations allow Federal agencies to conduct “nondestructive project planning activities before completing compliance with Section 106” (36 CFR Part 800.1[c]), and the regulations encourage Federal agencies to consider a broad range of alternatives during the planning process for the undertaking. Reclamation will not have a specific undertaking until such time as Congress makes a decision regarding whether to authorize a project that would involve constructing a new dam and appropriates funding for this purpose.

Reclamation conducted a record and literature search of the primary study area to assess which portions of the primary study area have been previously inventoried, and to identify all previously recorded cultural resources. Methods used to document existing information on the cultural resources included archival records searches (that identified previously recorded sites, site records, and Native American ethnographic studies), agency consultation, and Native American consultations. Information on archaeological sites and historical structures was obtained for sites within the primary study area that may be affected by the action alternatives. Sensitivity analyses, discussed in sections below, were also conducted for prehistoric and historic-era resources to address data gaps using methods tailored to each data set. Native American issues and resource locations within the primary study area were discussed during meetings with local Native American groups and individuals.

Included in the analysis was an assessment of the effects of inundation and drawdown on cultural resources located within the pool of a reservoir. Previous reservoir studies have shown that the greatest impacts occur in the zone of inundation and drawdown (fluctuation zone), where cultural resources are repeatedly exposed to scouring, wave action, wet/dry cycles, and de-vegetation. This means that the most significant impacts will occur during the early years of inundation, and if reservoir operations change and causing an increase in reservoir fluctuation.

Archaeological and Historic-Era Structural Resources

Although the records search revealed that significant portions of the primary study area were surveyed previously, the frequency and distribution of recorded sites within the primary study area only give a limited and incomplete picture of the actual number of resources. This is because only a very small percentage of the primary study area has been systematically inventoried for cultural resources to contemporary standards. To estimate site densities for the primary study area as a whole, sensitivity analyses were undertaken. Separate sensitivity analyses for prehistoric and historic-era sites were conducted to predict where unrecorded sites should be concentrated within unsurveyed areas. The resulting site-density predictions provide the most accurate estimate of site sensitivity available at present. The following discussion presents the methods and approach taken.

Research conducted for the Investigation was designed to identify the types of cultural resources known to be present in the primary study area. However, the frequency and distribution of formally recorded resources give only a limited and incomplete picture of the actual number of resources.

Therefore, a comparative sensitivity analysis was conducted to take both documented and likely but undocumented resources (including archaeological sites and historic-era structures) into account that may be affected by the action alternatives. The sensitivity analysis was restricted to the primary study area.

Separate sensitivity analyses using methods tailored to each data set were conducted for prehistoric and historic-era sites to estimate the total number of cultural resources present (see Rich et al. (2014) for methodological details and specific data). The prehistoric sensitivity analysis used a weights-of-evidence quantitative analysis to predict the overall density and distribution of sites. In contrast, the historic-era sensitivity study gathered archival data (mainly maps) within the primary study area to make predictions regarding the number and type of potential unrecorded historic-era resources (both structures and sites). Results of the prehistoric and historic-era sensitivity analyses were integrated to provide quantitative estimates of the total number of cultural resources likely documented after full inventory. These estimates are for planning purposes only; additional pedestrian surveys would be needed if one of the action alternatives were to be authorized by Congress for implementation.

Traditional Cultural Properties and Sacred Sites and Areas

A qualitative evaluation of the potential to affect traditional cultural properties or sacred sites or areas was conducted based on the results of record searches at the Information Center and California Native American Heritage Commission. Tribal consultation for the Investigation is pending.

Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A “[s]ignificant effect on the environment” means a substantial, or potentially substantial, adverse change in any of the physical conditions within the

area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State and CEQA Guidelines, Section 15126.4(a).

Federal Criteria

Under Federal regulation, the Protection of Historic Properties (36 CFR Section 800(a)(1)), which defines the Section 106 process mandating Federal agencies to undergo a review process for all federally funded and permitted projects that will impact sites listed on, or eligible for listing on, the NRHP, states:

> *"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative."*

Examples of adverse effects (36 CFR Section 800(a)(2)) include the following:

- Physical destruction, damage, or alteration, including moving the property from its historic location
- Isolation from, or alteration of, the setting
- Introduction of intrusive elements
- Neglect leading to deterioration or destruction
- Transfer, sale, or lease from Federal ownership

State Criteria

California regulations require that effects to cultural resources be considered only for resources meeting the criteria for eligibility to the California Register of Historical Resources, outlined in Section 5024.1 of the California Public Resources Code. Demolition, replacement, substantial alteration, or relocation of an eligible resource are actions that could change those elements of the resource which make it eligible. The following eligibility criteria were developed using guidance provided by the State CEQA Guidelines, which considers the context and intensity of the environmental effects as required under NEPA. Under the State CEQA Guidelines, impacts on cultural resources may be considered significant if an action alternative would result in any of the following:

- Cause a substantial adverse change in the significance of a historical resource, as defined in Guidelines Section 15064.5
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to Guidelines Section 15064.5
- Disturb human remains, including those interred outside formal cemeteries

According to the above criteria, the project would be considered to have a significant impact on cultural resources if it would result in any of the following:

- Substantial adverse change in the significance of a historical resource
- Substantial adverse change in the significance of a unique archaeological resource
- Disturbance of any human remains, including those interred outside of formal cemeteries
- Elimination of important examples of the major periods of California history or prehistory

Under CEQA an impact to a cultural resource can be reduced to a less-than-significant level through mitigation. Statements of impact significance are relative to both existing conditions (January 2014) and future conditions (Year 2030), unless stated otherwise. Only those elements of a resource which contribute

to its eligibility need to be considered; effects to noncontributing elements are less than significant.

Topics Eliminated from Further Consideration

As no construction activities or changes in the landscape would occur in extended study area under the action alternatives, this geographic area is not considered further in this analysis.

Direct and Indirect Effects

This section describes the environmental consequences of the alternatives, and proposed mitigation measures for any impacts determined to be significant or potentially significant.

Impact CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation

Primary Study Area

No Action Alternative Dam construction, infrastructure, reservoir area inundation, and construction activities adjacent to the area of project impacts would not occur under the No Action Alternative. Therefore, no additional prehistoric cultural resources and archaeological sites would be impacted, and conditions would be the same as they currently exist.

The condition of known and previously undiscovered prehistoric cultural resources and archaeological sites within the existing Millerton Lake fluctuation zone will continue to be impacted by fluctuations in the water level under the No Action Alternative. As stated above, dam construction, infrastructure and facilities relocation, and additional reservoir area inundation would not occur under the No Action Alternative. No new impacts on cultural resources related to construction or inundation are expected.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Known or previously undiscovered prehistoric-era cultural resources potentially impacted by action alternatives include those within the San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the proposed Temperance Flat RM 274 Dam and Reservoir, as well as areas that could be directly affected by construction-related activities. Operation and maintenance of the Temperance Flat RM 274 Dam and Reservoir would damage

or destroy known prehistoric resources, and could damage or destroy previously undiscovered prehistoric cultural resources through increased erosion in the zone of inundation and drawdown (fluctuation zone), where cultural resources are repeatedly exposed to scouring, wave action, wet/dry cycles, and de-vegetation. Additionally, construction and management of project components could disturb human remains, including those interred outside of formal cemeteries. Implementation of the action alternatives would have a direct impact on cultural resources.

The construction schedule for the project as described in detail in the Engineering Summary Appendix, approximates a three-phase, up to 10-year period of construction for the 200 TAF reservoir and dam, as well as appurtenant structures, and includes drawdown of Millerton Lake. Temporary construction actions for the action alternatives include: the movement of borrow area materials; mass excavation for a dam foundation, power generation, and other construction areas; and staging for construction materials and equipment.

When filled, prehistoric-era cultural resources in Temperance Flat RM 274 Dam and Reservoir fluctuation zone would be subject to the erosive processes of periodic fluctuations in water level. Operation and maintenance of the Temperance Flat RM 274 Dam and Reservoir and power generation features would damage or destroy known prehistoric resources, and could damage or destroy previously undiscovered prehistoric cultural resources through exposure in the fluctuation zone, through increased recreation access (recreation facilities, roads, utilities, trails, etc.), and by enhanced access to exposed resources in the fluctuation zone by visitors to the recreation area. Additionally, while the action alternatives would not change modify Friant Dam, they would increase the carryover pool in Millerton Lake and hence increase the elevation of the low water level, increasing the duration that cultural resources are inundated.

The surveys to date in the primary study area indicate that prehistoric resources exist within the zone of construction and may be subject to the construction, operation, and maintenance impacts associated with the action alternatives. The 40 prehistoric sites account for 80 percent of the known archaeological sites. These include 27 bedrock milling localities, 10 residential sites (defined by the presence of midden deposits), two lithic scatter/bedrock milling localities, and one lithic scatter. Many of the residential sites have surface

evidence of house pits as well as bedrock milling features, while bedrock milling sites typically contain numerous milling elements on multiple outcrops. These results are summarized in Table 9-1.

Sensitivity analyses indicate the potential to find more archaeological sites in the primary study area. The prehistoric site sensitivity analysis suggests sites should be found on older soils, relatively low slopes, and close to water.

It is not possible at this stage of the Investigation to determine how many known or previously undiscovered historic-era resources may be determined eligible for listing under NHPA, or how many of the eligible resources could sustain adverse impacts from the action alternatives. Reclamation would comply with the Federal NHPA Section 106 process to avoid, minimize, or mitigate adverse impacts. As described in Chapter 2, "Alternatives," Reclamation could enter into a Programmatic Agreement with the Advisory Council on Historic Preservation (if it chooses to participate), the SHPO, and other consulting parties that would identify how the Section 106 process would be completed for the authorized project. The Programmatic Agreement could include alternative methods for compliance or phased identification efforts/phased finding of effects efforts, as agreed upon with the consulting parties. As part of a Programmatic Agreement, Reclamation would work with the consulting parties to determine the need to provide a full evaluation of archaeological sites and recovery of data at any eligible sites that would be adversely affected by the action alternatives. Other potential outcomes of consultation are to protect sites left in place and provide for interpretation and curation of archaeological artifacts.

This impact would be **significant** under the action alternatives**.** Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation

Primary Study Area

No Action Alternative Temperance Flat RM 274 Dam construction, infrastructure, reservoir area inundation, and construction activities adjacent to the area of project impacts would not occur under the No Action Alternative. Therefore, no additional historic-era cultural resources and archaeological

sites would be impacted, and conditions would be the same as they currently exist.

The condition of known and previously undiscovered historic-era cultural resources and archaeological sites within the existing Millerton Lake fluctuation zone will continue to be impacted by fluctuations in the water level under the No Action Alternative. As stated above, dam construction, infrastructure and facilities relocation, and additional reservoir area inundation would not occur under the No Action Alternative. No new impacts on cultural resources related to construction or inundation are expected.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Known or previously undiscovered historic-era cultural resources potentially impacted by the action alternatives include those within the San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake and the area that would be inundated by the proposed Temperance Flat RM 274 Dam and Reservoir, as well as areas that could be directly affected by construction-related activities. Operation and maintenance of the reservoir would damage or destroy known historic-era resources, and could damage or destroy previously undiscovered historic-era cultural resources due to increased erosion in the zone of inundation and drawdown (fluctuation zone), where cultural resources are repeatedly exposed to scouring, wave action, wet/dry cycles, and de-vegetation. Implementation of action alternatives would have a direct impact on historic-era cultural resources.

When filled, the reservoir fluctuation zone of Temperance Flat RM 274 Reservoir would be subject to the erosive processes of periodic fluctuations in water level. The action alternatives would not change the size of Millerton Lake, but would increase the carryover pool and hence increase the elevation of the low water level. Operation and maintenance of Temperance Flat RM 274 Dam and Reservoir could damage or destroy known and previously undiscovered historic-era cultural resources through exposure in the fluctuation zone, through increased recreation access through new recreation facilities, roads, utilities, trails, etc., and enhanced recreation access to resources in the fluctuation zone.

The survey of known historic-era archaeological resources categorizes the resources as sites, multi-component sites, and structures. Known historic-era sites comprise 8 percent of the survey sample of total archaeological resources, and include two mining sites, one location with two ore crushers, and a series of rock cairns, some of which fall are located outside of the primary study area. None of these previously recorded historic-era sites has intact standing structures. The five multi-component sites include some combination of bedrock milling loci, prehistoric or historic artifact scatters, and prehistoric or historic Native American residential evidence, and make up 10 percent of the sample. No historic-era Native American villages are depicted on the GLO plat maps for the portions of five townships that are located fall within the primary study area.

As described previously, sensitivity analyses indicate the potential to find more historic-era resources in the primary study area. It is not possible at this stage to determine how many known or previously undiscovered historic-era resources may be determined eligible for listing under NHPA, or how many of the eligible resources could sustain adverse impacts from the action alternatives. Adverse effects would be avoided, minimized, or mitigated through the environmental commitments within the project design, in compliance with NHPA Section 106 procedures, and, when warranted through project redesign as discussed in this chapter and Chapter 28, “Other NEPA and CEQA Considerations.”

Reclamation would comply with the Federal NHPA Section 106 process to avoid, minimize, or mitigate adverse impacts to the extent feasible. As described in Chapter 2, “Alternatives,” Reclamation could enter into a Programmatic Agreement with the Advisory Council on Historic Preservation (if it chooses to participate), the SHPO, and other consulting parties that would identify how the Section 106 process would be completed for the authorized project. The Programmatic Agreement could include alternative methods for compliance or phased identification efforts/phased finding of effects efforts, as agreed upon with the consulting parties. As part of a Programmatic Agreement, Reclamation would ensure the evaluation and recovery of data or documentation at any eligible historic-era sites that would be adversely affected by the action alternatives.

This impact would be **significant.** Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District

Primary Study Area

No Action Alternative Temperance Flat RM 274 Dam construction, infrastructure, reservoir area inundation, and construction activities adjacent to the area of project impacts would not occur under the No Action Alternative. Therefore, no additional historic-era cultural resources and archaeological sites would be impacted, and conditions would remain as they currently exist.

The condition of known and previously undiscovered historic-era cultural resources and archaeological sites within the existing Millerton Lake fluctuation zone will continue to be impacted by fluctuations in the water level under the No Action Alternative. As stated above, dam construction, infrastructure and facilities relocation, and additional reservoir area inundation would not occur under the No Action Alternative; therefore, no new impacts on cultural resources related to construction or inundation are expected.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives As described previously, portions of the Squaw Leap Archaeological District are located within the primary study area. Fourteen Squaw Leap Archaeological District sites are located within the primary study area. As mapped, components of the Squaw Leap Archaeological District that would be impacted by action alternatives total about 499 acres.

The only known resources within the primary study area that have been identified as a historic property under Section 106 are related to Friant Dam. As described previously, Friant Dam is a contributor to a larger discontiguous Central Valley Project Historic District (Reclamation 2005, 2007) and it along with its contributing features (spillway, canal outlets, four gantry cranes, and three small dikes used to contain Millerton Lake) are also individually eligible for the NRHP (Reclamation 2005, 2006).

Reclamation would comply with the Federal NHPA Section 106 process to avoid, minimize, or mitigate adverse impacts to

less than significant levels. As described in Chapter 2, "Alternatives," Reclamation could enter into a Programmatic Agreement with the Advisory Council on Historic Preservation (if it chooses to participate), the SHPO, and other consulting parties that would identify how the Section 106 process would be completed for the authorized project. The Programmatic Agreement could include alternative methods for compliance or phased identification efforts/phased finding of effects efforts, as agreed upon with the consulting parties. As part of a Programmatic Agreement, Reclamation would ensure the appropriate evaluation, recovery of data and/or recordation at any eligible sites that would be adversely affected by the action alternatives. However, unique archaeological sites can be difficult to mitigate under traditional methods.

This impact would be **significant.** Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact CUL-4: Destruction or Damage to Traditional Cultural Properties

Primary Study Area

No Action Alternative Temperance Flat RM 274 Dam construction, infrastructure, reservoir area inundation, and construction activities adjacent to the area of project impacts would not occur under the No Action Alternative. No traditional cultural properties would be impacted, and conditions would remain as they currently exist.

There would be **no impact** under the No Action Alternative.

Action Alternatives No traditional cultural properties are known to exist in the primary study area, however the potential for undocumented traditional cultural properties does exist. It is not possible to know the number of resources present, how many would be determined eligible, and how many of the eligible resources would be adversely impacted from the action alternatives since only a small fraction of the area has been inventoried. However, since the action alternatives include inundation and ground-disturbing activities, potential exists for significant adverse impacts to occur to traditional cultural properties.

As described in Chapter 2, "Alternatives," the action alternatives include measures to minimize or avoid impacts to these resources to less than significant levels. Reclamation would follow the process in the implementing regulations at 36

CFR Part 800 to identify historic properties (including traditional cultural properties, as appropriate), assess effects, and resolve adverse effects through the consultation process. Consulting parties for the National Historic Preservation Act Section 106 process would include the SHPO, the Advisory Council on Historic Preservation (if it choose to participate), other Federal agencies where applicable, tribal representatives, and other interested parties (including non-Federally recognized Native Americans, members of the public, and other State or local agencies) to develop methods to avoid, minimize, or mitigate adverse effects. Any human remains, funerary objects, sacred objects, or objects of cultural patrimony that were removed from federally managed or tribal lands during any project activities would be treated consistent with the Native American Graves Protection and Repatriation Act. If human remains were removed from non-federally managed lands, they would be subject to the PRC regarding the treatment of human remains outside a dedicated cemetery.

This impact would be **significant.** Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact CUL-5: Destruction or Damage to Indian Sacred Sites

Primary Study Area

No Action Alternative Temperance Flat RM 274 Dam construction, infrastructure, reservoir area inundation, and construction activities adjacent to the area of project impacts would not occur under the No Action Alternative. No Indian Sacred Sites would be impacted, and conditions would remain as they currently exist.

There would be **no impact** under the No Action Alternative.

Action Alternatives Documented sacred areas are located in the primary study area, and undocumented sacred areas or sacred sites may also be present in the primary study area. It is not possible to know the number of resources present, how many would be determined eligible, and how many of the eligible resources would be adversely impacted from these alternatives since only a small fraction of the area has been inventoried. However, since the action alternatives include inundation and ground-disturbing activities, potential exists for significant adverse impacts to occur to sacred sites and sacred areas.

As described in Chapter 2, "Alternatives," the action alternatives include measures to minimize or avoid impacts to these resources. Reclamation would follow the process in the implementing Executive Order 13007 (May 24, 1996). Where appropriate, Reclamation would maintain the confidentiality of sacred sites. Reclamation would provide reasonable notice of proposed actions that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. Reclamation would comply with the April 29, 1994, executive memorandum, "Government-to-Government Relations with Native American Tribal Governments." Any human remains, funerary objects, sacred objects, or objects of cultural patrimony that were removed from federally managed lands during any project activities would be treated consistent with the Native American Graves Protection and Repatriation Act. If human remains were removed from non-federally managed lands, they would be subject to the PRC regarding the treatment of human remains outside a dedicated cemetery.

This impact would be **significant** under the action alternatives**.** Mitigation for this impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 9-2.

Impacts CUL-1, CUL-2, CUL-3, CUL-4, and CUL-5 within the primary study area would be significant for all action alternatives. Mitigation Measure CUL-1, described below, is proposed for Impacts CUL-1, CUL-2, CUL-3, CUL-4, and CUL-5.

Mitigation Measure CUL-1: Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Impacts on some sites from increased access and vandalism will be minimized by implementing a Cultural Resources Management Plan. To ensure the long-term protection of these sites, the plan will provide guidelines to prevent impacts on historic properties, such as restrictions for use in areas of sensitivity, and a long-term monitoring program to ensure that cultural resources are protected in the future.

Implementing Mitigation Measure CUL-1 would aid in reducing adverse effects and vandalism to prehistoric resources. However, this mitigation measure would not be

sufficient to reduce Impact CUL-1 to a less-than-significant level. As a result, Impact CUL-1 would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure CUL-2: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Implementing Mitigation Measure CUL-2 would aid in reducing adverse effects and vandalism to historic-era resources. However, this mitigation measure would not be sufficient to reduce CUL-2 to a less-than-significant level. As a result, Impact CUL-2 would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure CUL-3: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Implementing Mitigation Measure CUL-3 would aid in reducing adverse effects and vandalism to a historical and/or unique archaeological resource, historic property, or historic district. However, this mitigation measure would not be sufficient to reduce CUL-3 to a less-than-significant level. As a result, Impact CUL-3 would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure CUL-4: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Implementing Mitigation Measure CUL-4 would aid in reducing adverse effects and vandalism to traditional cultural properties. However, this mitigation measure would not be sufficient to reduce CUL-4 to a less-than-significant level. As a result, Impact CUL-4 would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure CUL-5: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Implementing Mitigation Measure CUL-5 would aid in reducing adverse effects and vandalism to Indian sacred sites. However, this mitigation measure would not be sufficient to reduce CUL-5 to a less-than-significant level. As a result, Impact CUL-5 would remain **significant and unavoidable** under the action alternatives.

Chapter 10
Environmental Justice

This chapter describes the affected environment for environmental justice, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas). Chapter 23, "Socioeconomics, Population, and Housing," analyzes impacts on social and economic characteristics and the non-environmental justice issues related to population, employment, and housing.

An analysis of Federal actions that have the potential to result in disproportionately high and adverse impacts on minority and low-income populations is required under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 Federal Register [FR] 7629).

Affected Environment

The affected environment discussion for environmental justice addresses race, ethnic origin, and economic status of affected groups. For purposes of this analysis, the definitions of minority individuals and minority and low-income populations are provided in the CEQ's Guidance for Agencies on Key Terms in Executive Order 12898 (CEQ 1997).

The CEQ defines minority individuals as persons from any of the following U.S. Census categories for race: Black/African American, Asian, Native Hawaiian or Other Pacific Islander, and American Indian or Alaska Native. Additionally, for the purposes of this analysis, minority individuals also include all other nonwhite racial categories that were added in the most recent census, such as "some other race" and "two or more races." The CEQ also mandates that persons identified through

the U.S. Census as ethnically Hispanic, regardless of race, should be included in minority counts (CEQ 1997).

A minority population is present within a study area under either of the following conditions (CEQ 1997):

- The minority population percentage of the affected area is meaningfully greater than the minority population percentage of the general population.
- The minority population percentage of the affected area exceeds 50 percent.

Low-income populations are identified based upon poverty thresholds provided by the U.S. Census Bureau and are identified in one of the following ways (CEQ 1997):

- The population percentage below the poverty level is meaningfully greater than that of the population percentage in the general population.
- The population percentage below the poverty level in the affected area exceeds 50 percent.

Significant concentrations of minority or low-income individuals are sometimes referred to as environmental justice populations. Historically, minority and low-income populations have suffered a greater share of adverse environmental and health impacts related to industry and development relative to the benefits.

Primary Study Area

The primary study area can be described in terms of U.S. Census Bureau Census Tract 64.05 in Fresno County and Census Tract 1.02 in Madera County, which together include the area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274.

For the purposes of this analysis, the environmental justice population was determined to be areas that could be subject to construction- or operation-related impacts associated with implementing any of the alternatives, including Census Tracts 64.05 and 1.02; the Auberry Census-Designated Place (CDP) in Census Tract 64.05; and Fresno Census-County Division (CCD), which includes the cities of Fresno and Clovis, the community of Friant, and other unincorporated areas south and east of the San Joaquin River, southwest of the Friant-Kern

Canal, west of the community of Sanger, and north of the community of Fowler (Figure 10-1). CDPs and CCDs are locations identified by the U.S. Census Bureau for statistical purposes. CDPs are delineated to provide data for settled concentrations of population that are identifiable by name but, like the community of Auberry, are not legally incorporated, whereas CCDs are designed to represent community areas focused on employment centers, such as the Fresno CCD. Data compiled for Fresno and Madera counties and the nearby cities of Clovis, Fresno, and Madera allow for a comparison of primary study area characteristics to a larger reference area.

Minority Populations

Table 10-1 presents racial and ethnic characteristics for the primary study area which consists of the potentially affected Census Tracts and Auberry CDP and potentially affected areas outside of the primary study area, which consist of Census Tracts 55.15, 55.25, and 10; the Friant CDP; the Fresno CCD; the nearby cities of Clovis, Fresno, and Madera; Fresno and Madera counties; and the State as a whole. These data are from the 2010 decennial census because the decennial census is the most recently completed dataset that can be used to show racial and ethnic heritage data at the Census Tract level.

Outside of the primary study area, the Friant CDP had the highest proportion of residents identified as White (85.1 percent), while the City of Fresno had the lowest proportion of White residents (49.6 percent) in 2010. In general, the Fresno CCD had a higher proportion of African American and Asian populations than the surrounding communities and the State. The Hispanic population represented the largest non-White population, ranging from 12.4 percent in the Friant CDP to 76.7 percent in the City of Madera. With the exception of the City of Clovis, the percentage of people outside of the primary study area who are of Hispanic origin was higher, with the exception of the city of Clovis than the State average (37.6 percent). The proportions of residents who identified themselves as American Indian, Pacific Islander, and “two or more races” is generally consistent with the State for many of the cities and counties in this study area. However, the proportions of residents who identified themselves as “some other race” are higher in the study area than in the State as a whole.

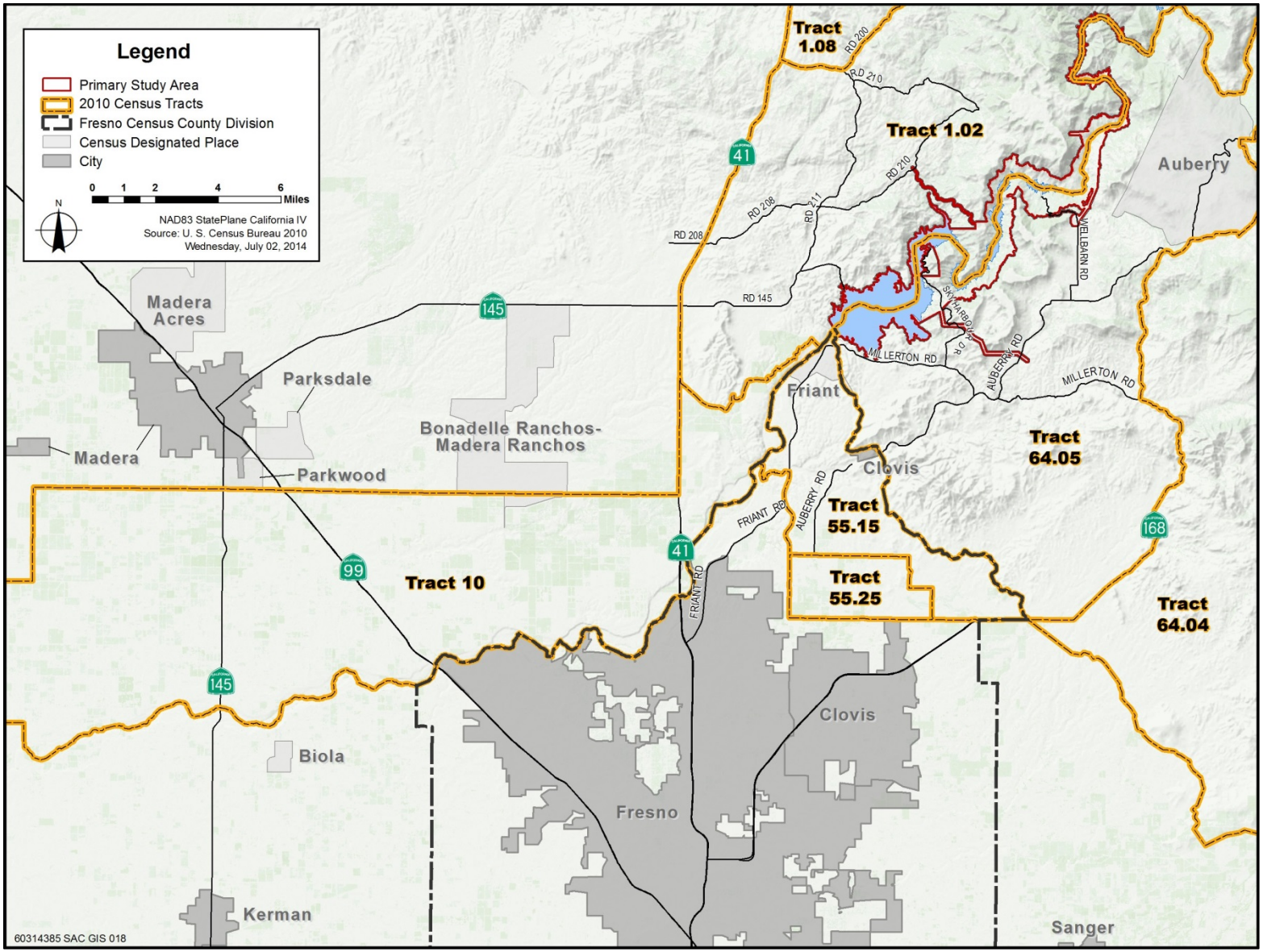


Figure 10-1. Census Tracts in the Primary Study Area

Table 10-1. Racial Composition and Ethnicity in the Primary Study Area, Fresno and Merced Counties, Nearby Cities, and State of California, 2010 (Percent of Total)

Geographic Area	White	Black/ African American	American Indian and Alaska Native	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races	Hispanic (Any Race)
Census Tract 64.05[1]	87.4	0.4	3.1	1.6	0.1	3.2	4.2	12.1
Census Tract 1.02[2]	80.8	0.8	10.0	0.8	0.1	2.2	5.3	10.2
Fresno County	55.4	5.3	1.9	9.6	0.2	23.3	4.5	50.3
Census Tract 55.15	79.0	1.6	1.6	8.5	0	4.5	4.8	14.4
Census Tract 55.25	81.7	1.6	1.1	8.4	0	3.1	4.2	15.8
Auberry CDP[3]	86.4	0.4	4.4	1.0	0.1	2.9	4.7	13.0
Friant CDP	85.1	0.8	2.8	1.4	0	2.2	7.9	12.4
City of Clovis	70.9	2.7	1.4	10.7	0.2	9.3	4.8	25.6
City of Fresno	49.6	8.3	1.7	12.6	0.2	22.6	5.0	46.9
Fresno CCD	54.2	6.9	1.7	12.0	0.2	20.2	4.8	43.1
Madera County	62.6	3.7	2.7	1.9	0.2	24.8	4.2	53.7
Census Tract 10	66.1	1.2	1.8	2.6	0.1	24.9	3.4	53.8
City of Madera	49.9	3.4	3.4	2.2	0.1	38.8	4.4	76.7
State of California	57.6	6.2	1.0	13.0	1.0	17.0	4.9	37.6

Source: U.S. Census Bureau 2010

Notes:

[1] Census Tract 64.05 is located within the Fresno County portion of the primary study area.

[2] Census Tract1.02 is located within the Madera County portion of the primary study area.

[3] The Auberry CDP is located within Census Tract 64.05.

Key:

CCD = Census-County Division

CDP = Census-Designated Place

Within the primary study area, the population of individuals identifying themselves as White in Census Tracts 64.05 and 1.02 and the Auberry CDP, which is located in Census Tract 64.05 (87.4 percent, 80.8 percent, and 86.4 percent, respectively), and American Indian in these areas (3.1 percent, 10.0 percent, and 4.4 percent, respectively) was greater than that in Fresno and Madera counties; the nearby cities; and the State as a whole. Although not greater than 50 percent, the population percentages of Native Americans in Census Tract 64.05, the Auberry CDP, and Census Tract 1.02 are be considered meaningfully greater than for the State as a whole. The African American population and Asian population were substantially less than those in the surrounding communities and in the State as a whole.

People identifying themselves as Hispanic represented the largest non-White group in Census Tracts 64.05 and 1.02 and the Auberry CDP, accounting for approximately 12.1 percent, 10.2 percent, and 13.0 percent, respectively, of the total population. However, this percentage is substantially lower than the average county (54 percent) and city (50 percent) populations and the State population (37.6 percent) identified as Hispanic.

As described in Chapter 9, “Cultural Resources,” a strong likelihood exists that important Native American heritage locations are present within the primary study area. The Study Area was the focus of intensive Native American occupation during historic times, with a variety of religious, economic, historic, and other values identified by Native American groups and is currently used by these groups.

Low-Income Populations

Persons living with income below the poverty level are identified as “low-income” populations, according to the annual statistical poverty thresholds established by the U.S. Census Bureau. Income thresholds that vary by family size and composition to determine which families are living in poverty. Poverty thresholds do not vary geographically but are updated annually for inflation using the Consumer Price Index. According to the U.S. Census Bureau, the poverty threshold in 2011 was $11,484 for an individual and $22,891 for a family of four (U.S. Census Bureau 2011a).

Table 10-2 presents the median household income, per capita income, and proportion of individuals living below the poverty threshold for the potentially affected Census Tracts and

Auberry CDP within the primary study area and potentially affected areas outside of the primary study area, which consist of Census Tracts 55.15, 55.25, and 10; the Friant CDP; the nearby cities of Clovis, Fresno, and Madera; the Fresno CCD; Fresno and Madera counties; and the State of California as a whole. Data in Table 10-2 were obtained from the U.S. Census Bureau 2007–2011 American Community Survey (ACS). Estimates from the ACS are all "period" estimates that represent data collected over a period of time (as opposed to "point-in-time" estimates, such as the decennial census, that approximate the characteristics of an area on a specific date). The primary advantage of using multiyear estimates in this analysis of low-income populations is the increased statistical reliability of the data for less populated areas and small population subgroups.

Table 10-2. Median Household Income and Poverty Levels in the Primary Study Area, Fresno and Merced Counties, Nearby Cities, and State of California, 2011

Geographic Area	Median Household Income	Per Capita Income	Percent of Population Below Poverty Level
Census Tract 64.05[1]	$73,750	$34,854	3.9
Census Tract 1.02[2]	$51,339	$27,547	12.9
Fresno County	$46,903	$20,638	23.4
Census Tract 55.15	$108,681	$56,702	2.0
Census Tract 55.25	$79,420	$38,443	6.2
Auberry CDP[3]	$70,096	$31,289	3.4
Friant CDP	$24,152	$23,924	7.3
City of Clovis	$65,300	$27,749	10.4
City of Fresno	$43,440	$19,978	25.9
Fresno CCD	$47,875	$22,063	22.6
Madera County	$47,724	$18,817	19.8
Census Tract 10	$21,904	$8,484	22.1
City of Madera	$41,991	$14,685	26.1
State of California	$60,632	$29,674	14.4

Source: U.S. Census Bureau 2011b

Notes:

Values are presented in 2011 dollars.

[1] Census Tract 64.05 is located within the Fresno County portion of the primary study area.

[2] Census Tract 1.02 is located within the Madera County portion of the primary study area.

[3] The Auberry CDP is located within Census Tract 64.05.

Key:
CCD = Census-County Division
CDP = Census-Designated Place

As shown in Table 10-2, the median household income (2011 dollars) for both counties and the majority of the nearby communities outside of the primary study area is less than the

statewide median household income ($60,632). The Friant CDP registered the highest median household income, approximately $108,681. Census Tract 10 recorded the lowest median household income ($41,991), which averaged $19,000 less than the State's average and lowest per capita income ($14,685).

The population percentage in counties and nearby communities outside of the primary study area below the poverty level does not exceed 50 percent and is not meaningfully greater than the percentage of the population in the State and is not twice as great as those of the State. The percentage of populations of Fresno and Madera Counties at income levels below the poverty threshold (23.4 percent and 19.8 percent, respectively) were higher than the statewide average of 14.4 percent. The City of Fresno had the highest poverty rate (25.9 percent) in the area, and Census Tracts 55.15 and 55.25 (2.0 percent and 6.2 percent, respectively), the Friant CDP (7.3 percent), and Clovis (10.4 percent) had proportions below the statewide poverty threshold.

It should be noted that Fresno and Madera counties and the cities of Fresno and Madera exhibit relatively high proportions of low-income residents, although the proportion does not exceed 28.8 percent, suggesting that there are clusters of low-income residents present in each of these urban centers. Overall, the distribution of employment for the low-income populations in both counties and cities by industry is similar. A greater percentage of residents were employed in agricultural, forestry, and mining industries, with Madera County and City of Madera having the highest percentage (17.9 percent and 27.8 percent, respectively), when compared to the primary study area (U.S. Census Bureau 2011b).

Within the primary study area, Census Tract 64.05 and the Auberry CDP had median household incomes ($73,750 and $70,096, respectively) that were substantially greater than the statewide median household income ($60,632), and the per capita income of Census Tract 64.05 and the Auberry CDP ($34,854 and $31,289, respectively) were greater than the statewide per capita income ($29,674). Census Tract 1.02 had a median household income ($51,339) and per capita income ($27,547) that were less than the State's average but greater than the median household income and per capita income of Fresno and Madera counties and the cities of Fresno and Madera in 2010. The population below poverty threshold in the Census Tracts 64.05 and 1.02 (3.9 percent and 12.9 percent,

respectively) and the Auberry CDP (3.4 percent) was lower than both counties and nearby cities, with the exception of Clovis, and lower than the State as a whole (14.4 percent).

Census Tracts 64.05 and 1.02 consist of smaller rural communities that provide tourism and recreational services to the Millerton Lake area. These Census Tracts exhibit a lower proportion of low-income residents than Fresno and Madera counties and the cities of Fresno, Clovis, and Madera. Within Census Tracts 64.05 and 1.02, the percentage of workers employed in the arts, entertainment, and accommodations industry (10.3 percent and 20.1 percent, respectively) was greater than that in the surrounding urban areas (U.S. Census Bureau 2011b).

Extended Study Area

The portion of the San Joaquin River extending from Friant Dam to the confluence with the Merced River is now subject to changed instream flows associated with implementing the SJRRP. Interim and Restoration flows have not resulted in a physical change that substantially affected minority and low-income populations (SJRRP 2009).

All of the action alternatives would deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to the Friant Division of the CVP and SWP water users. Alternative Plans 2, 3, 4, and 5 would also deliver additional water supply to CVP SOD contractors. These deliveries would be dispersed over the 36 counties that are served by the CVP and SWP and would be less discernible to a single jurisdiction. Implementing any of the action alternatives would improve surface water supply reliability to agricultural producers in the CVP and SWP water service areas. About 30 percent to 60 percent of the water made available for delivery would be conveyed directly to Friant Division water contractors, depending on the alternative plan implemented. Therefore, increased surface water reliability would provide the greatest benefit to agricultural water users in the six counties within the Friant Division water service area (i.e., Fresno, Kern, Kings, Madera, Merced, and Tulare counties). This description of the environmental justice setting focuses on this six-county area. Environmental justice demographic data are also provided for the State of California to provide a basis for comparison of the six-county area to a larger reference area.

Minority Populations

Table 10-3 presents racial and ethnic characteristics for the six counties within the Friant Division of the CVP water service area and for the State of California. These data are from the most recent decennial census completed in 2010 that provided racial and ethnic heritage data at the countywide and statewide level.

Table 10-3. Racial Composition and Ethnicity in the Six-County Friant Division Water Service Area and State of California, 2010 (Percent of Total Population)

Geographic Area	White	Black/ African American	American Indian and Alaska Native	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races	Hispanic (Any Race)
Fresno County	55.4	5.3	1.9	9.6	0.2	23.3	4.5	50.3
Kern County	59.5	5.8	1.5	4.2	0.1	24.3	4.5	49.2
Kings County	54.3	7.2	1.7	3.7	0.2	28.1	4.9	50.9
Madera County	62.6	3.7	2.7	1.9	0.2	24.8	4.2	53.7
Merced County	58.0	3.9	1.4	7.4	0.2	24.5	4.7	54.9
Tulare County	60.1	1.6	1.6	3.4	0.1	29.0	4.2	60.6
State of California	57.6	6.2	1.0	13.0	1.0	17.0	4.9	37.6

Source: U.S. Census Bureau 2010

Most of the people in this six-county area are White, but the proportion of population identified as White varies substantially between counties. The White population of Madera County (62.6 percent) in 2010 was the highest proportion of any county in the area, while Kings County had the lowest proportion of White residents (54.3 percent). Kings County (7.2 percent) registered a higher percentage of African Americans than the State as a whole (6.2 percent). The American Indian populations in all six counties were higher than the State's population (1.0 percent), and the Asian populations in all six counties were less than the State's population (13.0 percent). The proportions of residents responding as being Pacific Islander are generally consistent with the statewide levels. The proportions of residents responding as "some other race" in all six counties were also substantially higher than the statewide levels (17.0 percent). In all of the counties, the Hispanic population represented the largest non-White population, ranging from 49.2 percent in Kern County to 60.6 percent in Tulare County. No other sizeable variations in minority populations were observed between State and county levels.

Low-Income Populations

Table 10-4 presents the median household income and per capita income in 2011 dollars, and the proportion of individuals living below the poverty threshold for the six-county area. The median household income and per capita income were less than the State ($60,632 and $29,674, respectively), and the poverty level was greater than the statewide average (14.4 percent) for all six counties. Fresno County had the highest median and per capita income ($49,903 and $20,638, respectively), and Tulare County had the lowest median and per capita income ($43,550 and $17,986, respectively). The percentage of populations at income levels below the poverty threshold ranged from 19.3 percent in Kings County to 23.8 percent in Tulare County.

Table 10-4. Median Household Income and Poverty Levels in the Friant Division, and State of California, 2011

Geographic Area	Median Household Income	Per Capita Income	Percent of Population Below Poverty Level
Fresno County	$49,903	$20,638	23.4
Kern County	$48,021	$20,167	21.4
Kings County	$48,838	$18,296	19.3
Madera County	$47,724	$18,817	19.8
Merced County	$43,945	$18,304	23.0
Tulare County	$43,550	$17,986	23.8
State of California	$60,632	$29,674	14.4

Source: U.S. Census Bureau 2011b
Note:
Values presented in 2011 dollars.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine whether implementing any of the alternatives might cause disproportionately high and adverse human health or environmental impacts on minority or low-income populations. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately. The potential impacts are summarized in Table 10-5.

Table 10-5. Summary of Impacts and Mitigation Measures for Environmental Justice

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low Income Populations	Primary Study Area	No Action Alternative	NDHA	None Required	NDHA
		Alternative Plan 1	DHA	ENJ-1: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources	DHA
		Alternative Plan 2	DHA		DHA
		Alternative Plan 3	DHA		DHA
		Alternative Plan 4	DHA		DHA
		Alternative Plan 5	DHA		DHA
	Extended Study Area	No Action Alternative	NDHA	None Required	NDHA
		Alternative Plan 1	NDHA		NDHA
		Alternative Plan 2	NDHA		NDHA
		Alternative Plan 3	NDHA		NDHA
		Alternative Plan 4	NDHA		NDHA
		Alternative Plan 5	NDHA		NDHA

Key:
DHA = disproportionately high and adverse
NDHA = not disproportionately high and adverse

Methods and Assumptions

For the purposes of this environmental justice analysis, racial and ethnic characteristics were obtained from the U.S. Census Bureau 2010 decennial census, and income characteristics and poverty status were obtained from the U.S. Census Bureau 2007–2011 ACS. As discussed above, the environmental justice population was determined to be areas that could be subject to construction- or operation-related impacts associated with implementing any of the action alternatives, including Census Tract 64.05, Census Tract 1.02, and the Auberry CDP in the primary study area. Potentially affected areas outside of the primary study area, consisting of Census Tract 55.15, Census Tract 55.25, Census Tract 10, the Friant CDP, and the Fresno CCD, were also analyzed. Finally, the nearby cities of Clovis, Fresno, and Madera, and the entire Fresno and Madera county areas, were also evaluated. Environmental justice demographic data are also presented for the entire state to provide a basis for comparison to a larger reference area.

According to CEQ and EPA guidelines, the first step in conducting an environmental justice analysis is to define minority and low-income populations (CEQ 1997). Based on these guidelines, a meaningfully greater minority population is present if it meets one of the following criteria:

- The minority population of the affected area exceeds 50 percent.
- The proportion of the minority population residing in the affected area is meaningfully greater than the proportion of the minority population in the general population or other appropriate unit of geographic analysis.
- The proportion of population in the primary study area whose income is below the poverty level, as defined by the U.S. Census Bureau, exceeds 50 percent.
- The proportion of people living in households below the poverty threshold is meaningfully greater than the proportion of the general population or other appropriate unit of geographic analysis who live below the poverty level.

The second step of an environmental justice analysis requires that a determination be made as to whether a “high and

adverse" impact would occur. The CEQ guidance indicates that when determining whether the impacts are high and adverse, agencies are to consider whether the risks or rates of impact "are significant (as that term is defined by the NEPA lead agency) or above generally accepted norms."

The final step requires a determination as to whether the impact on the minority or low-income population would be "disproportionately high and adverse." Although there are no published guidelines defining the term "disproportionately high and adverse," CEQ includes a nonquantitative definition stating that an impact is disproportionate if it appreciably exceeds the risk to the general population. If an impact remains significant after all mitigation is implemented, then the impact is included in the environmental justice analysis, and the equity of the impact across the affected population is determined. For impacts determined to be less than significant or less than significant with implementation of mitigation, no additional evaluation is needed because those effects would not result in disproportionate effects on minority and low-income populations.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. To make a finding that disproportionately high and adverse impacts would likely fall on a minority or low-income population, the following three conditions must be met simultaneously:

- A minority or low-income population must reside in the affected area.
- A high and adverse impact on the natural or physical environment must exist.
- The impact on the minority or low-income population must be disproportionately high and adverse.

The EPA's environmental justice guidance states that "impacts that may affect a cultural, historical, or protected (e.g., treaty) resource of value to an Indian Tribe or a minority population, even when the population is not concentrated in the vicinity" should be considered in an environmental justice analysis (EPA

1998). A qualitative evaluation of the potential to affect traditional cultural properties or sacred sites or areas was conducted based on the results of record searches at the Information Center and California NAHC (see Chapter 9, "Cultural Resources"). Sixteen groups, including those listed by the NAHC, represent Native American interests in the Study Area: the Big Sandy Rancheria of Western Mono Indians; Choinumni Tribe; Cold Springs Rancheria of Mono Indians; Dumna Tribal Government; the Dumna Wo-Wah Tribal Government; Dunlap Band of Mono Indians; North Fork Mono Tribe; North Fork Rancheria; Nototonme/North Valley Yokut Tribe, Inc.; Picayune Rancheria of the Chukchansi Indians; Tachi-Yokut Tribe (Santa Rosa Rancheria); Sierra Nevada Native American Coalition; Southern Sierra Miwuk Nation; Table Mountain Rancheria; Tule River Tribe; and the Traditional Choinumni Tribe. Tribal consultation for the Investigation is pending.

Topics Eliminated from Further Consideration

No topics related to environmental justice that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

Direct and Indirect Effects

This section describes the environmental consequences of implementing any of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low-Income Populations

Primary Study Area

No Action Alternative Under the No Action Alternative, none of the action alternatives would be constructed, and there would be no physical changes to the environment. Existing facilities in the primary study area would continue to be operated similar to current conditions.

No disproportionately high and adverse impacts on minority or low-income populations in the primary study area would occur.

Action Alternatives As shown in Table 10-1, no minority or low-income populations in Census Tract 64.05, the Auberry

CDP in Fresno County, or Census Tract 1.02 in Madera County are greater than 50 percent of the total population or proportionally larger than in either county or the State. Although not greater than 50 percent, the population percentages of Native Americans in Census Tract 64.05, the Auberry CDP, and Census Tract 1.02 are be considered meaningfully greater than for the State as a whole, as shown in Table 10-1. The Hispanic population within Fresno and Madera counties is greater than the 50 percent threshold and is substantially greater than the average State population identified as Hispanic (37.6 percent), as shown in Table 10-1.

The percentage of the population below the poverty level in Census Tract 64.05 (3.9 percent), the Auberry CDP (3.4 percent), and Census Tract 1.02 (12.9 percent) does not exceed 50 percent and is not considered meaningfully greater than the percentage of the population in the State that is living in poverty (28.8 percent), as shown in Table 10-2. Similarly, none of the population outside of the primary study area exceeds 50 percent of the population in the State living in poverty and therefore is not considered meaningfully greater, as shown in Table 10-2.

It should be noted that Fresno and Madera counties and the cities of Fresno and Madera exhibit relatively high proportions of low-income residents, although the proportion does not exceed 28.8 percent, suggesting that there are clusters of low-income residents present in each of these urban centers. A Cumulative Environmental Vulnerability Assessment (CEVA) was prepared for the eight counties that comprise the San Joaquin Valley. The CEVA considers the combined single, multiple, routine, and accidental release of hazardous materials and air quality emissions and produces spatial analysis that identifies the places that are subject to both the highest concentrations of cumulative environmental hazards and the fewest social and economic resources to prevent, reduce, or adapt to these conditions. The CEVA determined that substantial overlap between environmental hazards and social vulnerability that occurs in many rural areas throughout the San Joaquin Valley where minority and low-income communities reside in the vicinity of agricultural fields, regional transportation corridors, and non-agricultural industries such as power plants and waste disposal facilities. In the primary study area, areas within and adjacent to the Fresno CCD are shown to be areas with high vulnerability levels (Ganlin and London 2012).

Implementing any of the action alternatives could cause disproportionately high and adverse impacts on minority and low-income populations because the population percentages of American Indian in the primary study area is meaningfully greater than for the State; the Hispanic population in areas adjacent to the primary study area is greater than 50 percent of the total population and the State as a whole; and there are likely clusters of low-income populations within this area.

After consideration of actions, operations, and features to avoid, mitigate, and/or compensate for adverse impacts, implementing any of the action alternatives would likely result in significant and unavoidable or potentially significant and unavoidable direct and indirect impacts on local air quality and GHG emissions, aquatic resources, botanical resources, terrestrial biological resources, geology and soils, land use planning and agricultural resources, noise and vibration, power and energy, public health and hazards, recreational opportunities, and visual resources. The following discussion summarizes significant and unavoidable impacts identified in these resource chapters and discusses the potential for those impacts to result in disproportionately high and adverse effects on minority populations in the primary study area.

As discussed in Chapter 4, “Air Quality and Greenhouse Gas Emissions,” implementing the action alternatives would result in generation of criteria air pollutant (PM_{10}) and precursor emissions (ROG and NO_X) due to construction (Impact AQ-1, significant and unavoidable) and generation of GHG emissions due to construction activities, recreation visitation, energy consumption, and loss of CO_2 sequestration from vegetation clearing (Impact AQ-4, significant and unavoidable). Construction would cause temporary air quality impacts, and these short-term impacts would be localized to the inundation areas. Long-term air quality impacts would occur throughout the primary study area and affect the primary study area’s population equally, regardless of race, ethnicity, or income level.

Chapter 5, “Biological Resources – Fisheries and Aquatic Resources,” Chapter 6, “Biological Resources – Botanical and Wetlands,” and Chapter 7, “Biological Resources – Wildlife,” addressed impacts on fish species, riparian habitat and sensitive natural communities, and special-status wildlife species. Implementing the action alternatives would result in the loss of riverine habitat for lotic fish species (Impact FSH-1, significant and unavoidable); loss of existing spawning habitat of

American shad and spawning habitat of striped bass (Impact FSH-9, significant and unavoidable); change in water temperature conditions supporting juvenile salmon and steelhead migration (Impact FSH-11, significant and unavoidable); effects on Delta fish habitat from changes in water temperature and DO concentrations (Impact FSH-18, potentially significant and unavoidable); loss of riparian habitat and other sensitive natural communities (Impact BOT-2, significant and unavoidable); and substantial impact on special-status raptors (Impact WLD-3, significant and unavoidable). There are no minority or low-income populations in the area that subsist on aquatic, botanical, and terrestrial biological resources; therefore, there would not be a disproportionately high and adverse human health or environmental effect on minority populations and low-income populations, including tribal populations.

Chapter 9, "Cultural Resources," states implementing the action alternatives would result in significant and unavoidable impacts from disturbance or destruction of known or previously undiscovered prehistoric resources due to construction, inundation, and project operation (Impact CUL-1, significant and unavoidable); disturbance or destruction of known or previously undiscovered historic-era resources due to construction, inundation, and project operation (Impact CUL-2, significant and unavoidable); destruction or damage to traditional cultural properties (Impact CUL-4, significant and unavoidable); and or destruction or damage to Indian sacred sites (Impact CUL-5, significant and unavoidable). The primary study area contains historic-era archaeological resources, including two mining sites, one location with two ore crushers, and a series of rock cairns, and multi-component sites, including some combination of bedrock milling loci, prehistoric or historic artifact scatters, and prehistoric or historic Native American residential evidence. No traditional cultural properties are known to exist in the primary study area; however, the potential for undocumented traditional cultural properties does exist. Documented sacred areas are located in the primary study area, and undocumented sacred areas or sacred sites may also be present in the primary study area.

Reclamation would follow the process in the implementing regulations at 36 CFR Part 800 to identify historic properties (including traditional cultural properties, sacred sites, and sacred areas, as appropriate), assess effects, and resolve adverse effects through the consultation process. Consulting parties for the National Historic Preservation Act Section 106

process would include the SHPO, the Advisory Council on Historic Preservation (if it chooses to participate), other Federal agencies where applicable, tribal representatives, and other interested parties (including non-Federally recognized Native Americans, members of the public, and other State or local agencies) to develop methods to avoid, minimize, or mitigate adverse effects. In addition, to ensure the long-term protection of these sites, a Cultural Resources Management Plan will provide guidelines to avoid, minimize, or mitigate impacts on historic properties and a long-term monitoring program to ensure that cultural resources are protected in the future, and the plan would aid in reducing adverse effects and vandalism to prehistoric resources. Implementation of mitigation measures would not reduce this impact to a less-than-significant level and the impact would remain significant and unavoidable. Therefore, destruction or damage to prehistoric resources, traditional cultural properties, or Indian sacred sites would result in a disproportionately high and adverse effect on Native American populations. Implementing the action alternatives would cause a substantial adverse change in the significance of a historical and/or unique archaeological resource, historic property, or historic district (Impact CUL-3, significant and unavoidable). The only known resources within the primary study area that have been identified as historic properties under Section 106 are related to Friant Dam. Impacts on Friant Dam would not affect any one minority population; therefore, no impacts on environmental justice populations would occur.

As discussed in Chapter 11, “Geology and Soils,” alteration of fluvial geomorphology could adversely affect aquatic habitat in the reservoir by creating new delta deposits (Impact GEO-2, potentially significant and unavoidable) and could cause substantial soil erosion or loss of topsoil due to construction and operations (Impact GEO-4, potentially significant and unavoidable). Impacts associated with geology and soils would not result in impacts on environmental justice populations.

As discussed in Chapter 17, “Land Use Planning and Agricultural Resources,” implementing the action alternatives could result in physical disruptions of existing land uses resulting from inundation affecting existing San Joaquin River crossings, trails, and roads (Impact LUP-1, potentially significant and unavoidable). These potential disruptions in land uses would occur in the immediate vicinity of the inundation area. None of these changes would affect minority

populations in Census Tracts 64.05 and 1.02 and the Auberry CDP.

Conversion of farmland to nonagricultural uses and cancellation of Williamson Act Contracts (Impact LUP-3, potentially significant and unavoidable) would not directly affect minority populations. Indirectly, conversion of farmland could result in impacts associated with agricultural-related employment and income. Active agricultural land uses occur in the primary study area and grazing activities do not employ substantial numbers of workers; therefore, loss of grazing lands would not result in impacts on environmental justice populations.

The conversion of forestlands (Impact LUP-4, potentially significant and unavoidable) would not directly affect minority populations. Indirectly, conversion of forestland could result in impacts associated with timber harvest-related employment and income. Timber harvesting in the primary study area does not employ substantial numbers of workers; therefore, loss of forestlands would not result in impacts on environmental justice populations.

Implementing the action alternatives would result in potential conflicts with adopted land use plans, goals, and policies of affected jurisdictions, including the BLM Bakersfield Proposed RMP, Millerton Lake RMP and General Plan, and Big Table Mountain Ecological Reserve (Impact LUP-2, potentially significant and unavoidable); the Fresno County and Madera County general plan objectives and guidelines to protect natural communities (Impact WLD-10, significant and unavoidable); and with guidelines for visual resources in the BLM Bakersfield Proposed RMP (Impact VIS-1, significant and unavoidable). However, inconsistencies between adopted or proposed land use plans, goals, policies are related to land use regulations and not to a physical environmental consequence of project implementation. Therefore, no impacts on environmental justice populations would occur.

As discussed in Chapter 18, “Noise and Vibration,” exposure of sensitive receptors to noise generated by facility construction (Impact NOI-1, significant and unavoidable) and short-term exposure of sensitive receptors to construction-related traffic noise due to increases in traffic noise would occur within the primary study area (Impact NOI-3, significant and unavoidable). Long-term increases in traffic noise due to increases in daily traffic would result from improved

conditions at Millerton Lake and additional recreational opportunities (Impact NOI-5, significant and unavoidable). These impacts would occur throughout the primary study area and affect the primary study area's population equally, regardless of race, ethnicity, or income level.

Implementing the action alternatives would result in a decrease in Kerckhoff Hydroelectric Project energy generation and ancillary services (Impact PWR-1, significant and unavoidable). As discussed in Chapter 20, "Power and Energy," electricity generated by the Kerckhoff Hydroelectric Project provides electrical supplies to cities and communities throughout the upper San Joaquin River Basin; therefore, impacts associated with a decrease in energy generation would affect the population equally, regardless of race, ethnicity, or income level.

As discussed in Chapter 22, "Recreation," implementing the action alternatives would result in the permanent loss of recreational opportunities associated with the Millerton Lake Cave System (Impact REC-2, significant and unavoidable), substantial or long-term reduction or elimination of recreation opportunities or experiences (Impact REC-3, significant and unavoidable), and the temporary loss of access to the Temperance Flat boat-in campground or SRA Temperance Flat and Big Bend areas during construction (Impact REC-4, significant and unavoidable). Various races, ethnicities, and income levels participate in recreational opportunities in the primary study area; therefore, these impacts would affect recreationists equally.

Implementing the action alternative would degrade and/or obstruct a scenic view (Impact VIS-2, significant and unavoidable), and increase daytime glare and/or nighttime lighting (Impact VIS-3, significant and unavoidable). As discussed in Chapter 26, "Visual Resources," changes in views and increased glare and nighttime lighting would affect recreational users, including motorists, hikers, campground users, and watercraft users and motorists, residents and nearby workers near Auberry Road and other local roads. These impacts would affect the primary study area's population equally, regardless of race, ethnicity, or income level.

As discussed in Chapter 23, "Socioeconomics, Population, and Housing," substantial employment and personal income in Fresno and Madera counties would be generated from construction- and operations-related activities and increased

recreation visitation. These new jobs are expected to provide employment opportunities to many workers, particularly unemployed workers, and spending related to increases in personal income would result in new local economic activity in Fresno and Madera counties.

In addition, implementing any of the action alternatives would also result in a substantial increase in business income and local sales tax revenue in Fresno and Madera counties from spending of personal income and expenditures and purchases. Increased revenues could be reinvested into existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, and/or used in other ways. These increased employment and income opportunities would likely benefit minority and low-income populations in the region.

Disproportionately high and adverse impacts on minority or low-income populations in the primary study area could occur under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, no changes in water supply delivery or flood storage operations for Friant Dam would occur, and there would be no substantial changes from existing conditions.

No disproportionately high and adverse impacts on minority or low-income populations in the CVP and SWP water service areas would occur.

Action Alternatives The Friant Division of the CVP, other CVP SOD contractors, and SWP contractors are considered as beneficiaries in the action alternatives. Each action alternative would deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to the Friant Division of the CVP and SWP water users. Alternative Plans 2, 3, 4, and 5 would also deliver new supply to CVP SOD contractors.

No significant and unavoidable impacts were identified to occur in the CVP and SWP water service areas that could cause disproportionately high and adverse impacts on minority and low-income populations. Therefore, none of the action alternatives would have environmental impacts in the CVP and SWP water service areas that would disproportionately affect minority or low-income populations.

Improved surface water reliability expected to result from implementing any of the action alternatives would result in less crop idling, thereby increasing agricultural production and net income. Within the CVP and SWP water service areas, the increased surface water reliability would provide the greatest economic benefits to agricultural water users in the six counties within the Friant Division of the CVP water service area (i.e., Fresno, Kern, Kings, Madera, Merced, and Tulare counties).

Agricultural water users in the CVP and SWP water service areas outside of the Friant Division of the CVP would also benefit from increased surface water reliability; however, these economic impacts would be dispersed over the 36 counties that are served by the CVP and SWP and would be less discernible to a single jurisdiction. There would be beneficial impacts on the population at large in the water service areas that cannot be reduced to discrete benefits for any particular segment of the population, but it is likely that minority and low-income populations in the CVP and SWP water service areas would benefit from increased employment and income opportunities.

As discussed in Chapter 23, “Socioeconomics, Population, and Housing,” agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many workers, particularly unemployed workers in the CVP and SWP water service areas. In addition, implementing any of the action alternatives would also result in a substantial increase in business income and local sales tax revenue in the CVP and SWP water service areas from spending of personal income and expenditures and purchases. Increased revenues and profits could be reinvested into existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways. Therefore, these increased employment and income opportunities would likely benefit minority and low-income populations in the Friant Division and CVP and SWP water service areas outside of the Friant Division water service area.

No disproportionately high and adverse impacts on minority or low-income populations in the CVP and SWP water service areas would occur under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

As shown in Table 10-5, implementing the action alternatives would result in disproportionate high and adverse effects on

environmental justice populations (i.e., Native Americans) in the primary study area (Impact ENJ-1). Mitigation Measure ENJ-1, described below, is proposed for Impact ENJ-1.

No disproportionately high and adverse impact on minority or low-income populations would occur within the extended study area, as presented in Table 10-5. No further mitigation is proposed.

Mitigation Measure ENJ-1: Implement Mitigation Measure CUL-1, Precautions for Limiting Post-Construction Vandalism to Cultural Resources

Chapter 9, "Cultural Resources," states implementation of the action alternatives would result in significant impacts from destruction or damage to traditional cultural properties or Indian sacred sites. Implementation of Mitigation Measure CUL-1 would reduce this impact but not to a less-than-significant level, and the impact would remain significant and unavoidable. Therefore, destruction or damage to traditional cultural properties or Indian sacred sites, Impact ENJ-1, would result in a disproportionately high and adverse effect on Native American populations under the action alternatives. No further mitigation is proposed.

Chapter 11
Geology and Soils

This chapter describes the affected environment for geology and soils, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

This section describes the affected environment related to geology, geologic hazards, erosion and sedimentation, geomorphology, mineral resources, soils, and salts.

Where appropriate, geology and soils characteristics are described in a regional context, including geologic provinces, physiographic regions, or other large-scale areas, with some area-specific geologic maps and descriptions of specific soil associations.

Geology

This section describes the geology of the primary and extended study areas.

Primary Study Area

A description of the surficial geologic units encountered in the primary study area is presented in Table 11-1. Geologic maps of the primary study area and the area of project features are presented in Figure 11-1 and Figure 11-2, respectively.

Table 11-1. Description of Surficial Geologic Units of the Primary Study Area

Geologic Map of Millerton Lake Quadrangle, West-Central Sierra Nevada, California[1]		
Formation Abbreviation	**Surficial Deposits**	**General Features**
Kbl	Tonalite of Blue Canyon - blocky hornblende facies	Plutonic rocks characterized by undeformed blocky hornblende prisms as long as 1 cm and by biotite books as much as 5 mm across. Surface geology would potentially be intercepted by area project features, including the 500-foot power transmission alignment and haul roads under Option C.
Pzv	Metamorphosed Volcanic and Volcanogenic Rocks	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite, often massive. Surface geology would be intercepted by area project features, including access roads cut and fill and the powerhouse footprint.
Pzs	Metasedimentary Rocks - quartz-biotite schist	Metasedimentary rocks are strongly foliated and lineated with minor folds that are isoclinal, and which axes plunge steeply. These rocks include thin layers of quartzite.
Kblb	Tonalite of Blue Canyon - Biotite-rich facies	Biotite-rich facies of the tonalite of Blue Canyon in the northeastern part of the primary study area may contain 5 to 12 percent poikilitic K-feldspar crystals 1 to 3 cm across. The portion of the biotite-rich facies in the south-central portion of the quadrangle that overlaps with the primary study area may contain subhedral biotite books and quartz crystals as large as 1 cm across.
KJgb	Gabbro	Gabbro is primarily plagioclase-hornblende that exhibits a range of textures and locally contains minor olivine and/or augite. Surface geology would be intercepted by area project features, including access and haul roads, cut and fill, potential batch plant (Options A, B, and C), diversion tunnel, and selective level intake structure (Alternative Plan 4).
Qdf	Debris Flow	Debris flow deposits may be a few meters thick and are typically composed of angular trachyandesite blocks, from erosional undercutting of margins of Kennedy Table, and rounded metavolcanic cobbles in a sandy matrix. Surface geology could be intercepted by potential area project features, including access roads under Option C.
Kgd	Biotite Granodiorite	Millerton Ridge pluton is located in the south-central part of the quadrangle and would overlap with area project, features including the potential aggregate quarry (Option A) and batch plant (Options A, B, and C), a portion of the proposed Temperance Flat RM 274 Dam site, and staging area. Millerton Ridge is a leucogranodiorite and contains garnet (0.1 – 2 mm across) along the western edge.
Pzvh	Metamorphosed Volcanic and Volcanogenic Rocks - quartz-hornblende-plagioclase schist	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite, often massive. Surface geology would potentially be intercepted by area project features, including the 500-foot power transmission alignment and potential batch plant (Options B and C).
Pzva	Metamorphosed Volcanic and Volcanogenic Rocks - plagioclase-diopside-hornblende amphibolite	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite, often massive. Surface geology would potentially be intercepted by area project features, including a potential aggregate quarry (Option C).

Table 11-1. Description of Surficial Geologic Units of the Primary Study Area (contd.)

Geologic Map of Millerton Lake Quadrangle, West-Central Sierra Nevada, California[1] (contd.)		
Formation Abbreviation	**Surficial Deposits**	**General Features**
Pzu	Metasedimentary and Metavolcanic Rocks, Undifferentiated	Metasedimentary and metavolcanic rocks, undifferentiated
Qal	Alluvium	Stream and gravel alluvium
Geologic Map of California, Fresno Sheet[2], Scale 1:250,000		
Formation Abbreviation	**Surficial Deposits**	**General Features**
Tvb	Tertiary volcanic	Pyroclastic rocks
Tc	Tertiary nonmarine	Tertiary nonmarine
grg	Mesozoic granitic rocks	Granodiorite

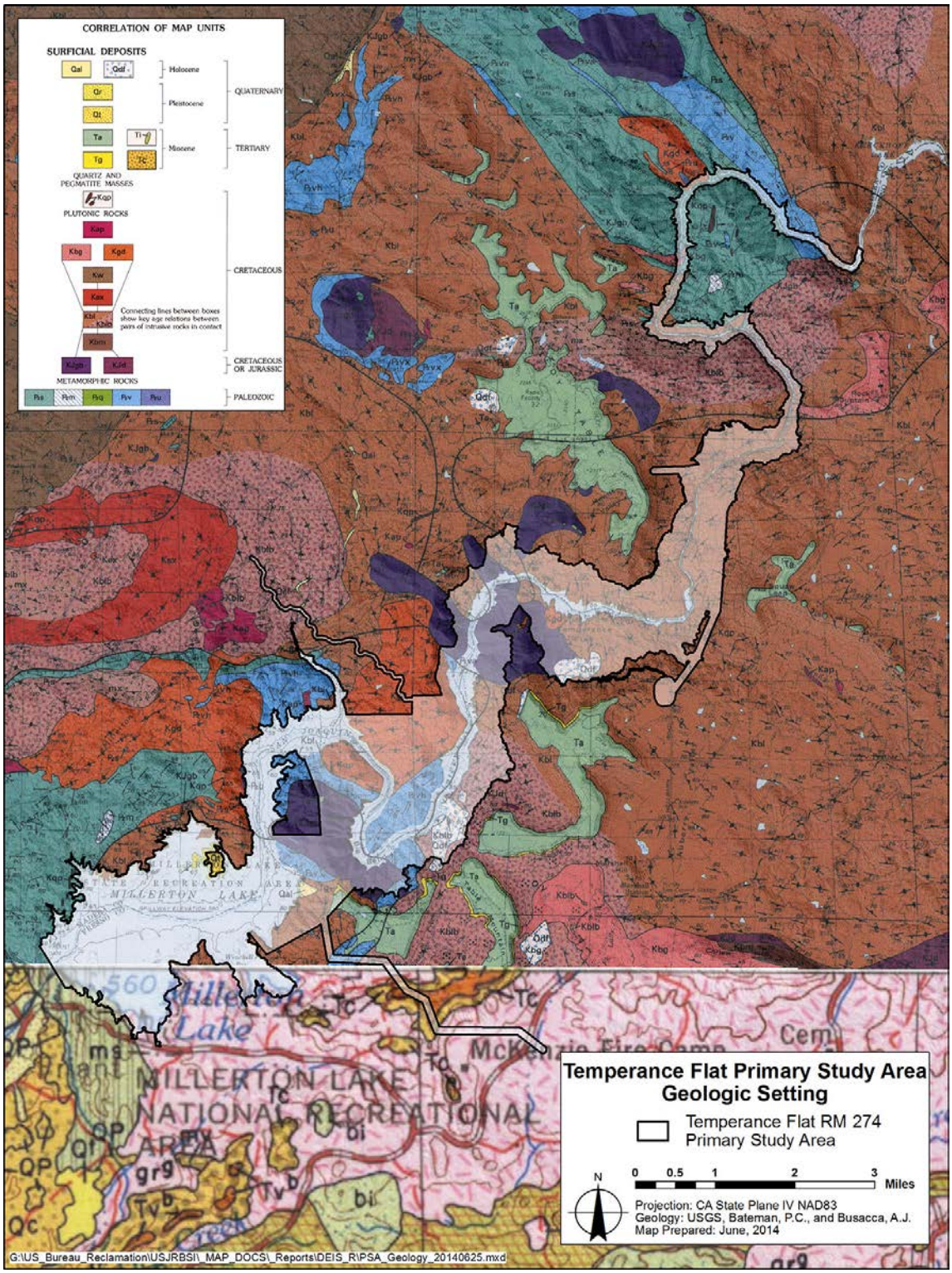
Sources:
[1] *Bateman and Busacca 1982*
[2] *Matthews and Burnett 1966*

Key:

cm = centimeter

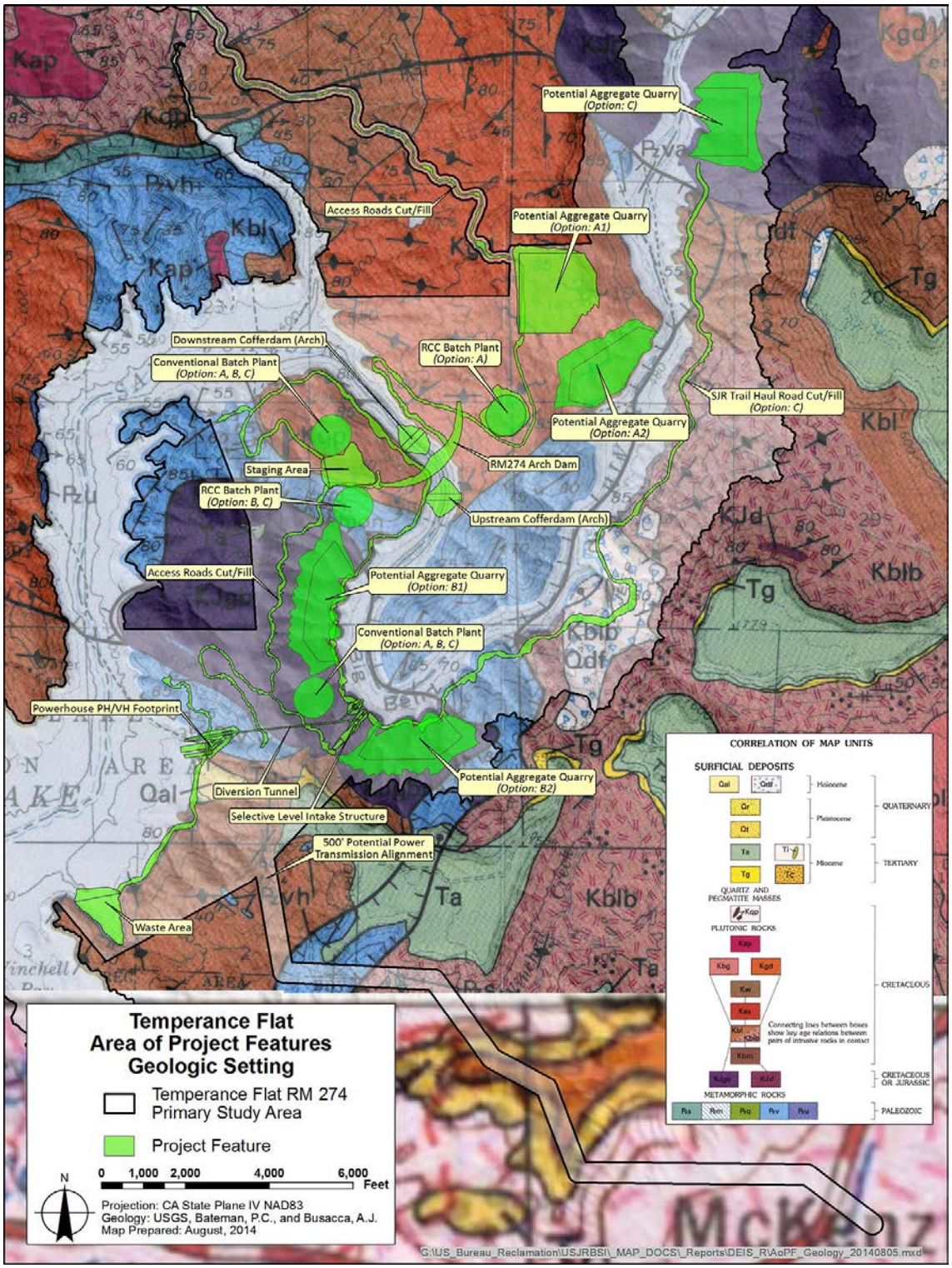
mm = millimeter

RM = river mile



Note: Resolution varies across the area shown due to differences in resolution of source maps.

Figure 11-1. Surficial Geology of the Primary Study Area



Note: Resolution varies across the area shown due to differences in resolution of source maps.

Figure 11-2. Geology in the Vicinity of Project Features

The location of the proposed dam and appurtenant facilities rises uniformly from elevation 385 in the original San Joaquin River channel near RM 274. The left abutment location (facing downstream) rises to elevation 1,582 at Pincushion Mountain and the right abutment location (facing downstream) rises to elevation 1,473 at an unnamed mountain. The proposed dam site, both abutment locations, and appurtenant site are mostly granite and granodiorite, with alluvium in the channel section. The granite is typically hard to very hard where exposed in the bottom of drainages and along the reservoir shoreline. The upper 1 to 10 feet of the granite are intensely weathered to decomposed, and soft to very soft. This decomposed granite represents a weathered in-place, soil-like profile at the ground surface.

Hard, erosion-resistant granite outcrops are scattered on the proposed abutment locations. Some outcrops are detached blocks of rock up to 25 feet in maximum dimension. A zone of hard, slightly fractured meta-granite or granite gneiss is present near the dam centerline on the left abutment, and appears to outcrop in a shallow drainage located upstream from the proposed dam centerline on the right abutment.

Alluvium of unknown thickness occurs below the reservoir water surface in the San Joaquin River channel. The alluvium likely ranges from fine to coarse-grained, with rock blocks up to 25 feet in maximum dimension that detached from the slopes near the proposed abutments. No unstable wedges, toppling, or slides were observed at the site (Reclamation 2002a).

Extended Study Area

The various geologic processes active in California over millions of years have created many geologically different areas, called provinces. The upper San Joaquin River lies in the Sierra Nevada Province, and lower San Joaquin River in the Central Valley Province.

The upper San Joaquin River is located in the central portion of the Sierra Nevada Province at its boundary with the eastern edge of the Central Valley Province. The Sierra Nevada Province encompasses the Sierra Nevada, and comprises primarily intrusive rocks, including granite and granodiorite, with some metamorphosed granite and granite gneiss. The province is a tilted fault block nearly 400 miles long, with a high, steep multiple-scarp eastern face and a gently sloping western face that dips beneath the Central Valley Province (CGS 2002a). The central Sierra Nevada has a complex history

of uplift and erosion. The greatest uplift tilted the entire Sierra Nevada block to the west. The high elevation of the Sierra Nevada leads to the accumulation of snow, including the Pleistocene glaciation responsible for shaping much of the range. Snowmelt in the Sierra Nevada feeds the San Joaquin River and its major tributaries, including those upstream from Friant Dam, as well as the Merced, Tuolumne, Stanislaus, and Mokelumne rivers and other tributaries downstream from the Merced River confluence. These large rivers and their smaller tributaries cut through the granitic rocks present in the upper San Joaquin River Basin, and through intrusive formations and sedimentary and metamorphosed rocks. The metamorphic bedrock in these watersheds contains gold-bearing veins in the northwest-trending Mother Lode that are not present in the more southerly portion of the upper San Joaquin River Basin. To the south, the Kings River originates in the Sierra Nevada Province and cuts through bedrock similar to the bedrock in the headwaters of the San Joaquin River (CGS 2002b).

At the western border, alluvium and sedimentary rocks overtop the Sierra Nevada Province. Occasional remnants of lava flows and layered tuff are present in the area at the highest elevations. Metamorphic rocks in the Friant Dam area dip steeply downstream to the west, and strike northwesterly. The contact of these metamorphic rocks with the Sierra Nevada batholith lies just east of Friant Dam under Millerton Lake. Friant Dam is founded on metamorphic rocks consisting of quartz biotite schist intruded by aplite and pegmatite dikes, and by inclusions of dioritic rocks. Erosion has resulted in thin colluvial cover (Reclamation 2002a). Intrusive Sierra Nevada batholith rocks underlie most of Millerton Lake and areas immediately upstream from Friant Dam. Surface weathering has produced some decomposed granite and soils.

The Central Valley Province encompasses the Central Valley, an alluvial plain about 50 miles wide and 400 miles long in the central part of California, stretching from just south of Bakersfield to Redding. The San Joaquin Valley makes up approximately half of the Central Valley Province and is drained by the San Joaquin River. The San Joaquin River and its tributaries flow out of the Sierra Nevada Province into the Central Valley, depositing sediments on the alluvial fans, riverbeds, floodplains, and historical wetlands of the Central Valley Province. The Central Valley Province is characterized by alluvial deposits and continental and marine sediments deposited almost continually since the Jurassic Period (CGS 2002b).

The more recent Quaternary Period was characterized by continental sedimentary deposition. Tertiary and Quaternary continental rocks and deposits in the San Joaquin Valley contain lenses of clay and silt comprising lacustrine, marsh, and floodplain deposits. These deposits are of varying thickness, in some instances, thousands of feet thick (Page 1986). These continental deposits, including the Mehrten, Kern River, Laguna, San Joaquin, Tulare, Tehama, Turlock, Riverbank, and Modesto formations, make up the major aquifer system of the San Joaquin Valley (Ferriz 2001, Page 1986). This aquifer system is further discussed in Chapter 13, "Hydrology – Groundwater." The San Joaquin Valley is a structural trough into which sediments have been deposited as much as 6 miles deep. Some of the recent surficial alluvial deposits are mined for aggregate, as discussed below (CGS 2002a). Tectonic activity during the Tertiary Period strongly influenced the evolution of the Central Valley, alternately trapping water in the San Joaquin Valley or entire Central Valley to form inland seas that deposited marine sediments, and opening to allow drainage to the ocean, as under current conditions.

Geologic Hazards

No major faults or shear zones have been identified in the primary study area, and historic seismicity rates are low in the vicinity of the proposed Temperance Flat RM 274 Reservoir (Reclamation 2002b). Reclamation conducted a feasibility design risk analysis in 2009, and concluded that potential wedge formation and sliding due to seismic loading as a significant potential failure mode at the site did not warrant consideration (Reclamation 2009). Therefore, further description of the primary study area is not provided.

The following section provides a regional description of the geologic hazards in the extended study area. Both the Sierra Nevada and Central Valley provinces continue to be subject to minor tectonic activity. Current activity is defined as occurring within the past 1.6 million years, called the Quaternary Period, and continuing through the present day.

Sierra Nevada Microplate Motion

Both the Sierra Nevada and Central Valley provinces are part of the Sierra Nevada microplate, which is one component of a broad tectonically active belt that accommodates motion between the North American Plate to the east and the Pacific Plate to the west. On its eastern side, the Sierra Nevada microplate is bounded by the Sierra Nevada frontal fault

system. This system, marked by the steep eastern escarpment of the Sierra Nevada, is characterized by normal and right-lateral strike-slip faults that mark the beginning of the Basin and Range Province. On the west, the microplate is bounded by the fold and thrust belt of the Coast Range Province (Wakabayashi and Sawyer 2001).

Relative to the North American Plate to the east, the right-lateral movement of the Sierra Nevada microplate is 10 to 14 mm/year (0.4 to 0.6 inch per year [in/year]). Its relative right-lateral motion compared to the Pacific Plate to the west is much higher, at 38 to 40 mm/year (1.5 to 1.6 in/year). Internal deformation of the Sierra Nevada microplate is minimal compared to the deformation occurring along its boundaries. However, vertical deformation along the frontal fault system has caused westward or southwestward tilting of the Sierra Nevada block (Bartow 1991; Wakabayashi and Sawyer 2001). Westward tilting has been concurrent with 5,610 to 6,330 feet of uplift by the Sierra Nevada crest over the past 5 million years, equivalent to uplift of 0.34 to 0.39 mm/year (0.013 to 0.015 in/year) (Wakabayashi and Sawyer 2001). This uplift triggered rapid stream incision and deep canyon erosion by the rivers draining the range, including the San Joaquin River and its glacial-meltwater-fed tributaries (Wakabayashi and Sawyer 2001).

Locally, normal faults are found in the Sierra Nevada foothills, probably because the west, or valley, side of the Sierra block is subsiding faster than uplift of the east side (Bartow 1991). One such tensional feature, and west-northwest-trending fault, is thought to be present in the Merced-Chowchilla area based on an offset of a post-Eocene unconformity. This fault may be related to a superficial feature called the Kings Canyon lineament, which crosses the valley north of Chowchilla, parallels the south fork of the Kings River, and continues nearly to Death Valley in the southeast (Bartow 1991). It is unclear whether this fault has been active recently (mapping did not characterize the age of the fault).

San Joaquin Valley Deformation and Subsidence

Regional deposition and deformation patterns of sediments in the San Joaquin Valley have been strongly controlled by recent (Quaternary) tectonic activity (Bartow 1991). Quaternary deposits in the San Joaquin Valley are deformed into a broad, asymmetrical trough with its axis 12 to 19 miles west of the current course of the San Joaquin River (Lettis and Unruh 1991). Valley subsidence is continuing at a rate thought to be a

minimum of 0.2 to 0.4 mm/year (0.008 to 0.016 in/year) (Lettis and Unruh 1991). Subsidence is probably due in part to the uplift and tilting of the Sierran block to the west and the Coast Ranges to the east, although the rate of valley subsidence is higher than that of Sierran uplift. It is hypothesized that valley subsidence may also be due to sediment loading and compressional downwarping or thrust loading from the Coast Ranges (Lettis and Unruh 1991). Regional subsidence in the valley is also known to be occurring because of (1) aquifer compaction caused by pumping-related reduction of groundwater levels, as discussed in Chapter 13, "Hydrology – Groundwater," and (2) compaction and disappearance of soils with high organic content due to development (Reclamation 1997), as discussed in the soils section below.

Active and inactive faults are recognized on both the northern and southern sides of the San Joaquin Valley. On the north, the basin is bounded by the Stockton fault. This fault forms the northern boundary of the Stockton arch, and is a south-dipping reverse fault that runs roughly west-northwest across the valley (Bartow 1991). Faulting at the southern boundary of the San Joaquin Valley is concentrated around the Bakersfield arch, a broad southwest plunging subsurface ridge (Bartow 1991). Few faults fall north of the Bakersfield arch, which offset Quaternary sediments, suggesting a lack of recent (Quaternary) tectonic activity (Bartow 1991). The Pond and Greeley fault systems are two major buried structures recognized to have normal offsets of as much as 1,640 to 2,020 feet, but offsets decrease upward so that no deposits younger than late Miocene have shifted. Similarly, neither the Clovis fault, about 5 miles from the City of Clovis, nor the Foothills fault system, comprising the Bear Mountain and Melones fault zones about 70 to 80 miles north of Fresno, are considered to have been active in the Quaternary period. Additionally, a series of northwest-trending lineaments is exposed at the surface around the Kern River, but they have not been shown to be connected with subsurface faults (Bartow 1991). However, the Nunez reverse fault, located 7 miles northwest of Coalinga, was first mapped after it ruptured during the 1983 Coalinga earthquake and its aftershocks (Lin and Stein 2006). Details of the timing and total offset along the fault remain unknown.

The easternmost fault subsystem separating the Central Valley from the Coast Ranges is the Great Valley blind thrust, part of the San Andreas Fault system. This reverse fault separates Great Valley sequence deposits on the east from Franciscan rocks on the west. The fault subsystem comprises at least 14

segments along an extent of over 300 miles, although precise locations of its surface traces are not well documented (USGS 1996). The Great Valley thrust system is thought to accommodate a nominal 0.5 to 1.5 mm/year (0.02 to 0.06 in/year) of motion (CGS 2002c, USGS 1996).

Ground Shaking and Liquefaction Hazards

Although a fault rupture can cause significant damage along its narrow surface trace, earthquake damage is mainly caused by strong, sustained ground shaking (WG02 2003). Seismic ground shaking can also cause soils and unconsolidated sediments to compact and settle. If compacted soils or sediments are saturated, pore water is forced upward to the ground surface, forming sand boils or mud spouts. This soil deformation, called liquefaction, may cause minor to major damage to infrastructure. Earthquake ground shaking hazard potential is low in most of the San Joaquin Valley and Sierra Nevada foothills (CSSC 2003). Although the San Joaquin Valley is not considered to be a high-risk liquefaction area because of its generally low earthquake and ground shaking hazard risk, it can be assumed that some liquefaction risk exists throughout the valley in areas where unconsolidated sediments and a high water table coincide, such as near rivers and in wetland areas (Merced County 2007).

Erosion and Sedimentation

The sediment load of the San Joaquin River and its tributaries originates from the erosion of soil and rock units of the Sierra Nevada Province, as discussed above. In upstream reaches of the San Joaquin River, the sediment load generally comprises large boulders, cobbles of diameters greater than or equal to 4 inches, fine sand, and less commonly, intermediate-sized gravels (SCE 2003). Direct erosion and mass wasting (movement of material downslope under the influence of gravity) into the watercourses is the primary reason that angular to subangular, medium- to coarse-grained sands and large boulders make up most of the substrate of granitic watersheds, like that of the San Joaquin River above Millerton Lake (SCE 2003).

Soil erosion and sediment transport in the Study Area are described below.

Soil Erosion Potential

Natural physical and chemical forces constantly work to break down soils. This process, called erosion, has two effects. First, erosion removes soils, undermining structures like bridges and

forming unstable slopes. Second, erosion deposits these soils in low-lying areas, causing sedimentation of streams and reservoirs. Erosion also results in landslides that may damage roads, buildings, and other infrastructure. Soil characteristics that affect the erosion rate are soil surface texture and structure, particle size, permeability, infiltration rate, and the presence of organic or other cementing materials. Other key factors determining erosion potential are the extent of vegetation, type of vegetative cover, human or other disturbance, topography, and rainfall.

Along the San Joaquin River above Friant Dam, soils on steep, un-vegetated slopes are particularly vulnerable to erosion, especially on slopes greater than 30 percent (Fresno County 2000). Approximately 6,000 acres of soils in the primary study area have slopes equal to or exceeding 30 percent (Soil Survey Staff 2013). Since natural and cut slopes in decomposed granite soils erode readily, soils are particularly vulnerable to erosion in the Sierra Nevada and foothills (FERC 2002). In the San Joaquin Valley, the bluffs of the San Joaquin River below Friant Dam are steep and exhibit severe erosion potential (Fresno County 2000).

Human activities can also accelerate natural erosion processes. The greatest cause of localized sedimentation problems is construction and development, which usually involves vegetation removal, compaction of porous soils, and drainage of large areas. In particular, road building and timber harvesting have the greatest potential to increase erosion that results in watercourse sedimentation (SCE 2003). Improper agricultural management practices can also accelerate erosion. Overgrazing and land clearing, particularly on steep slopes, but also on flat areas, make surfaces vulnerable to topsoil loss (Rojstaczer et al. 1991).

Infrastructure Effects on Sediment Transport

The most significant effect of dams and storage reservoirs on a watershed is on sediment supply because they serve as impediments to sediment transport downstream. Because of the slowing of river velocity in the reservoir that forms behind a dam, river carrying capacity decreases and the sediment load drops out of the water column and onto the channel bottom. Although the water and some of its fine sediment may be released on the downstream side of the dam, the majority of the sediment load, particularly the coarse materials, remains on the upstream side. This sediment accumulation may be so marked

that over time it can significantly decrease the storage volume of the reservoir itself.

Removal of accumulated sediments can also be problematic. In the past, sluicing to remove sediments from the relatively small Kerckhoff Reservoir (storage volume of 4,000 acre-feet) on the San Joaquin River immediately upstream from Friant Dam resulted in extremely high levels of sediment downstream, although flood flows in intervening years may have flushed these sediments from the river into Millerton Lake (SCE 2003). Dam operations also limit the release of flows to downstream reaches, reducing the frequency of sediment-transporting flows in most years (SCE 2007). Major dams with potential to limit sediment supply to the main stem San Joaquin River and its major tributaries, along with their corresponding reservoirs and volumes, are listed in Table 11-2. As shown in Table 11-3, the San Joaquin River Basin upstream from RM 274 is highly modified; the dams in this watershed have modified not only the hydrology but also the sediment regime of the watershed.

Table 11-2. Major Dams and Reservoirs with Storage Capacity Greater than 50,000 Acre-Feet in the San Joaquin River Basin

River	Reservoir/Dam[1]	Volume (TAF)	Year Completed	Operating Agency[2]
Calaveras	New Hogan	317	1965	USACE
Chowchilla	Eastman/Buchanan	150	1975	USACE
Fresno	Hensley/Hidden	90	1974	USACE
Kaweah	Kaweah/Terminus	183	1962	USACE
Kern	Isabella	570	1953	USACE
Kings	Pine Flat	1,000	1954	USACE
Merced	McClure/New Exchequer	1,032	1967	Merced ID
Mokelumne	Camanche	341	1964	EBMUD
San Joaquin	Millerton/Friant	520	1942	Reclamation
Stanislaus	New Melones	2,400	1979	Reclamation
Tule	Success	82	1961	USACE
Tuolumne	New Don Pedro	2,031	1971	Turlock and Modesto IDs

Notes:

[1] The dam name is only listed when it differs from the reservoir name.

[2] For reservoirs with a Federal flood control purpose, USACE is the operating agency during the flood control season. Refer to Chapter 12, “Hydrology – Flood Management,” for more information.

Key:
EBMUD = East Bay Municipal Utility District
ID = Irrigation District
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
TAF = thousand acre-feet
USACE = U.S. Army Corps of Engineers

Table 11-3. Dams in the San Joaquin River Basin Upstream from River Mile 274[1]

Name of Dam	Name of Lake	Distance from RM 274 (RM)	Name of River/Creek	Normal Storage Capacity (TAF)
Kerckhoff Dam	Kerckhoff Reservoir	18.53	San Joaquin River	4.3
Redinger Dam (Big Creek Dam No. 7)	Redinger Lake	27.4	San Joaquin River	26.1
Big Creek Dam No. 6	NA	38.4	San Joaquin River	1
Mammoth Pool Dam	Mammoth Pool	47.9	San Joaquin River	120
Manzanita Diversion Dam	Manzanita Lake	43.66	North Fork Willow Creek	0.164
Crane Valley Dam	Bass Lake	41.6	North Fork Willow Creek	45.4
Chilkoot Dam	Chilkoot Lake	61.63	Chilkoot Creek	0.31
Shaver Lake Dam	Shaver Lake	39.5	Stevenson Creek	135
Big Creek Dam No. 5	NA	40.2	Big Creek	0.05
Balsam Meadow Forebay Main Dam	Balsom Meadow Forebay	52.99	Tributary of Balsam Creek	1.55
Big Creek Dam No. 4	NA	43.4	Big Creek	0.06
Big Creek Dam No. 1, 2, 3, and 3a	Huntington Lake	46.1[2]	Sheep Thief Creek	89.8
Rutherford Dam	Rutherford Lake	86.27	Tributary of West Fork Granite Creek	0.2
McClure Dam	McClure Lake	87.36	Tributary of East Fork Granite Creek	0.21
Vermillion Valley Dam	Thomas A. Edison Lake	90.3	Mono Creek	125
Portal Forebay Main Dam	Portal Forebay	86.15	Camp Sixty One Creek	0.33
Bear Creek Diversion Dam	NA	90.53	Bear Creek	0.1
Florence Lake Dam	Florence Lake	87.6	South Fork San Joaquin River	64.4

Source: Stanford University, 2014.
Note:
[1] Excludes dams impounding less than 100,000 acre-feet.
[2] Big Creek Dam No. 3 used for river mile measurement
Key:
No. = Number
PG&E = Pacific Gas and Electric
RM = river mile
SCE = Southern California Edison
TAF = thousand acre-feet

Under unaltered conditions, geomorphic fluvial processes, including sediment transport, occur on a relatively consistent basis along the length of a river, and flow energy in the river channel is dissipated gradually. Bridges and culverts constrict

the natural channel and disrupt these processes, which also alter channel form. This may occur at either high or low flows, depending on the size of the structure.

In the extended study area, the effects of channel constrictions caused by bridge and culvert crossings include the following:

- Sediment deposition upstream from the constriction (backwater effects)
- Scour at the constriction due to an elevated water surface and increased water velocity
- Sediment deposition downstream from the constriction due to flow expansion and velocity reduction, leading to the formation of splay bars
- Reduced flood conveyance capacity due to filling in of floodplain space when building bridge and culvert abutments

The function and operation of the water supply and flood management infrastructure present in the Study Area also affect fluvial processes of the San Joaquin River. Such infrastructure includes diversion structures, bypasses and bypass diversions, other hydraulic control structures, offstream flood control dams, levees, and canals. These structures divert base flows and/or flood flows and thereby significantly alter fluvial processes. The processes most affected are sediment transport, local incision and deposition, and channel migration (Table 11-4).

Table 11-4. Generalized Effects on Geomorphic Processes of Major Flood Management and Water Supply Infrastructure

Infrastructure	Effects
Diversion structures	Backwater effects cause disruption of local incision and deposition patterns; riprap protection prevents channel migration and avulsion; reroute sediment load.
Bypasses	Reroute sediment load within the extended study area.
Bypass diversion structures	Backwater effects cause disruption of local incision and deposition patterns; reroute sediment load within the extended study area.
Other hydraulic control structures	Backwater effects cause disruption of local incision and deposition patterns; reroute sediment load within the primary and extended study areas.

Table 11-4. Generalized Effects on Geomorphic Processes of Major Flood Management and Water Supply Infrastructure (contd.)

Infrastructure	Effects
Offstream flood control dams	Reroute sediment load within the Study Area.
Levees	Dissect the historic floodplain; stop channel migration and avulsion; and increase river velocity and, thus, also increase incision, bed armoring, and channel simplification.
Canals	Embankments dissect the historic floodplain; stop channel migration and avulsion; reroute sediment load; and increase river velocity and, thus, also increase incision, bed armoring, and channel simplification.

Sediment load is carried by flows, and all infrastructure that reroutes flows alters sediment transport within the watershed. Flood control bypasses, in particular, divert most of the sediment load of the San Joaquin River directly to the bypass system. This results in a long-term effect on river sedimentation patterns. Small diversion structures, including the Chowchilla Bypass Bifurcation Structure, Mendota Dam, Sack Dam, Sand Slough Control Structure, and the Eastside Bypass Bifurcation Structure, also affect sediment transport by modifying the delivery of sediment downstream. Diversion and other hydraulic control structures may constrict the river channel, which alters local incision and deposition patterns, as described above. Levees and canal embankments dissect the historic floodplain, which prevents channel migration and avulsion. This prevents oxbow formation and also increases river velocity, which encourages channel incision, bed armoring, and channel simplification.

Geomorphology

Geomorphologic characteristics of the primary and extended study areas are described in the following sections.

Primary Study Area

Millerton Lake is set in the lower foothills of the Sierra Nevada, is fairly open, and is mostly surrounded by low hills. Tributaries to Millerton Lake include Winchell and Fine Gold creeks in the downstream portion, and Big Sandy Creek in the upstream or Temperance Flat area.

The San Joaquin River upstream from Temperance Flat lies in a steep and narrow canyon with a bedrock channel that has an overall average gradient of about 1 percent, many long narrow pools, and an occasional steep cascade. One unnamed perennial drainage and 78 intermittent drainages enter the San Joaquin River in this reach. There are 183 ephemeral drainages in the primary study area (Reclamation 2008 and 2010). Most of the river margins are steep and rocky and flood flows frequently scour the channel.

Extended Study Area

Major tributaries to the San Joaquin River downstream from Friant Dam, including the Merced, Tuolumne, Stanislaus, and Mokelumne rivers, flow west out of the Sierra Nevada to join the San Joaquin River. South of the San Joaquin River, the Kings River flows west out of the Sierra Nevada. Similar to the San Joaquin River, these tributary rivers lie in steep, narrow canyons in the Sierra Nevada and foothills, then flow west into the Central Valley over broad, open alluvial fans and floodplains.

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. The dissected uplands consist of consolidated and unconsolidated continental deposits of Tertiary and Quaternary age that have been slightly folded and faulted.

The alluvial fans and plains consist of unconsolidated continental deposits that extend from the edges of the valleys toward the valley floor. The alluvial plains cover most of the valley floor and make up some of the intensely developed agricultural lands in the Central Valley. Alluvial fans along the Sierra Nevada consist of high percentages of clean, well-sorted gravel and sand. Fans from Coast Range streams are less extensive. West-side fans tend to be poorly sorted and contain high percentages of fine sand, silt, and clay. Interfan areas between major alluvial fans of the east side are drained by smaller intermittent streams similar to those on the west side. Thus, these interfan areas tend to be poorly sorted and have lower permeabilities than main fan areas. In general, alluvial sediments of the western and southern parts of the Central Valley tend to have lower permeability than east-side deposits.

River floodplains and channels lay along the major rivers and to a lesser extent the smaller streams that drain into the valley

from the Sierra Nevada. Some floodplains are well defined where rivers incise their alluvial fans. These deposits tend to be coarse and sandy in the channels and finer and silty in the floodplains. Lake bottoms of overflow lands include historical beds of Tulare Lake, Buena Vista Lake, and Kern Lake, as well as other less defined areas in the valley trough.

Mineral Resources

In 2011, California ranked seventh in the nation in nonfuel mineral production. In that year, California yielded $2.9 billion in nonfuel minerals, totaling 4 percent of the nation's entire production (Clinkenbeard and Smith 2011). The value and quantity produced of the most economically important products in the State are summarized in Table 11-5. Of these products, construction sand and gravel are the most widely mined resources in the vicinity of the San Joaquin River. Historically, gold was also extracted from the riverbed of the San Joaquin River and its tributaries. Information in this section is presented at the available regional resolution.

Sand, Gravel, and Other Rock Products

In 2011, California produced 120.5 million tons of aggregate, including sand, gravel, and crushed stone, an increase over production in 2010. Portland cement production also increased over 2010, to 8.3 million tons (Table 11-5). Together, the market value of these products totaled $1.5 billion, just over 50 percent of the total value of State nonfuel mineral production (Clinkenbeard and Smith 2011).

Table 11-5. California Nonfuel Mineral Production in 2011

Product	Quantity (short tons)	Value ($ millions)
Construction sand and gravel	87,277,000	590.5
Industrial sand and gravel	1,500,000	39.4
Portland cement	8,279,000	587.4
Masonry cement	172,000	16.6
Dimension stone	31,800	6.7
Crushed stone	33,700,000	295.4
Common Clays	393,000	5.4
Gold	6.8	323.7
Gemstones	NA	0.7
Total[1]	NA	2,897.0

Source: Clinkenbeard and Smith 2011

Note:

[1] Total includes values not listed to avoid disclosing company proprietary data, including boron minerals, other clays (bentonite, fire, and kaolin), diatomite, feldspar, gypsum, iron ore, lime, magnesium compounds, perlite, pumice and pumicite, rare earths, salt, soda ash, silver, sodium sulfate, talc, and zeolites.

Key:

NA = Not available

The California Department of Conservation, Division of Mines and Geology, maps mineral resource zones in California, based on the mineral resource potential of that land. According to the mapping completed in the Fresno area, the San Joaquin River below Friant Dam is a significant source of sand and gravel in the State, and mining occurs at multiple locations on the floodplain and river terraces. The California Department of Conservation, Division of Mines and Geology, reported the total quantity of aggregate available in the Fresno area (including the San Joaquin and Kings river areas in Fresno, Madera, and Kings counties) as approximately 2.2 billion tons (including permitted and non-permitted sources) (Youngs and Miller 1999). The San Joaquin River area upstream from Friant Dam has not been mapped as part of a mineral resource zone.

Gold

Historically, gold was mined from quartz veins in the Mother Lode of the northern Sierra Nevada as well as from placer deposits in loosely consolidated alluvial sediments throughout the Sierra Nevada foothills. These activities significantly reworked the riverine environments, redistributing sediments and altering channel forms. However, the San Joaquin River was less affected by dredge mining than the more northerly Sierra Nevada drainages, where gold was more plentiful (McBain & Trush 2002).

A survey conducted in 2003 by BLM in support of the Investigation identified three abandoned mine sites within the Temperance Flat Reservoir Area, including the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. These mines include multiple audits and millsites (Springer 2005).

Soils

The following section describes soils in the primary and extended study areas. Because of the nature of the resource, the extended study area is described from a regional perspective.

Primary Study Area

The primary study area, including the Millerton Lake watershed area, includes eight soil associations. These soils have been described to vary between a few inches up to 6 feet in depth. A generalized description of each of the soils in the primary study area is provided in Table 11-6.

Table 11-6. Generalized Soils in the Vicinity of the Primary Study Area

General Soil Map, Eastern Fresno Area, California	
Soil Association	**General Features**
Auberry-Ahwahnee Association	Auberry-Ahwahnee association soils are described as well drained and somewhat excessively drained sandy loams. These sandy loams are moderately deep and deep over granitic rocks.
Coarsegold Association	Coarsegold association soils are described as somewhat excessively drained fine sandy loams that are deep over metasedimentary rock.
Trimmer-Trabuco Association	Trimmer-Trabuco association soils are described as well drained and somewhat excessively drained sandy loams to loams. These sandy loams are moderately deep and deep over igneous rock.

Table 11-6. Generalized Soils in the Vicinity of the Primary Study Area (contd.)

Soil Survey of the Madera Area, California	
Soil	**General Features**
Madera Sandy Loam	Madera sandy loam extends to a depth of 1 feet to 6 feet and is characterized as light-brown to dark-brown sandy loam.
San Joaquin Sandy Loam	San Joaquin sandy loam extends to a depth of 18 inches to 6 feet and is characterized as reddish-brown to yellowish-brown sandy loam, which is underlain by dense impenetrable red hardpan.
Rough Stony Sand	Rough stony sand exists in hilly areas and elevated plateaus.
Hanford Sandy Loam	Hanford sandy loam extends to a depth of 6 feet or more and is characterized as light-brown, grayish-brown, or buff-colored micaceous sandy loam.
Daulton Sandy Loam	Daulton sandy loam extends to a depth from 6 inches to 4 feet and is characterized as grayish to dark brown.

Source: U.S. Department of Agriculture, Soil Conservation Service 1970; Strathorn et al 1910

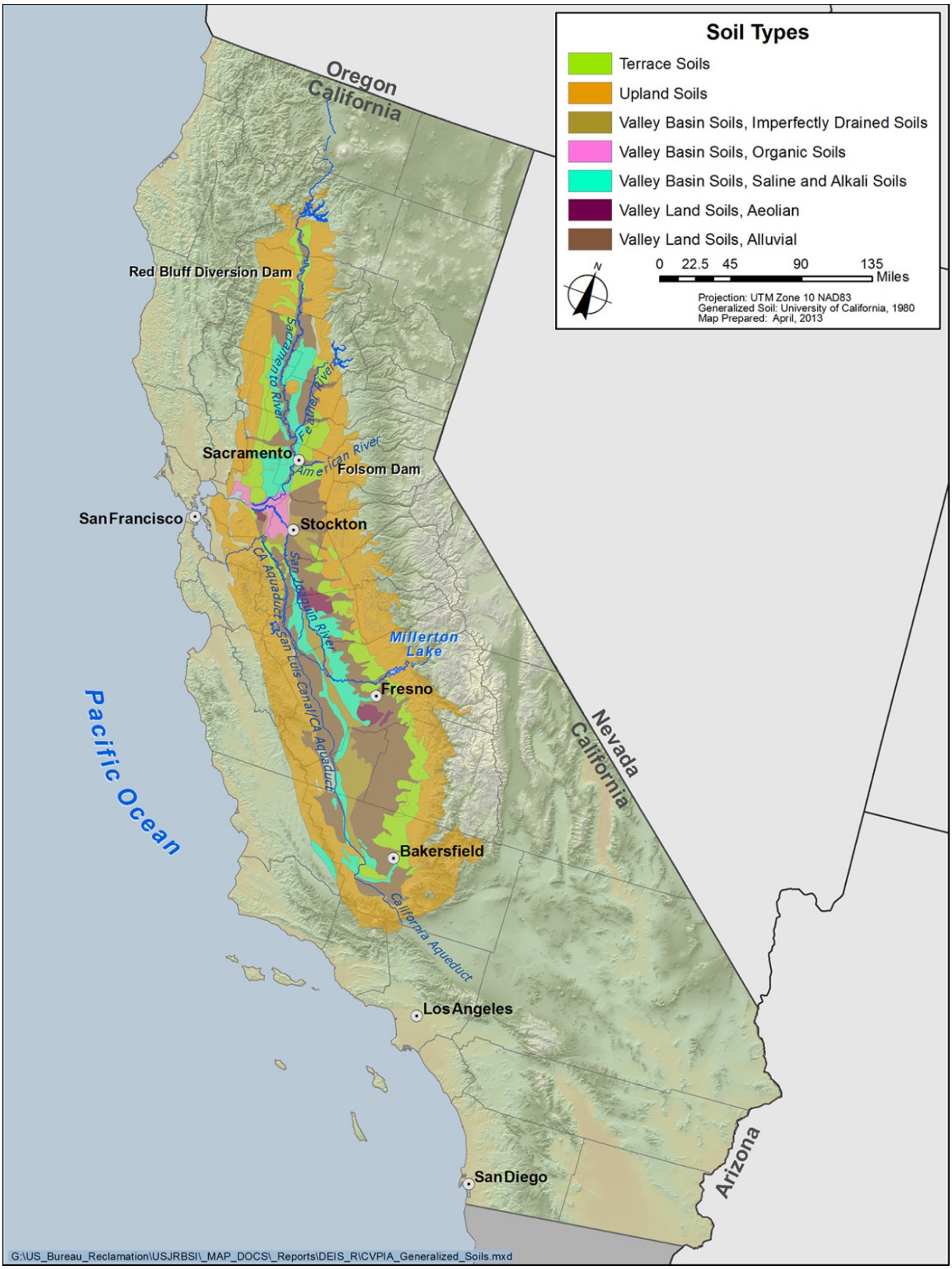
Extended Study Area

The development of individual soils is based largely on parent material, climate, associated biology, topography, and age. These factors combine to create the more than 2,000 unique soils in the State. Because these factors are similar within physiographic regions, soils in the vicinity of the San Joaquin River are described here according to four distinct physiographic regions: valley basin land, valley land, terrace land, and upland, as summarized in Table 11-7. Valley basin land and valley land soils occupy most of the San Joaquin Valley floor, including the Delta, as shown in Figure 11-3. Valley land soils consist of deep alluvial and aeolian soils that make up some of the best agricultural land in the State. Valley basin land soils consist of organic soils, imperfectly drained soils, and saline and alkali soils in the valley trough and on the basin rims. Areas above the San Joaquin Valley floor consist of terrace land and upland soils, on higher elevations and steeper slopes. Overall, these soils are not as productive as the valley land and valley basin land soils. Without irrigation, these soils are primarily used for grazing and timberland; with irrigation, additional crops can be grown. These soil types and their geographic extents are described in detail below, followed by a brief description of soil salts in the San Joaquin Valley, an important feature of some soils.

Table 11-7. Summary of Soils in San Joaquin River Basin

Physiographic Region	Location	Texture
Valley Basin Land		
Organic Soils	Sacramento-San Joaquin Delta	Peat, organic
Imperfectly Drained Soils	Sacramento-San Joaquin Valley trough	Clays
Saline/Alkaline Soils	West side of San Joaquin Valley	Clay loam–clay
Valley Land		
Alluvial Soils	Alluvial fans and low terraces in Sacramento-San Joaquin Valley	Sandy loam–loam
Aeolian Soils	Portions of Stanislaus, Merced, and Fresno counties	Sands–loamy sand
Terrace Land		
Brown, Neutral Soils	West side of Sacramento Valley and southeast San Joaquin Valley	Loam–clay
Red-Iron Hardpan Soils	East side of Sacramento and San Joaquin valleys	Sandy loam–loam hardpan
Upland		
Shallow Depth to Bedrock	Foothills surrounding Central Valley	Loam–clay loams
Moderate Depth to Bedrock	East side of Merced and Stanislaus counties	Sandy loam–clay loam
Deep Depth to bedrock	Higher elevations of Sierra Nevada, Klamath Mountains, and Coast Range	Loam–clay loams

Source: University of California, Division of Agricultural Sciences 1980



Source: University of California 1980

Figure 11-3. Physiographic Region Soil Types in the Central Valley and Delta

Valley Basin Land Valley basin land soils occupy the lowest parts of the San Joaquin Valley and the Delta. These soils fall into three categories: organic soils, imperfectly drained soils, and saline/alkali soils.

- **Organic Soils –** Organic soils are so named because of their high organic matter content, which is 12 percent or more by weight and typically greater than 50 percent in the upper layers. These soils are typically dark and acidic because of their high organic matter content, and are usually referred to as peat. They often form in areas that are frequently saturated with water (poorly drained), and are therefore common in the Delta, at the downstream end of the San Joaquin River.

- **Imperfectly Drained Soils –** This category of soils generally contains dark clays and has a high water table or is subject to overflow. These soils are found in the trough of the San Joaquin Valley, and are present in parts of several thick lake-bed deposits.

- **Saline/Alkali Soils –** These soils are characterized by excess salts (saline), excess sodium (sodic), or both (saline-sodic). In many of the older soil surveys, salinity and sodicity were jointly referred to as alkaline. A distinction was sometimes made because the saline soil many times formed a white crust on the surface and was called “white alkali,” and the soils with excess sodium appeared to be “black,” thus, black alkali. Both are fairly common throughout the San Joaquin Valley. In uncultivated areas, saline soils are used for saltgrass pasture and native range. Some of these soils support seasonal salt marshes. In areas of intermediate to low rainfall, the soils have excess sodium as well as salt. Many of these soils are irrigated with moderately saline Delta surface water, imported via the DMC and California Aqueduct, or with slight to moderately saline groundwater. In addition, salts are added through the application of fertilizers or other additives needed for farming. This saline addition to already saline soils forms a crust on top of the soils, changes the chemical characteristics of the soils in the root zone, and reduces the capability of the soils to transfer applied moisture to the roots. To minimize salinity problems, irrigators apply water to the soil before planting seed or plants to leach salts from the root zone. Leaching is complicated by poor drainage, low permeability, and high sodium

content. Leaching increases salinity in the groundwater aquifers, which further exacerbates the salinity problem because the saline groundwater is used for irrigation. Because of the rise in groundwater salinity, the area with soil salinity problems has grown. This most recently occurred during the 1987 to 1994 drought, when surface water availability was limited and groundwater use escalated. Leaching also increases the salinity in flows from subsurface drains, which affects water quality in surface waters that receive return flows, or the quality of water and sediments in evaporation ponds. The increase in groundwater salinity and its effects on the capability of land to be used for irrigated crops are further discussed in Chapter 13, "Hydrology – Groundwater."

Valley Land Valley land soils are generally found on flat to gently sloping surfaces, such as on alluvial fans. These well-drained soils include some of the best all-purpose agricultural soils in the State. Both alluvial- and aeolian-deposited soils are present in the San Joaquin Valley.

- **Alluvial Soils** – Alluvial-deposited valley land soils include calcic brown, noncalcic brown, and gray desert alluvial soils. Figure 11-3 shows the distribution of all San Joaquin Valley alluvial soils. Calcic brown and noncalcic brown alluvial soils are found in the San Joaquin Valley on deep alluvial fans and floodplains occurring in areas of intermediate rainfall (10 to 20 inches annually). These two soils tend to be brown to light brown with a loam texture that forms soft clods. Calcic brown soil is calcareous; noncalcic soil is usually neutral or slightly acid. These soils are highly valued for irrigated crops such as alfalfa, apricots, carrots, corn, lettuce, peaches, potatoes, sugar beets, and walnuts. Where the climate is suitable, avocados, citrus fruits, cotton, and grapes can be grown. These soils are found in the northern and central San Joaquin Valley. Gray desert alluvial soil is found on alluvial fans and floodplains that receive low rainfall (4 to 7 inches annually). This soil appears in the western San Joaquin Valley as light-colored calcareous soil that is low in organic matter. These soils are too dry to produce crops without irrigation. When irrigated, these soils are valued for alfalfa, cotton, and flax.

- **Aeolian Soils** – Aeolian-deposited and wind-modified soils found in the east side of the San Joaquin Valley are noncalcic brown sand soils. These soils are prone to wind erosion, have low water-holding capacity, and are somewhat deficient in plant nutrients.

Terrace Land Terrace land soils are found along the edges of the San Joaquin Valley at elevations of 5 to 100 feet above the valley floor. Several groups of terrace soils surround the floor of the Central Valley. Two of the more widespread groups are discussed in the following paragraphs. Terrace land soils are grouped together and shown in Figure 11-3.

- **Brown Neutral Soils** – The first group consists of moderately dense, brownish soils of neutral reaction. These soils are found in areas receiving 10 to 20 inches of rain per year. In the southeastern San Joaquin Valley, these soils tend to have a clay texture. This soil group is commonly used for irrigated pasture; however, citrus orchards are grown on some of these soils. Following ripping (e.g., deep tilling), these soils are suitable for orchard and vineyard development.

- **Red Iron Pan Soils** – A second type of terrace soil has a red-iron hardpan layer and is found along the east side of the San Joaquin Valley. These soils consist of reddish surface soil with a dense silica-iron cemented hardpan, which is generally 1 foot thick. Some of these hardpan soils have considerable amounts of lime. These soils occur in areas receiving 7 to 25 inches of rain per year. Dry farming practices have fair results with hay, grains, and pastures. Following ripping, these soils are well suited for orchards and vineyards.

Upland Soils Upland soils are found on hilly to mountainous topography and are formed in place through decomposition and disintegration of the underlying parent material. The more widespread upland soil groups include shallow depth, moderate depth, and deep depth to bedrock. Two upland soil groups, shallow depth and moderate depth, are more common because of their geographic location and elevation. Upland soils are found around the perimeter of the San Joaquin Valley, as shown in Figure 11-3. Soils on the west side have mostly developed on sedimentary rocks while those on the east side typically developed on igneous rocks.

- **Shallow Depth to Bedrock** – This group of upland soils is found in the Sierra Nevada and Coast Range foothills that surround the San Joaquin Valley. The soils have a loam-to-clay-loam texture with low organic matter, and some areas have calcareous subsoils. These soils usually have a shallow depth to weathered bedrock (less than 2 feet). These soils are found in areas of low to moderate rainfall that support grasslands used primarily for grazing. Tilled areas are subject to considerable erosion.

- **Moderate Depth to Bedrock** – This group of upland soils is found on hilly to steep upland areas having medium rainfall and that can support grasslands. These soils have a sandy-loam-to-clay-loam texture and moderate depth to weathered bedrock, about 2 feet. This slightly acidic soil group is dark and is found in the Stanislaus County and Merced County foothills east of the valley floor.

- **Deep Depth to Bedrock** – This group of upland soils is found at the higher elevations in the Sierra Nevada and Coast Range on hilly to steep topography. These soils are characterized by a moderate to strongly acidic reaction, especially in the subsoils, which can extend 3 to 6 feet before reaching bedrock. Bedrock consists of meta-sedimentary and granitic rocks. Soils forming on granitic rocks consist of decomposed granitic sands. These soils receive 35 to 80 inches of precipitation per year and support extensive forests.

Salts

The accumulation of salts in the soils of the San Joaquin Valley is due to a combination of the regional geology, high water table, intensive irrigation practices, and the application of imported high-salinity water from the Delta. The Corcoran Clay and other clay layers contribute to a naturally high water table in the valley, concentrating salts in the root zone by evaporation through the soil. Landowners actively leach these salts from the soil into drainage water with irrigation and subsurface drainage practices. Drainage water with high concentrations of salts may be reused for irrigation (with or without treatment), accumulate in groundwater, or be discharged to evaporation ponds or tributaries to the San Joaquin River. Salinization caused by concentrations of naturally occurring soil salts is exacerbated by the use of more

saline Delta water, imported via the DMC and California Aqueduct, as a major source of irrigation water.

Additionally, naturally occurring trace elements in soils may be mobilized and concentrated along with salts. Soils throughout the San Joaquin Valley typically contain some selenium, and soils on the west side of the valley are particularly selenium rich. These soils have developed on alluvial deposits comprising eroded material from the Coast Range, where selenium is found in marine deposits. Selenium can pose a hazard to fish and wildlife when it becomes highly concentrated in surface waters.

The salinization of soils and water in the San Joaquin Valley is causing loss of agricultural production and damage to local water infrastructure, including pipes, pumps, and water heaters. To address this ongoing problem, the State Water Board, the Central Valley Water Board, and a multifaceted stakeholder group named the Central Valley Salinity Coalition have teamed to lead efforts to identify and manage salt sources and processes causing salt loading in the San Joaquin Valley. Through the program CV-SALTS, this diverse group is devising a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management strategy. Reclamation has also agreed to participate in salinity control efforts in the lower San Joaquin River Basin, as described in its Management Agency Agreement with the Central Valley Water Board.

Total Maximum Daily Loads (TMDL), which define a maximum acceptable level of loading of a particular constituent in surface water, exist, or are currently being developed, for salts in the San Joaquin River and several tributaries. More information on salt-related TMDLs, as well as a more detailed description of water quality conditions in the Study Area, is presented in Chapter 15, “Hydrology – Surface Water Quality.”

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on geology and soils that could result from implementing any of the alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on

geology and soils. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on geology and soils and associated mitigation measures are summarized in Table 11-8.

Table 11-8. Summary of Impacts and Mitigation Measures for Geology and Soils

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions and Slope Instability	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	GEO-1: Develop and Implement a Seismic Action Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	None Available	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 11-8. Summary of Impacts and Mitigation Measures for Geology and Soils (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations	Primary Study Area	No Action Alternative	NI	None Available	NI
		Alternative Plan 1	PS		PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 11-8. Summary of Impacts and Mitigation Measures for Geology and Soils (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GEO-5: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that Are Unsuited to Land Application of Waste	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
PS = potentially significant
PSU = potentially significant and unavoidable

Methods and Assumptions

The analysis presented in this chapter is qualitative and based on the general information on geology, soils, mineral resources, seismicity and neotectonics, and geomorphology documented for the region, as previously described. Impacts associated with geology and soils that could result from project construction and operational activities were evaluated qualitatively, based on expected construction practices, materials, locations, and duration of project construction and related activities, as well as the impacts of reservoir operations at the proposed Temperance Flat RM 274 Dam and Reservoir and Millerton Lake.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and the range of action alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project and a reasonable range of alternatives, if required. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on geology, geologic hazards, geomorphology, mineral resources, and soils would be significant under CEQA if project implementation would do any of the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, or injury, or death involving the following:
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the

area or based on other substantial evidence of a known fault

- Strong seismic ground shaking
- Seismic-related ground failure, including liquefaction
- Landslides

- Result in substantial soil erosion or loss of topsoil
- Locate project facilities on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse
- Locate project facilities on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for disposal of wastewater
- Result in the loss or availability of known mineral resources that would be of future value to the region and the State

Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

Topics Eliminated from Further Discussion

The potential impacts of the project on geologic resources would occur within the primary and extended study areas. Within the extended study area, impacts to geology and soils would occur within the vicinity of the San Joaquin River from Friant Dam to the Merced River confluence, but would not extend downstream or to the CVP and SWP water service areas. The action alternatives would have the greatest effect on conditions within the extended study area along the San Joaquin River from Friant Dam to the Merced River confluence, where the changes in flows due to the project would be greatest. Downstream from the Merced River confluence, inflows from the Merced River and other

downstream tributaries would dampen the relative contribution of the action alternatives such that geology and soils would not be substantially affected. The indirect impacts of changes in water deliveries in the CVP and SWP water service areas are mostly within canal systems and any effects on geology and soils would be unlikely and too speculative for meaningful consideration. Therefore, the extended study area beyond the San Joaquin River from Friant Dam to the Merced River confluence is eliminated from further consideration. See Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," for a discussion of the direct impacts of the action alternatives in this portion of the extended study area.

Subsidence occurring within the Study Area would be largely due to aquifer compaction caused by pumping-related reduction of groundwater levels; the potential for the project to affect subsidence is therefore addressed in Chapter 13, "Hydrology – Groundwater." Subsidence occurring within the Study Area would also be due to compaction and disappearance of soils with high organic content due to land development; as the project would not influence this mechanism, subsidence is not further discussed in this chapter.

Geologic hazards associated with volcanic activity are not addressed, because there are few volcanoes within the extended study area and none within the primary study area. Paleontological resources are addressed in Chapter 19, "Paleontology."

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact GEO-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions and Slope Instability

Primary Study Area

No Action Alternative No new construction would occur in the primary study area under the No Action Alternative, and the operations of Millerton Lake would change only to increase releases to the San Joaquin River under the SJRRP. Variation

in reservoir levels of Millerton Lake due to reoperating Friant Dam under the SJRRP could result in erosion of soils and loss of soil horizons down to bedrock along the reservoir shore in the zone of water elevation variation (SJRRP 2012). Geologic hazards and associated risks to people and structures in this area would remain unchanged from those described in the Affected Environment section of this chapter.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would have the potential to increase the exposure of structures and people to geologic hazards. No major faults or shear zones have been identified in the primary study area, historic seismicity rates are low in the vicinity of the proposed Temperance Flat RM 274 Reservoir (Reclamation 2002b), and no active faults have been identified within the primary study area. Because there is minimal seismic activity in the primary study area, the risks of earthquakes, ground shaking, or liquefaction would also be minimal. Areas of known slope instability have been avoided in locating the proposed project features, minimizing the risk of landslides that could expose structures or people to the risk of landslides.

Under all action alternatives, quarry, batch plant, and haul road option C could involve construction of a haul road across a debris flow with slopes of 30-70 percent (see Figure 11-2). Construction and use of roads on this formation could reduce the stability of this formation, increasing the risk of landslide. Standard construction practices (i.e., use of mesh net or other stabilizer on exposed cuts, adequate sizing of road width, etc.) would minimize the risk to construction workers associated with landslides. The area, owned by BLM and leased for grazing, contains no infrastructure or facilities (See Chapter 17, “Land Use Planning and Agricultural Resources”) aside from the San Joaquin River Trail, which would be closed before construction of the haul road, and ultimately relocated. Therefore no additional people or structures would be placed at risk.

Under all action alternatives, Temperance Flat RM 274 Reservoir would inundate 227 acres of mapped debris flows. Inundation of bedrock and soils resulting from the increased pool elevation, and earthwork and vegetation removal associated with new construction, could reduce the stability of hill slopes prone to mass wasting, and mass wasting features may become less stable. However, any landslides that could

develop would likely be below the waterline of Temperance Flat RM 274 Reservoir, and would not pose a risk to structures or people.

Temperance Flat RM 274 Reservoir and the immediate area could be subjected to reservoir triggered seismicity (RTS). The International Committee on Large Dams (ICOLD 2011), in their draft document, *Reservoirs and Seismicity – State of Knowledge*, accepted RTS as the most adequate term to describe the phenomena of earthquakes occurring in the vicinity of man-made water reservoirs. The two principal triggers of RTS are added weight stresses and pore pressure propagation. Compared with known cases of RTS at 28 reservoirs around the world, the volume, depth, geological conditions, and seismic conditions present at the proposed Temperance Flat RM 274 Reservoir site suggest that the reservoir would have the potential to trigger a seismic event (Baecher and Keeney 1982). Overall, potential seismic hazard potential at the site is low (Reclamation 2009). Construction of Temperance Flat RM 274 Dam and associated weight stresses and pore pressure propagation would not increase seismic hazard potential at the site (ICOLD 2011), and would therefore not trigger a seismic event greater than those the dam would be designed to withstand. However, other structures within the primary study area could be at risk in the event of RTS, either directly through seismic ground shaking or seiche. The risk of seismic ground shaking is low in most of the San Joaquin Valley and Sierra Nevada foothills (CSSC 2003).

The risk of seiche, a standing wave cause by seismic waves from an earthquake, in Millerton Lake or the proposed Temperance Flat RM 274 Reservoir due to RTS is low. A seiche was recorded in Millerton Lake after a large earthquake in Alaska in 1964; the seiche reached a height of 0.03 feet and lasted 100 minutes (Stanley 1968). The low magnitude and infrequent occurrence of seiches in Millerton Lake can likely be attributed to the geologic and seismic conditions present at the site (McGarr and Vorhis 1968). Similar conditions including a lack of unconsolidated sediments are present at the Temperance Flat Reservoir Area, and therefore the risk of seiche in the proposed Temperance Flat RM 274 Reservoir is considered minimal.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, construction and maintenance activities under the SJRRP would occur along the San Joaquin River from Friant Dam to the Merced River confluence. Flows in the San Joaquin River would increase under the SJRRP, but no other appreciable changes to water supply operations would occur (SJRRP 2012). Geologic hazards and associated risks to people and structures in this area would remain unchanged from those described in the Affected Environment section of this chapter.

There would be **no impact** under the No Action Alternative.

Action Alternatives No new construction would occur in the extended study area under any of the action alternatives, beyond that described for the No Action Alternative. Flows in the San Joaquin River would increase as described in Chapter 14, "Surface Water Supplies and Facilities Operations," but would not exceed the channel capacity. Geologic hazards and associated risks to people and structures in this area would remain unchanged from those described under the No Action Alternative.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Reservoir would not be constructed. The annual fluctuation in water surface elevation of Millerton Lake would not change, or would change minimally due to changes in releases to the San Joaquin River under the SJRRP. Therefore, there would be no change to streams tributary to the proposed Temperance Flat RM 274 Reservoir or Millerton Lake, or to the San Joaquin River upstream from Millerton Lake.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under all the action alternatives, stream channel equilibrium and geomorphology would be affected by the formation of Temperance Flat RM 274 Reservoir. Streams entering the San Joaquin River upstream from Millerton Lake in the inundation area of the proposed Temperance Flat RM 274 Reservoir would form deltas (roughly triangular-shaped

sediment deposits), while streams tributary to Millerton Lake in the inundation area of the proposed Temperance Flat RM 274 Reservoir would experience a change in the location of delta formation. At full pool, the San Joaquin River itself would be inundated up to Kerckhoff Reservoir.

During future operations of Temperance Flat RM 274 Reservoir, when the reservoir was high and regional flooding occurred, sediment transported from the uplands would be deposited as deltas at the confluence of the streams and lake. When the lake level was low, stream channels within the inundation zone would likely be channelized as they downcut into the delta deposits. Because most of the tributary streams are ephemeral or intermittent, the opportunity for sediment transport and delta formation would be highest during sustained rainy periods, such as occur most often during the winter months. The largest stream that would be inundated is Big Sandy Creek in the Temperance Flat area, with 3,431 feet (5.6 percent) inundated. Of the inundated length, 400 feet (11.7 percent) has a gradient of 3 percent or less, and would be prone to delta formation. Given the low sediment carrying capacity of small, ephemeral and intermittent streams, this effect would be minimal.

The proposed Temperance Flat RM 274 Reservoir would also inundate the San Joaquin River up to Kerckhoff Dam, up to 46,488 feet in length. At the top of active storage, the reservoir would reach to about 12 feet below the crest of Kerckhoff Dam. Though most sediment would be captured and stored by upstream reservoirs (see Table 11-3), some sediment would enter the San Joaquin River from Kerckhoff Dam and would be conveyed downstream to the confluence with Millerton Lake, primarily during normal maintenance activities to flush sediment from the reservoir, or during high-flow events during sustained rainy periods when the river’s sediment load would be greatest. Given the complete or near-complete inundation of the San Joaquin River in this reach, this would be substantial.

This impact would be **potentially significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Extended Study Area

No Action Alternative Under the No Action Alternative, flow releases from Friant Dam to the San Joaquin River would increase under the SJRRP in most cases, while the frequency, volume, and duration of high-flow events would decrease. This could increase downstream channel erosion and change downstream geomorphic characteristics. However, water releases from the dam would continue to vary within their historical range, based on time of year, water year type, and system conditions, as modified by climate change in the extended future (see Chapter 8, "Climate Change"). Channel construction under the No Action Alternative as part of the SJRRP would alter the river channel in several reaches, including construction of a bypass channel around Mendota Pool. These actions are designed to improve the geomorphology and hydrology of aquatic habitats for targeted species.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would affect the flow regime in the San Joaquin River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream erosion and geomorphologic characteristics. However, it is expected that the frequency, volume, and duration of high-flow events resulting from the action alternatives would be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Reservoir would not be constructed. The annual fluctuation in water surface elevation of Millerton Lake would not change, or would change minimally due to changes in releases to the San Joaquin River under the SJRRP (SJRRP 2012). Therefore, there would be no loss or diminished

availability of known mineral resources that would be of future value to the region.

There would be **no impact** under the No Action Alternative.

Action Alternatives Approximately 7 million tons of aggregate, including cement, concrete sand and aggregate, and coarse aggregate, would be needed under all action alternatives. The action alternatives would also require approximately 5.3 million cubic yards of embankment material/fill. These materials (with the exception of cement) would be locally sourced from one of the potential aggregate quarries shown in Figure 11-2. Aggregate materials are produced locally along the San Joaquin River downstream from Friant Dam, and south along the Kings River. The quantity of aggregate that would be needed under any action alternative would be less than 1 percent of the total quantity available locally (see the Affected Environment section of this chapter), and would not substantially reduce local mapped aggregate resources.

A survey conducted in 2003 by BLM in support of the Investigation identified three abandoned mine sites within the primary study area, including the Patterson Mine, San Joaquin Mine, and the Sullivan Mine Group (Springer 2005). These sites are small deposits with no known activity, and are therefore likely to be of little value to the region or State (USGS 2005).

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, implementation of the SJRRP would result in variation in San Joaquin River levels due to reoperating Friant Dam, which could result in inundation of existing gravel and sand mining locations. As described in the SJRRP PEIS/R (SJRRP 2012), reoperating Friant Dam to release Restoration Flows could change the timing, frequency, and duration of fluctuations in the water level of the San Joaquin River. However, release of Restoration Flows would fall within the historical range of reservoir releases, and attendant river-level fluctuations would be within the historical range of fluctuations, as modified by climate change in the extended future (see Chapter 8, “Climate Change”). SJRRP construction activities could result in short-

term alteration of existing gravel or sand mining locations, but would not result in long-term interruption of mining activities. The No Action Alternative would not alter the use of these existing gravel or sand mining locations.

There would be **no impact** under the No Action Alternative.

Action Alternatives Flows in the San Joaquin River would increase as described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," but would not exceed channel capacity. The release of additional water from Friant Dam to the San Joaquin River under the action alternatives would fall within the historical range of reservoir releases, and attendant river-level fluctuations would be within the historical range of fluctuations from flood management releases, as modified by climate change in the extended future (see Chapter 8, "Climate Change"). No new construction beyond that described under the No Action Alternative would occur in the extended study area under any of the action alternatives and no gravel and sand extraction locations would be affected by the action alternatives.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Reservoir would not be constructed. Variation in reservoir levels of Millerton Lake due to reoperating Friant Dam under the SJRRP could result in erosion of soils and loss of soil horizons down to bedrock along the reservoir shore in the zone of water elevation variation (SJRRP 2012).

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction-related erosion of topsoil would occur within the primary study area, but would be minimized through implementation of the erosion and sediment control plans and stormwater pollution prevention plans that are a part of the environmental commitments common to all action alternatives, as described in Chapter 2, "Alternatives." Once Temperance Flat RM 274 Dam was constructed and the reservoir filled, shoreline erosion would occur along the zone

of reservoir-elevation fluctuation. Substantial soil erosion and loss of topsoil would result.

Construction of Temperance Flat RM 274 Dam, powerhouse, batch plant, and transmission facilities would require the excavation, transport, stockpiling, grading, drilling, blasting, and use of bedrock, alluvium, and soil obtained from the aggregate quarry (see Figure 11-2). Other activities would include the demolition and removal of existing facilities within the inundation zone, installation of support structures, construction of permanent access roads and temporary haul roads, and use of staging areas. Soils disturbed by these activities, as well as materials stockpiled for use during construction, would be susceptible to the effects of wind- or water-induced erosion and loss of topsoil.

Construction-related erosion would be avoided and/or minimized via implementation of the erosion and sediment control plans and stormwater pollution prevention plans (i.e., erosion and sediment control plans, including site revegetation) that are a part of the environmental commitments common to all action alternatives. These plans would address the necessary local jurisdiction requirements regarding erosion control and site revegetation, and would implement BMPs for erosion and sediment control. The plans would include site-specific structural and operational BMPs to prevent and control short- and long-term erosion and sedimentation effects, stabilize soils and vegetation in areas affected by construction activities, and prevent and control impacts on runoff quality. Types of BMPs to be included in the plans could include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, silt fencing, sediment basins, fiber rolls, sandbag barriers, straw bale barriers, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

Once Temperance Flat RM 274 Dam was constructed and the reservoir filled, shoreline erosion would occur along the zone of reservoir-elevation fluctuation between the top-of-active-storage capacity (1,331 TAF) and the top-of-minimum-carryover-storage capacity (200 TAF under Alternative Plans 1, 2, and 3; 325 TAF under Alternative Plan 4; and 100 TAF under Alternative Plan 5). Substantial soil erosion and loss of topsoil would occur in the area of shoreline subject to fluctuating water levels.

Water surface elevations in Temperance Flat RM 274 Reservoir could fluctuate between the top-of-active-storage

capacity and the top-of-minimum-carryover-storage capacity within a single year. This area comprises about 4,300 acres under Alterative Plans 1, 2, and 3; about 3,700 acres under Alternative Plan 4; and about 5,000 acres under Alternative Plan 5. The actual fluctuation in any single year is a function of the starting storage for that year, the inflow, and the operational diversions and releases and is limited, but not driven, by the maximum physical fluctuation potential. The maximum theoretical fluctuation of Temperance Flat RM 274 Reservoir in any action alternative is in Alternative Plan 5, and is 382 feet. From the CalSim II operations modeling, Temperance Flat RM 274 Reservoir elevation reached the maximum theoretical fluctuation in a single year of the 83 year simulation period once under each action alternative under existing conditions, and did not reach the maximum theoretical fluctuation under future conditions. The simulated fluctuation under Alternative Plan 5 is below 300 feet in about 96 percent of the years, and below 245 feet in about 90 percent of the years, with an average annual fluctuation of about 150 feet.

Sediment delivery into the reservoir resulting from shoreline erosion would be retained within the reservoir. The rate of shoreline erosion would be greatest during the first several years after construction, and would reduce over time as the new shoreline stabilizes. Much of the topography in the general vicinity of the proposed Temperance Flat RM 274 Reservoir is steep, increasing susceptibility to erosion, particularly the first several miles downstream from Kerckhoff Dam and along the north side of Millerton Lake just upstream from RM 274.

This impact would be **potentially significant** under the action alternatives. All feasible avoidance and minimization measures have been included in the project commitments, but would not reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Extended Study Area

No Action Alternative Under the No Action Alternative, implementation of the SJRRP would result in variation in San Joaquin River levels due to reoperating Friant Dam, which could increase downstream channel erosion. Reoperating Friant Dam to release full Restoration flows when downstream channel capacity permits, including a reduction in the timing, frequency, duration, and volume of flood releases (as described in Chapter 12, “Hydrology – Flood Management”), would change the timing, frequency, duration, and volume of flows in

the San Joaquin River and bypasses, and could change rates of stream channel erosion and meander migration. However, the overall rates of erosion and sedimentation would remain similar to those under existing conditions (SJRRP 2012).

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the five action alternatives, operation of the proposed Temperance Flat RM 274 Reservoir and Millerton Lake would change the timing, frequency, duration, and volume of flows in the San Joaquin River and bypasses, and could change rates of stream channel erosion and meander migration. Flows within the San Joaquin River would remain within the range of historical flows, while the number of flood releases from Friant Dam would be reduced (as described in Chapter 12, "Hydrology – Flood Management"), as modified by climate change in the extended future (see Chapter 8, "Climate Change"). Therefore, downstream erosion would not be anticipated to increase.

The action alternatives would reduce the frequency, magnitude, and duration of Friant Dam releases greater than Restoration Flows. This in turn would reduce the potential for riparian zone/bank erosion, the rate of unmanaged migration of gravel from spawning areas (potentially reducing the required rate of gravel augmentation), and the rate of downstream unmanaged sand migration (potentially reducing the rate/frequency of required sand removal at flow control structures).

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact GEO-5: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that Are Unsuited to Land Application of Waste

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Reservoir would not be constructed. The annual fluctuation in water surface elevation of Millerton Lake would not change, or would change minimally due to changes in releases to the San Joaquin River under the SJRRP. Therefore, there would be no increase in the risk of failure of septic tanks or alternative wastewater disposal systems.

There would be **no impact** under the No Action Alternative.

Action Alternatives In general, soils in the primary study area are poorly suited to use as septic tank leach fields or alternative waste disposal systems due to shallow soil depth, high rock content, and excessive slope. Under the action alternatives, relocated wastewater facilities associated with new or relocated facilities, such as recreational facilities and maintenance buildings, would be designed and constructed to satisfy the conditions of sewage disposal permits issued by Fresno County or Madera County, as applicable. Existing septic facilities within the inundation area that would not be relocated would be demolished according to regulatory requirements.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, no septic tanks or wastewater disposal systems would be constructed in the extended study area. Therefore, there would be no increase in the risk of failure of septic tanks or alternative wastewater disposal systems.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, no septic tanks or wastewater disposal systems would be constructed in the extended study area. Therefore, there would be no increase in the risk of failure of septic tanks or alternative wastewater disposal systems.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 11-8.

No mitigation is required for Impacts GEO-3 and GEO-5 within the primary study area, or for Impacts GEO-1, GEO-2, GEO-3, GEO-4, and GEO-5 within the extended study area, as these impacts would be **less than significant** for all action alternatives.

Impacts GEO-1, GEO-2 and GEO-4 within the primary study area would be potentially significant. Mitigation measure

GEO-1, below, is proposed to reduce the effects of Impact GEO-1. Feasible measures to reduce effects of GEO-2 and GEO-4 have been designed into the action alternatives. No feasible mitigation measures are available at the time of preparation of this Draft EIS to reduce Impacts GEO-2 and GEO-4 to less-than-significant levels. Therefore, Impacts GEO-2 and GEO-4 (within the primary study area) would be **potentially significant and unavoidable**.

Mitigation Measure GEO-1: Develop and Implement a Seismic Action Plan

Reclamation will develop and implement a Seismic Action Plan to monitor and analyze seismic activity at Temperance Flat RM 274 Dam and Reservoir, and take action to minimize risks associated with potential RTS. Specifically, monitoring and analyses will include:

- Monitor seismicity in the vicinity of Temperance Flat RM 274 Reservoir before, during, and after construction
- Analyze pre and post-impoundment seismicity on a regular basis, including examination of spatial and seismicity rate patterns in light of RTS cases observed worldwide
- Analyze seismicity variations associated with changes in filling and drawdown rates, once reservoir operations begin

If a seismic hazard associated with RTS is identified, Reclamation will take actions to minimize the risk to structures and people. Specific actions will depend on the risks identified, and will be outlined in the plan, but may include emergency notifications to the public, reinforcements of structures, and/or temporary closure of public facilities such as recreational facilities.

The seismic risk of the region is low, and implementation of the Seismic Action Plan would minimize risk of RTS. Implementation of this mitigation measure would reduce Impact GEO-1 to a **less-than-significant** level.

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Chapter 12
Hydrology – Flood Management

This chapter describes the environmental setting for flood management, including flood-related structures and operations, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. It focuses on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 247). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP service areas).

Affected Environment

This section describes the affected environment related to flood protection history in the San Joaquin River Basin, flood management structures, State Plan of Flood Control (SPFC) levees (also referred to as project levees), nonproject levees, and flood management operations and conditions.

Historical Perspective of Flood Management in the San Joaquin River Basin

Early Flood Management

Flood management in the San Joaquin River Basin began with the construction of levees to reclaim fertile tule lands and to protect agriculture from seasonal out-of-bank flows. Private levee systems were developed incrementally to protect individual tracts of land; this practice would often redirect floodwater elsewhere, thereby increasing flood stage and risk. The protection afforded by individual levee segments would also decrease because of the increased stage, and the flood protection provided varied widely due to the intermittent and irregular nature of the levees. The increased flood danger led to competition between landowners who continually raised and strengthened their levees to maintain or increase flood protection to their lands.

In 1920, Colonel Robert Marshall, chief geographer for the USGS, proposed a major water storage and conveyance plan to

transfer water from Northern California to meet urban and agricultural needs of Central and Southern California. This plan ultimately provided the framework for development of the CVP and its associated flood damage reduction benefits. Under the Marshall Plan, a dam would be constructed on the San Joaquin River near Friant to divert water north and south to areas in the eastern portion of the San Joaquin River Basin, and provide flood protection to downstream areas. The diverted water would be a supplemental supply to relieve some of the dependency on groundwater that had led to overdraft in areas of the eastern San Joaquin Valley. Water from the Sacramento Valley would be collected, stored, and transferred to the San Joaquin Valley by a series of reservoirs, pumps, and canals.

In 1933, the California State Legislature approved the Central Valley Project Act, which authorized construction of initial features of the CVP, including Shasta Dam; Friant Dam; power transmission facilities from Shasta to Tracy; and the DMC and Contra Costa, Madera, and Friant-Kern canals. The act authorized the sale of revenue bonds to construct the project, but during the Great Depression, the bonds could not be sold. The State appealed to the Federal government for assistance in constructing the CVP.

With the passage of the Rivers and Harbors Act of 1935, Congress appropriated funds and authorized construction of the CVP by the USACE. When the act was reauthorized in 1937, construction and operation of the CVP were assigned to Reclamation, and the project became subject to Reclamation Law. Construction of the CVP began on October 19, 1937, with the Contra Costa Canal. Construction of Shasta Dam began in 1938 and was completed for full operation in 1949. Friant Dam, on the San Joaquin River, was also completed in 1949.

Subsequent to and concurrent with the construction of the CVP, various other flood management facilities in the San Joaquin River Drainage Basin were constructed. These included various reservoirs with dedicated or incidental flood management benefits; a flood bypass system along the San Joaquin River; and various levees and control structures. Some of these facilities remain locally maintained and operated, while others were formally adopted into the State-Federal flood control system (the SPFC).

Major Recent Floods

Between 1900 and 1997, the Sacramento and San Joaquin river basins experienced 13 destructive floods. Each flood resulted from a storm with unique characteristics, each located in a different portion of the Central Valley. In addition, these floods occurred under different levels of development of the flood management systems described in the previous sections. The most recent floods (1983, 1986, 1995, and 1997) caused extensive damage in both the Sacramento and San Joaquin river basins and raised questions about the adequacy of the current flood management systems and land use in the floodplains (USACE 1999). In response to these floods, Congress authorized USACE in 1997 to undertake a comprehensive study of the flood damage reduction facilities in the Sacramento and San Joaquin river basins, and to prepare a summary of recent flood events (USACE 1999). The following flood event descriptions are drawn from this previous documentation (USACE 1999).

Flood of 1955 The December 1955 flood was centered north of Friant Dam, and was more intense in the northern portions of the San Joaquin Valley and in the Sacramento Valley. Before the start of the flood, Millerton Lake was well below flood management space and, as a result, flows on the San Joaquin River were completely controlled by Friant Dam. If storage had been at or above the allowable flood management level, releases from Friant Dam would have exceeded 37,100 cfs and would have resulted in extensive damage between Friant Dam and the mouth of the Merced River. A peak flow of 62,500 cfs was a record on the Stanislaus River at Ripon, while the Middle Fork of the Tuolumne River at Oakland Recreation Camp reached a record flow of 4,920 cfs. During the 1955 floods, two of the three forks of the Tuolumne River also reached record flows (USACE 1999).

Flood of 1967 Above-normal precipitation that occurred continuously from December 1966 through March 1967 resulted in the flooding of 35,000 acres of the San Joaquin River Basin. A record-breaking storm in early December 1966 resulted in very high runoff from the San Joaquin River. The San Joaquin River above Millerton Lake experienced high runoff during early December with a maximum mean daily inflow of 18,450 cfs to the lake. A vast snowmelt from April to July resulted in significant flood damage from flooding in the lower portions of the Fresno and Chowchilla rivers. Nearly all of the flooded areas were cropland, improved pasture, or grazing land (USACE 1999).

Flood of 1983 Northern and Central California experienced moderate flooding incidents from November through March because of numerous storms. In early May, snow water content in the Sierra Nevada exceeded 230 percent of normal, and the ensuing runoff resulted in approximately four times the average volume for Central Valley streams. The maximum daily flow on the San Joaquin River at Maze Road Bridge was about 38,400 cfs, and exceeded the estimated channel capacity (combined capacity of the San Joaquin River and Laird Slough) of 26,000 cfs. In the San Joaquin River Basin, levee breaks caused flooding at four locations along the San Joaquin River. Four levees failed in the Delta, resulting in partial or total flooding of some islands. Estimated damages exceeded $324 million in the San Joaquin River Basin (USACE 1999).

Flood of 1986 Flooding in 1986 resulted from a series of four storms over a 9-day period during February. Rains from the first three storms saturated the ground and produced moderate-to-heavy runoff before the arrival of the fourth storm. Peak daily inflow to Millerton Lake was about 20,800 cfs, with the storm taking up all up 16 percent of available flood control space. In the San Joaquin River Basin and the Delta, levee breaks along the Mokelumne River caused flooding in the community of Thornton and the inundation of four Delta islands. Estimated damages exceeded $15 million in the San Joaquin River Basin (USACE 1999).

Flood of 1995 Weather conditions in the Pacific forced major storm systems directly into California during much of the winter and early spring of 1995. The largest storm systems hit California in early January and early March. The major brunt of the January storms hit the Sacramento River Basin and resulted in small stream flooding primarily because of storm drainage system failures. The March 1995 storms were concentrated on the Coast Ranges, and caused high flows in some west-side tributaries to the San Joaquin River Basin. In particular, Arroyo Pasajero produced extremely high flows that collapsed bridges on Interstate 5 near Coalinga, killing six people. Peak daily inflow to Millerton Lake was about 23,700 cfs. At the time of the peak event, Millerton Lake had only 4 percent of its flood control space available. In total, estimated flood damages in 1995 exceeded $193 million in the San Joaquin River Basin (USACE 1999).

Flood of 1997 Watersheds in the Sierra Nevada had experience heavy snowfall and already were saturated by the time three subtropical storms added more than 30 inches of rain

in late December 1996 and early January 1997. The third and most severe of these storms lasted from December 31, 1996, through January 2, 1997. Record flows overwhelmed the flood management system in the San Joaquin River Basin. Peak daily inflow to Millerton Lake was about 51,800 cfs, with a peak hourly inflow of about 95,000 cfs as Millerton Lake exceeded its design capacity. Peak daily outflows to the San Joaquin River from Friant Dam were estimated at 37,500 cfs, with a peak hourly outflow of 62,900 cfs. Thirty-four levee failures occurred throughout the river system and widespread flooding ensued. The Delta also experienced several levee breaks and levee overtopping. Estimated damages exceeded $223 million in the San Joaquin River Basin (USACE 1999).

Flood of 2006 During late December 2005 and early January 2006, several storms caused substantial runoff over large portions of Northern California. Local flooding caused Federal disaster declarations in 10 counties and an estimated $300 million in damages, with most damage occurring in the Russian and Napa river basins (USGS 2006). Wet weather persisted through the late winter and early spring. Another large storm system hit California in early April, with the San Joaquin Valley receiving most of the precipitation. This storm system caused several days of high water in the San Joaquin River and associated flood bypass system. Stress was evident in the levee system, including boils and bank erosion. Active flood fighting limited the flood damage to mostly local agricultural lands, although several trailer parks and low-lying homes were evacuated (NWS 2010). The wet 2006 winter, including the April storm, resulted in high snowmelt runoff volumes, and several weeks of sustained flood released from Millerton Lake. These releases peaked at 9,000 cfs. This period of high, sustained flows highlighted several vulnerabilities of the San Joaquin River levee system to such flows.

Flood Management Structures

The following is a description of flood management structures in the Study Area. This section focuses on the dams and bypasses on the San Joaquin River upstream from its confluence with the Merced River. A description of levees within the Study Area is located in the Levees section of the Affected Environment section.

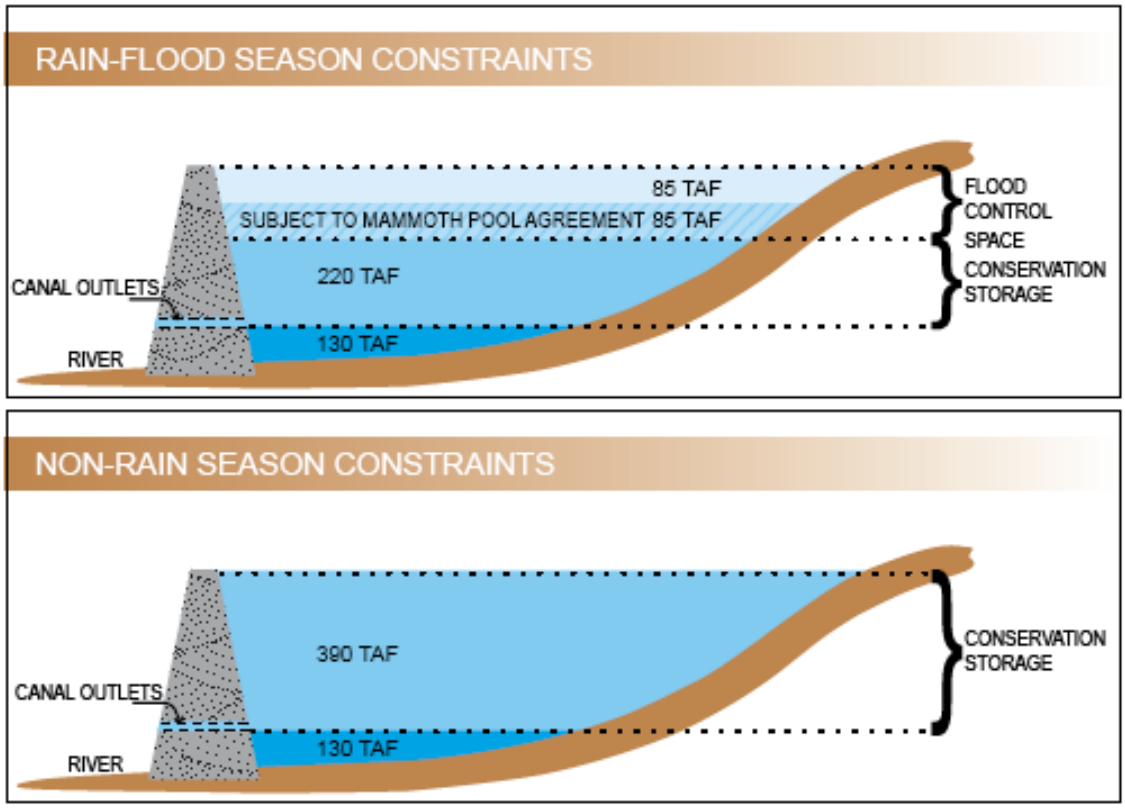
Primary Study Area

This section describes the flood management structures located in the primary study area, including the Temperance Flat Reservoir Area and Millerton Lake below RM 274.

Temperance Flat Reservoir Area Upstream from the site of the proposed Temperance Flat RM 274 Dam, the Southern California Edison Company (SCE) operates six major storage reservoirs, providing an aggregate storage space of 560 TAF. These reservoirs are: Florence Lake, Huntington Lake, Mammoth Pool, Shaver Lake, Redinger Lake, and Lake Thomas A. Edison. PG&E operates Bass Lake in Crane Valley, which provides an additional 45 TAF of storage. These reservoirs operate in conjunction with various diversion structures that convey water to 14 hydroelectric power plants above Friant Dam. The combined storage of these reservoirs provides significant storage during snowmelt and rainfall events (USACE 1955). Kerckhoff Reservoir and Dam, a 4 TAF power generation dam is immediately upstream from the proposed Temperance Flat RM 274 Reservoir, but provides no significant additional flood control space.

Millerton Lake Below RM 274 Friant Dam is the principal flood damage reduction facility on the San Joaquin River. It is a concrete gravity structure with dual purposes of storage for irrigation and flood management. Millerton Lake has a volume of 524 TAF, a surface area of 4,905 acres, and an elevation of 580.6 feet above msl (North American Vertical Datum 1988 [NAVD 1988]) at gross pool (Reclamation 2008). The spillway flood pool elevation is 587.6 feet. This elevation was almost reached during the January 1997 flood, when the maximum observed water surface elevation was 583 feet. The reservoir has three small dikes along the reservoir rim to close low-lying areas off from Millerton Lake. Millerton Road, a two-lane paved secondary highway, passes over these dikes. Additional physical information pertaining to Friant Dam and Millerton Lake are presented in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations.”

The minimum operating storage of Millerton Lake is 130 TAF, resulting in active available conservation storage of about 390 TAF (Figure 12-1). The minimum operating storage allows for diversion from dam outlets to the Friant-Kern Canal (elevation 466.6 feet), Madera Canal (elevation 448.6 feet), and the San Joaquin River (elevation 382.6 feet) (Reclamation 2008). The flood management reservation of 170 TAF is required to be maintained during the rain-flood season (October–April), but can be reduced down to 85 TAF based on available storage in Mammoth Pool.



Source: Reclamation 2005.
Key:
TAF = thousand acre-feet

Figure 12-1. Conceptual Representation of Millerton Lake Storage Requirements

Extended Study Area

This section describes the flood management structures, including dams, levees, and bypass systems, within the extended study area.

San Joaquin River from Friant Dam to Merced River The State constructed the Lower San Joaquin River Flood Control Project, which includes bypasses, control structures, and other facilities within the extended study area (Figure 12-2). Construction of these State facilities was initiated in 1959 and completed in 1966. These improvements were coordinated with the Federal government's Lower San Joaquin River and Tributaries Project (LSJRTP) to improve the effectiveness of the Federal portion of the project; the LSJRTP includes levee and channel improvements downstream from the Merced River confluence and was completed in 1968.

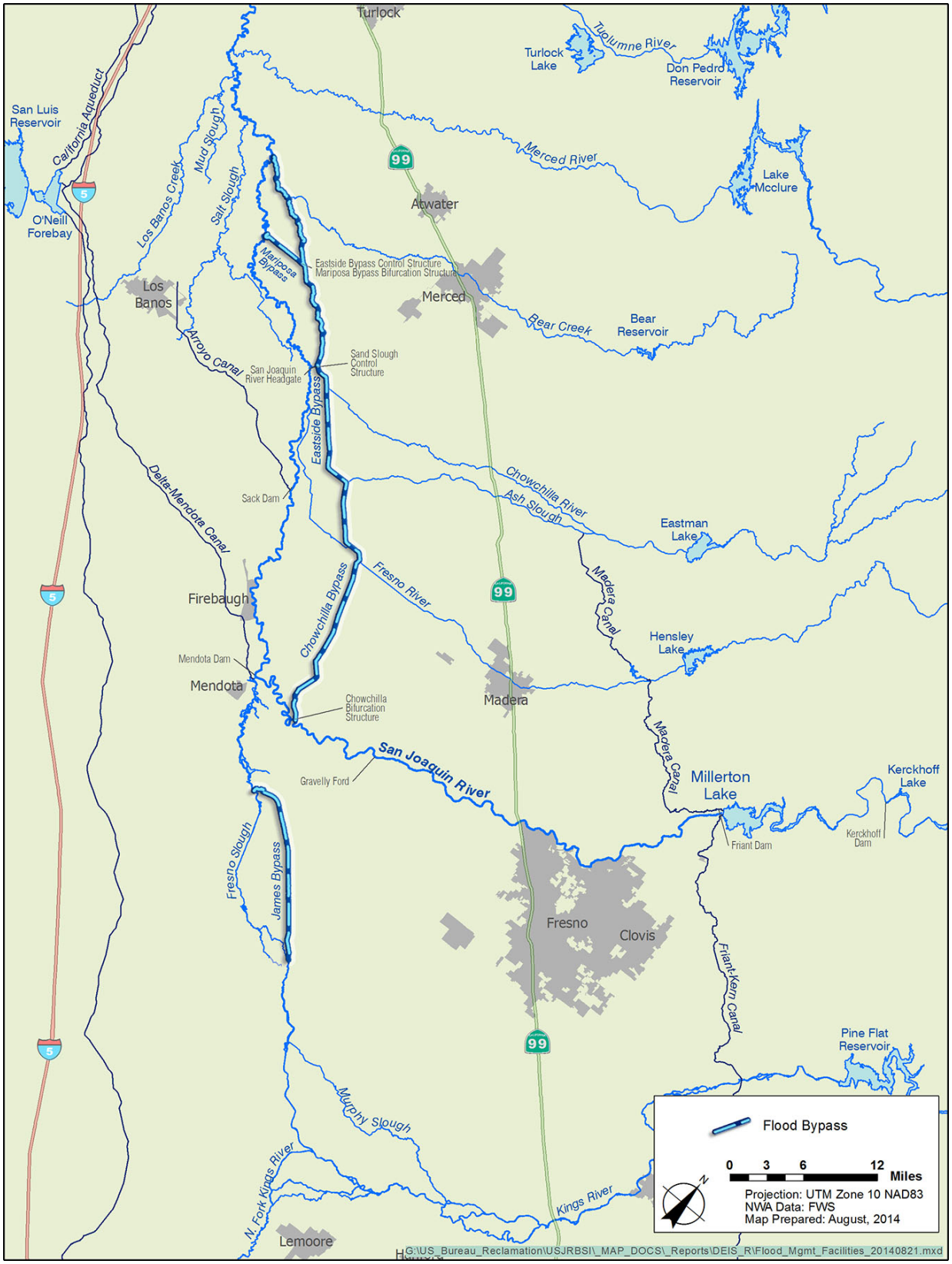


Figure 12-2. Existing Flood Bypass Facilities in the San Joaquin River Basin

The Lower San Joaquin River Flood Control Project is primarily a bypass system that consists of human-made channels (Eastside, Chowchilla, and Mariposa bypasses), which divert and carry flood flows from the San Joaquin River downstream from Gravelly Ford, along with inflows from the Kings River and other tributaries, downstream to the main stem San Joaquin River just above the Merced River confluence. The system consists of approximately 193 miles of levees, several control structures, and other appurtenant facilities. O&M of the State's completed upstream bypass features are performed by the Lower San Joaquin Levee District (LSJLD). The flood damage reduction structures and facilities within the extended study area are described below. Levees are described separately in a subsequent section.

Chowchilla Bypass and Chowchilla Bypass Bifurcation Structure The 5,500 cfs capacity Chowchilla Bypass begins at the Chowchilla Bypass Bifurcation Structure on the San Joaquin River. It runs northwest, parallel to the San Joaquin River, to its confluence with the Fresno River, where the Chowchilla Bypass ends and becomes the Eastside Bypass. The Chowchilla Bypass Bifurcation Structure is a gated structure that controls the proportion of flood flows that remain in the San Joaquin River between the Chowchilla Bypass and the Mendota Canal. The LSJLD O&M Manual provides for the Chowchilla Bypass Bifurcation Structure to be operated to keep flows on this portion of the San Joaquin River at a level less than 2,500 cfs because of channel capacity limitations (LSJLD 1978). Significant seepage has been observed at flows above 1,300 cfs and therefore current operations generally limit flow in this section of the San Joaquin River to 1,300 cfs (RMC 2007).

Eastside Bypass and Eastside Bypass Control Structure The Eastside Bypass extends from the confluence of the Fresno River and the Chowchilla Bypass to its confluence with the San Joaquin River, approximately 19.5 miles west of Merced at DWR RM 135.5. The Eastside Bypass gradually increases in design channel capacity from 10,000 cfs to 17,000 cfs between its start at the Fresno River and the Sand Slough Control Structure; this is because the bypass receives additional flows from the Fresno River, Berenda Slough, and Ash Slough. The bypass design channel capacity is 16,500 cfs between the Sand Slough Control Structure and the Eastside Bypass Bifurcation Structure. The Eastside Bypass then continues northwest and joins with Bear Creek and continues to its confluence with the San Joaquin River. The Eastside Bypass has a design channel

capacity of 13,500 cfs downstream from the Eastside Bypass Bifurcation Structure, and a design channel capacity of 18,500 cfs downstream from its confluence with Bear Creek. In addition to receiving flows from the San Joaquin River, this reach of the Eastside Bypass also receives flows from Bear, Deadman, and Owens creeks before joining the San Joaquin River (Reclamation 2009b).

The gated Eastside Bypass Control Structure works in coordination with the Mariposa Bypass Bifurcation Structure to direct flows to the most downstream reach of the Eastside Bypass or to the Mariposa Bypass. The channel capacities described above are design capacities; current capacities may be reduced because of subsidence of Eastside Bypass levees, including a cumulative subsidence of approximately 4.5 feet along the Eastside Bypass over the last 5 years due to changes in groundwater use (SLCC 2013).

Sand Slough Control Structure/San Joaquin River Headgates
The Sand Slough Control Structure, located in the short connection between the San Joaquin River at DWR RM 168.5 and the Eastside Bypass, is an uncontrolled weir working in coordination with the San Joaquin River Headgates to control the flow split between the main stem San Joaquin River and the Eastside Bypass. The Sand Slough Control Structure diverts flows from the San Joaquin River to the Eastside Bypass, and the San Joaquin River Headgates control the timing and quantity of flows continuing to pass through the San Joaquin River. The operating rule for the control structure and headgates is to divert the first 50 cfs of San Joaquin River flow to Sand Slough, and then equally divide flow in excess of 50 cfs to Sand Slough and the San Joaquin River. Historical operations have kept the headgates closed, diverting all flows to Sand Slough (RMC 2007).

Mariposa Bypass and Mariposa Bypass Bifurcation Structure
The Mariposa Bypass Bifurcation Structure controls the proportion of flood flows that continue down the Eastside Bypass or return to the San Joaquin River just south of the San Luis National Wildlife Refuge East Bear Creek Unit through the Mariposa Bypass. The Mariposa Bypass delivers flow from the Eastside Bypass back into the San Joaquin River. Of the 14 bays on the Mariposa Bypass Bifurcation Structure, 8 are gated. The operating rule for the Mariposa Bypass is to divert all flows to the San Joaquin River when flows in the Eastside Bypass above the Mariposa Bypass are less than 8,500 cfs, with flows greater than 8,500 cfs remaining in the Eastside

Bypass, eventually discharging back into the San Joaquin River at the Bear Creek confluence. However, flows of up to 3,000 cfs have historically remained in the Eastside Bypass, and approximately one-quarter to one-third of the additional flows were released to the Mariposa Bypass (McBain and Trush 2002). Flood flows not diverted to the San Joaquin River via the Mariposa Bypass continue down the Eastside Bypass and are returned to the San Joaquin River via Bravel Slough and Bear Creek. Bravel Slough reenters the San Joaquin River at the ending point of the bypass system.

Mendota Dam Mendota Dam is located at the confluence of the San Joaquin River and Fresno Slough. Fresno Slough connects the Kings River to the San Joaquin River. Fresno Slough delivers water to the south from Mendota Pool during irrigation season, and delivers water to the Mendota Pool and San Joaquin River from the Kings River when the Kings River is flooding. Mendota Pool is a small reservoir, with approximately 8,500 acre-feet of storage, created by the 23-foot-high Mendota Dam (Reclamation 2004). The Mendota Pool does not provide any appreciable flood storage. The water surface elevation in the pool is maintained by a set of gates and flashboards that are manually opened or removed in advance of high-flow conditions. This process lowers the water level in the pool for passing high flows to reduce seepage impacts on adjacent lands, but prevents diversions on Fresno Slough from the DMC and San Joaquin River flows.

Cyclically, the Mendota Pool fills with sediment during infrequent high-flow releases from Friant Dam. During times of high flows, some unknown portion of this sediment is able to flush and route downstream when flashboards have been pulled, restoring much of the Mendota Pool storage capacity. If the flashboards are not pulled before a high-flow event from either the San Joaquin River or Fresno Slough, the increased water surface elevations cause seepage problems on upstream and adjacent properties.

Sack Dam Sack Dam is 5-foot-high low-head structure used to divert water from the San Joaquin River into Arroyo Canal. Diversions to Arroyo canal are usually limited to 600 cfs, but range from 0 to 800 cfs (Reclamation 2009b). Recently, changes in groundwater use are causing subsidence between the Eastside Bypass and the San Joaquin River. The San Luis Canal Company (SLCC) reports recent subsidence of Sack Dam at rates exceeding 0.5 foot per year (SLCC 2013). Both Central California Irrigation District (CCID) and SLCC are

working with growers in the western portion of Madera County to develop potential solutions to subsidence in those areas that directly impact Sack Dam and other physical infrastructure (Exchange Contractors 2013, CCID 2012).

Structures on the Kings River Flood flows from the Kings River flow via the James Bypass and Fresno Slough into the Mendota Pool and San Joaquin River at their confluence with Fresno Slough. As a result, Kings River system operations influence operations on the San Joaquin River. Flood control facilities on the Kings River include the following:

- **James Bypass** – The James Bypass is a leveed channel beginning in the lower Kings River Basin at the end of the Kings River North, and running northwest to end at Fresno Slough. Fresno Slough transports overflows from the Kings River via the James Bypass to the Mendota Pool. Excess water in the Mendota Pool overflows into the San Joaquin River. The broad flood channels of Kings River North are farmed in the spring, and property owners are notified when flood releases are planned to be sent north so that farm equipment may be removed. Flows from the Kings River are controlled by Pine Flat Dam. Maximum flows in the James Bypass/Fresno Slough typically range from 4,750 cfs to 6,000 cfs (USACE 1993).

- **Pine Flat Dam** – Pine Flat Dam, completed in 1954, is owned, operated, and maintained by USACE. The dam is on the Kings River, about 28 miles northeast of Fresno, and provides flood protection to 200,000 acres of agricultural land in the Tulare Lake area. Pine Flat Dam is a 429-foot-high, 1,820-foot-long concrete gravity dam with a storage capacity of 1,000 TAF and a flood management reservation of 475 TAF. The major goal of flood operations at Pine Flat Dam, and its objective release of 4,750 cfs below the Crescent Weir, is to prevent flooding of farmland along over 100 miles of the Kings River (in the Tulare Lake bed) and along the San Joaquin River.

- **Army Weir** – The Army Weir, constructed in 1943, controls the flow split between Kings River South (south to the Tulare Lake bed) and Kings River North (north to the San Joaquin River). Although constructed by, and under the jurisdiction of, USACE, permission was granted to the Kings River Water Association to

operate the structure according to agreements among the water users. The association operates the weir to maximize flow north into the San Joaquin River up to a total of 4,750 cfs to partially relieve flooding within the Tulare Lake bed to the south. When flows exceed 4,750 cfs, the excess, up to 1,200 cfs, is diverted to the south. All flows over 5,950 cfs are sent north until maximum diversions at the Crescent Weir are reached.

- **Crescent Weir** – The Crescent Weir, downstream from the Army Weir, began operation on Kings River North in 1939; it is maintained and operated by the Crescent Canal Company under an agreement with the Zalda Reclamation District. The concrete weir has 18 openings and uses flashboards for flow control. The Zalda Reclamation District controls flows greater than 4,750 cfs at the Crescent Weir by sending the first 4,750 cfs north, and the excess, up to a maximum of 2,000 cfs, south. Flows greater than 7,950 cfs in the Kings River North (4,750 cfs north, 1,200 cfs south from the Army Weir, and 2,000 cfs south from the Crescent Weir) are divided by the Army and Crescent weirs equally between north and south, respectively, with consideration of existing levee and channel conditions.

Structures on Other Major San Joaquin River Tributaries Upstream from Merced River Each major tributary to the San Joaquin River has existing flood control facilities, including the following:

- **Hidden Dam and Hensley Lake** – Hidden Dam, completed in 1975, is on the Fresno River about 15 miles northeast of the City of Madera, and is owned, operated, and maintained by USACE. It provides flood protection to the City of Madera and agricultural lands downstream. Hidden Dam has a storage capacity of 90 TAF, a flood management reservation of 65 TAF, and an objective release of 5,000 cfs at the Merced River and Madera Canal confluence. Hensley Lake is formed by the 163-foot-high, 5,730-foot-long earthfill dam.

- **Buchanan Dam and H. V. Eastman Lake** – Buchanan Dam, completed in 1975, is owned, operated, and maintained by USACE to provide flood protection to the City of Chowchilla and the highly developed agricultural areas below the dam. The project is on the

Chowchilla River about 16 miles northeast of the City of Chowchilla. The Buchanan Dam is a 206-foot-high, 1,800-foot-long rockfill dam and has a storage capacity of 150 TAF, a 45 TAF flood management reservation, and a combined downstream objective release of 7,000 cfs via Ash (5,000 cfs) and Berenda (2,000 cfs) sloughs.

- **Redbank and Fancher Creeks Flood Control Project** – The Redbank and Fancher Creeks Flood Control Project is owned and operated by the Fresno Metropolitan Flood Control District. This is a single-purpose project that provides flood protection to the Fresno-Clovis metropolitan area and nearby agricultural land. This project has a storage capacity of approximately 42 TAF and includes five facilities: (1) Big Dry Creek Dam and Diversion, (2) Alluvial Drain Detention Basin, (3) Fancher Creek Dam and Reservoir, (4) Pup Creek Detention Basin, and (5) Redbank Creek Detention Basin.

- **Los Banos Detention Dam** – Los Banos Detention Dam, completed in 1965, is a joint CVP/SWP dam located on Los Banos Creek, a westside tributary to the San Joaquin River. This dam provides flood protection to the San Luis Canal and DMC, the community of Los Banos, and the agricultural lands downstream. Los Banos Detention Dam on Los Banos Creek has a storage capacity of 34.6 TAF and a flood management reservation of 14 TAF to control flows to a maximum of 1,000 cfs at Los Banos (USACE 1999).

- **Merced County Stream Group Project** – The Merced County Stream Group Project, with a combined storage capacity of approximately 41 TAF, consists of five dry dams (Bear, Burns, Owens, Mariposa, and Castle) located in the foothills east of Merced on tributaries to the San Joaquin River. These provide flood protection to the City of Merced. USACE owns and maintains the first four dams. Castle Reservoir is owned by the State and Merced County, and is operated and maintained by the Merced ID. The project objective is to restrict the flood flows of several streams in the Merced County Stream Group to the nondamaging capacity of the valley floor channels, from the foothill line to the City of Merced. This project also includes two diversion structures (Black Rascal Creek to Bear Creek

Diversion, and the Owens Creek to Mariposa Creek Diversion).

San Joaquin River from Merced River to the Delta Flood management facilities on major tributaries that affect flood conditions in the San Joaquin River from the confluence with the Merced River to the Delta include the following:

- **Paradise Cut** Paradise Cut is a channel with a rock weir on its upstream end at the San Joaquin River and a design capacity of 15,000 cfs that is a "shortcut" between the San Joaquin River and Old River. SPFC levees border both sides of Paradise Cut, with right-bank levees maintained by Reclamation District (RD) 2062 and RD 2107 and providing flood protection for Steward Tract and Lathrop. Left bank levees are maintained by RD 2058 and RD 2095. As part of the CVFMP, DWR is evaluating the expansion of Paradise Cut to reduce flood stages on the San Joaquin River between Mossdale and Stockton, thereby reducing the probability of flooding in Lathrop, Manteca, and other communities in unincorporated San Joaquin County.

- **New Exchequer Dam and Lake McClure** New Exchequer Dam is on the Merced River about 25 miles northeast of the City of Merced. The dam has a top-of-active-storage capacity of 1,024 TAF, a maximum flood management reservation of 350 TAF, and a downstream objective release of 6,000 cfs in the Merced River at Stevinson. The dam, completed in 1966, is a 1,220-foot-long, 490-foot-high rockfill structure, with a 1,500-foot-long, 62-foot-high rock-and-earthfill dike. The dam and lake, which are owned, operated, and maintained by the Merced ID, provide flood protection to agricultural lands below the dam and to the communities of Livingston, Snelling, Cressy, and Atwater.

- **New Don Pedro Dam and Lake** Don Pedro Dam is on the Tuolumne River, about 28 miles west of Modesto. The dam has a top-of-active-storage capacity of 2,030 TAF, a maximum flood management reservation of 340 TAF, and an objective release of 9,000 cfs below Dry Creek. The dam was constructed in 1971 jointly by Turlock ID and Modesto ID with participation by the City and County of San Francisco for water supply, hydropower, and flood control

purposes. However, only Turlock ID operates and maintains the dam. Don Pedro Dam is an earth and rockfill structure 580 feet high and 1,900 feet long. This dam provides flood management for agricultural property, infrastructure, and some low areas in suburban Modesto by controlling rain and snowmelt floods.

- **New Melones Dam and Lake** New Melones Dam replaced the original Melones Dam, and was completed by USACE in 1978 and approved to begin operation in 1983. The dam is on the Stanislaus River, 35 miles northeast of Modesto, and is operated as part of the CVP for water supply, hydropower, flood control, water quality, and environmental purposes. The dam has a top-of-active-storage capacity of 2,420 TAF, a maximum flood management reservation of 450 TAF, and a downstream objective release of 8,000 cfs or less at Orange Blossom Bridge in the Stanislaus River. New Melones Dam and Lake are owned, operated, and maintained by Reclamation as a unit of the CVP. The dam is an earth and rockfill structure 625 feet high and 1,560 feet long. New Melones Lake flood management protects more than 35,000 acres of leveed agricultural land, infrastructure, and some limited urban areas in Oakdale, Riverbank, and Ripon along the Stanislaus and San Joaquin rivers (USACE 1980).

Delta Flood management facilities within and adjacent to the Delta are present on Littlejohns Creek, Calaveras River and Mormon Slough, and the Mokelumne River, as described below.

Littlejohns Creek Farmington Reservoir on Littlejohns Creek is owned and operated by USACE to restrict downstream flood flows to nondamaging levels throughout the network of channels along the lower reaches of Littlejohns and Rock creeks. The reservoir has the capacity to temporarily store up to 52 TAF of floodwater. The project also includes a diversion channel from Duck Creek to Littlejohns Creek, channel improvement work on selected streams, cutoff dikes, and a small diversion dam to confine flood flows to the main channel of Littlejohns Creek. By reducing flows to the downstream objective release of 2,000 cfs, Farmington Dam provides flood protection to 58,000 acres of intensely developed agricultural lands below the dam, the City of Stockton, and the rural towns of Farmington and French Camp.

A dike across Duck Creek and a 5,000-foot-long diversion channel divert Duck Creek flow to Littlejohns Creek. The channel has a design capacity of 500 cfs. South Littlejohns Creek has a 2.3-mile-long right-bank levee in two segments and a 2.6-mile-long left-bank levee. The project is intended to reduce flood risk to Stockton and its surrounding urban area.

Calaveras River and Mormon Slough The Calaveras River enters the San Joaquin River near the City of Stockton. With a design capacity of 13,500 cfs, the Calaveras River receives nearly all of its flow from rainfall.

The major water management facility on the Calaveras River, New Hogan Dam and Reservoir, is operated for flood management and, if possible, for M&I water supply, irrigation, recreation, and power generation purposes. New Hogan Dam and Reservoir are owned and operated by USACE; the reservoir has a total storage capacity of 317.1 TAF and a flood management reservation of 165 TAF. The dam is constructed of rock-and-earthfill, and is 200 feet high and 1,960 feet long, with four earthfill dikes with a total crest length of 1,355 feet.

Flood management operations at New Hogan Dam and Reservoir protect about 46,000 acres of agricultural land and 14,000 acres of urban and suburban land along the Calaveras River, Mormon Slough, and the Stockton Diverting Canal. The reservoir provides protection to Stockton and the smaller cities of Linden, Waterloo, and Bellota. New Hogan Reservoir is operated to meet an objective release of 12,500 cfs downstream in Mormon Slough.

There are additional flood management facilities within the Calaveras River drainage. These include facilities of the Mormon Slough Project, which consist of a diversion from Mormon Slough, and pumping plants. The Mormon Slough Project is maintained by the San Joaquin County Flood Control and Water Conservation District. Mormon Slough diverts irrigation and higher flows from the Calaveras River at Bellota Weir and has a design capacity of 12,500 cfs.

Mokelumne River The Mokelumne River enters the lower San Joaquin River northwest of Stockton, in the Delta at Bouldin Island. On the Mokelumne River are two reservoirs, Pardee and Camanche, which are both owned and operated by East Bay Municipal Utility District (EBMUD).

Pardee Reservoir has a storage capacity of 210 TAF and is operated for water supply, power, and recreation. Downstream, Camanche Reservoir has a total storage capacity of 430.9 TAF and a maximum flood management reservation of 200 TAF. Camanche Reservoir is operated for flood management, downstream fishery needs, irrigation, hydroelectric power generation, and recreation. It provides flood protection to the lower Mokelumne River Basin—Lodi, Woodbridge, Thornton, and 69,000 acres of agricultural land—by maintaining river flows to the downstream objective release of 5,000 cfs.

Camanche Dam is operated in conjunction with Pardee Dam and Reservoir (EBMUD), and Salt Springs and Lower Bear reservoirs (PG&E), all located upstream from Camanche Dam. The required flood management reservation can be exchanged between Camanche and Pardee reservoirs.

CVP and SWP Service Areas The CVP and SWP services areas relevant to the action alternatives do not contain flood management structures that would be influenced by the action alternatives.

Levees

This section describes the leveed system on the San Joaquin River from Friant Dam to its confluence with the Merced River.

Primary Study Area

There are currently no levees in the primary study area.

Temperance Flat Reservoir Area There are no levees existing or planned around the proposed Temperance Flat RM 274 Reservoir.

Millerton Lake Below RM 274 There are no levees existing or planned around Millerton Lake.

Extended Study Area

There are two classes of levees along the San Joaquin River and associated flood bypass channels:

- **Project levees** – Levees constructed by USACE as part of the Lower San Joaquin River Flood Control Project and LSJRTP. These are SPFC levees for which the State has accepted responsibility for operations and maintenance.

- **Nonproject levees** – Levees constructed by individual landowners to protect site-specific properties, and thus not associated with SPFC. These levees are typically associated with levees and dikes constructed on the San Joaquin River by early flood control districts and adjacent landowners.

San Joaquin River from Friant Dam to Merced River
Levees in this reach form a parallel conveyance system that includes the following:

- A leveed bypass system on the east side of the San Joaquin River

- A leveed flow conveyance system along the main stem of the San Joaquin River

The main stem San Joaquin River levee system within the extended study area is composed of approximately 192 miles of project levees and various nonproject levees located upstream from the San Joaquin and Merced rivers confluence (see Figure 12-3 for the locations of project levees). Levees vary widely with respect to geometry (height and width) and construction.

Project levees occur on the San Joaquin River between Gravelly Ford and the Chowchilla Bypass Bifurcation Structure. Project levees also occur along the Chowchilla, Eastside, and Mariposa bypasses. A small section of project levees are present on the San Joaquin River upstream from Sand Slough, contiguous with project levees on the bypasses. Project levees begin again just upstream from the San Joaquin River and Mariposa Bypass confluence, contiguous with project levees on the bypasses, and continue downstream to the confluence of the Merced and San Joaquin rivers.

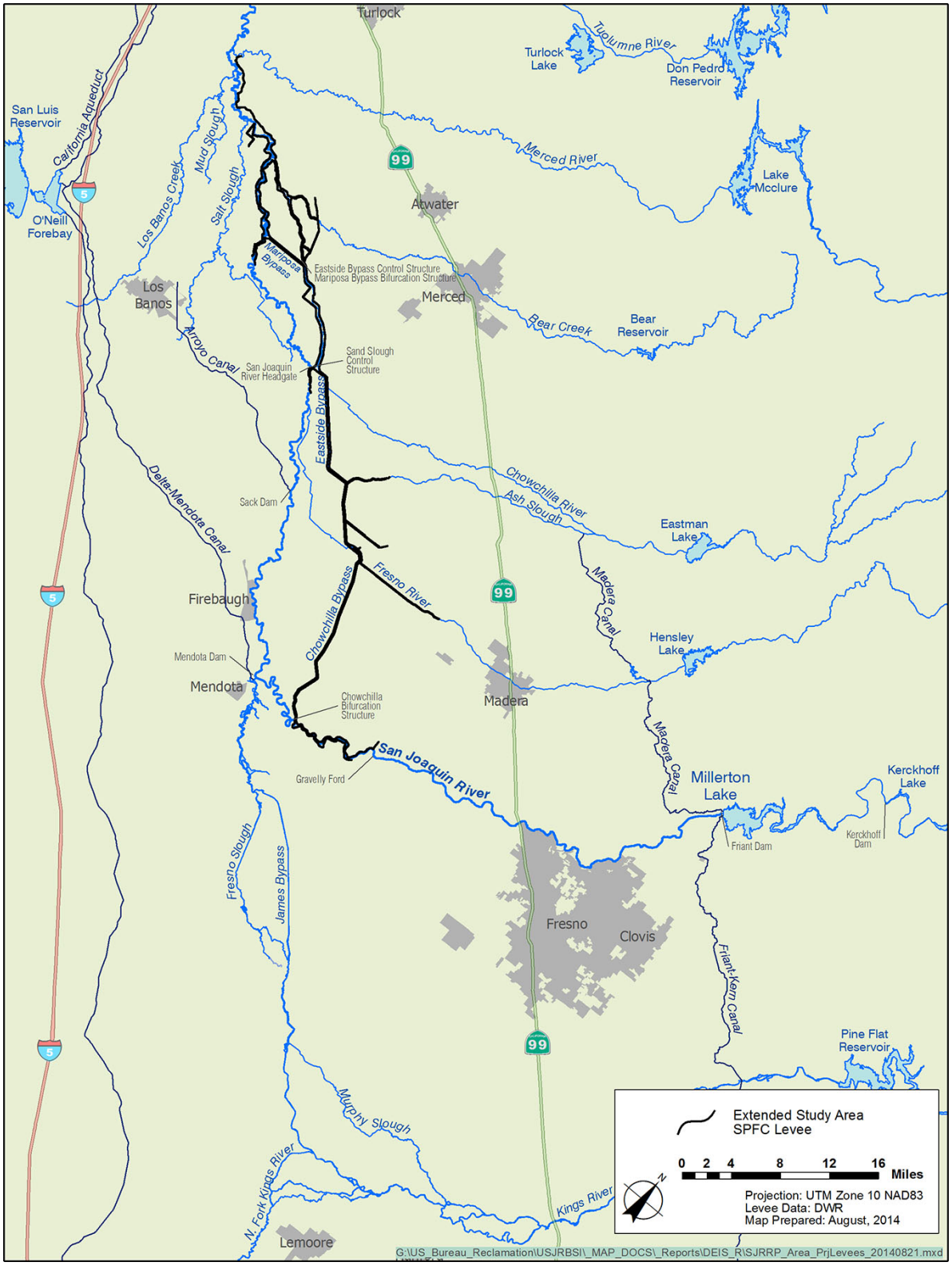


Figure 12-3. Project Levees along the San Joaquin River and Bypasses from Friant Dam to the Confluence with Merced River

Nonproject levees line the San Joaquin River between the Chowchilla Bypass Bifurcation Structure and the Mariposa Bypass confluence. Canal embankments bordering both sides of the San Joaquin River between Mendota Dam and approximately 2 miles upstream from the Sand Slough Control Structure effectively form a set of nonproject levees that have significantly reduced the width of the floodplain. The existing San Joaquin River channel capacity in this reach is approximately 4,500 cfs, but flows of this magnitude can cause seepage and threaten levee stability (RMC 2007). High, sustained flows during the 2006 snowmelt runoff period highlighted this capacity issue. Recent changes in groundwater use have contributed to subsidence, and may have further reduced the channel capacity in this reach (SLCC 2013). In addition, local landowners have constructed other low-elevation berms within the reach creating a narrower floodplain.

San Joaquin River from Merced River to the Delta From about 1956 to 1972, the USACE constructed the LSJRTP from the Delta upstream to the confluence of the San Joaquin and Merced rivers, under the authorization of the Flood Control Act of 1944. Additional modifications to the LSJRTP were completed in the mid-1980s. The federally constructed portion of the LSJRTP consists of about 100 miles of intermittent levees along the San Joaquin River, Paradise Cut, Old River, and the lower Stanislaus River. These levees vary in height from about 15 feet at the downstream end to an average of 6 to 8 feet over much of the project. The levees, along with upstream flow regulation, were designed to contain floods occurring, on average, once every 60 years at the lower end of the project to floods occurring, on average, once every 100 years at the upper limits. Local levees are located along many reaches of the river in the gaps between the LSJRTP levees.

Delta Levee protection within the Delta consists of levees along eastside Delta tributaries and levees surrounding Delta islands.

A combination of project and nonproject levees protects lands adjacent to Littlejohns and Duck creeks, the Calaveras River, and Mormon Slough. Project levees protect the City of Stockton from flood flows on the Calaveras River and Mormon Slough, and project levees on Littlejohns Creek protect French Camp just south of Stockton. On Bear Creek, project levees provide flood protection for agricultural lands and north Stockton.

In the Delta, about 65 major islands containing 538,000 acres of farmland, homes, and other structures, are protected from riverine and tidal waters by 1,100 miles of levees. A few small islands lack levees and a series of currently present open water areas were formerly islands. Most original Delta levees were built with dredged soils from nearby channels and generally provide low levels of flood protection for adjacent lands. Most levees were not engineered and have been locally built and maintained. Levees along the Delta waterways are nonproject levees, with the exception of some levees in the north Delta along the Sacramento River and along the San Joaquin River near Stockton.

CVP and SWP Service Areas There are no existing or planned levees within the CVP and SWP service areas that would be affected by the project.

Flood Management Operations and Conditions

The following sections contain information about flood management operations in the Study Area.

Primary Study Area

This section details the flood management operations in the Temperance Flat Reservoir Area and Millerton Lake below RM 274. It includes a brief description of the Temperance Flat Reservoir Area and current operational constraints on Friant Dam.

Area of Project Features Currently, a flood control operations manual has not been written for the proposed Temperance Flat RM 274 Dam. Expected flood reduction benefits are discussed below in the Temperance Flat Reservoir Area section.

Temperance Flat Reservoir Area The five action alternatives do not include additional dedicated flood storage capacity upstream from Friant Dam. Under each action alternative, the flood space requirement of 170 TAF would generally be maintained in Millerton Lake (operated in conjunction with Mammoth Pool). Temperance Flat RM 274 Reservoir could provide significant additional flood storage space if needed in very wet years, as the larger total storage volume increases the probability that the total storage in Millerton Lake and Temperance Flat RM 274 Reservoir would be less than the regulatory flood control limit.

Millerton Lake Below RM 274 Friant Dam and Millerton Lake are operated for flood management in accordance with rules and regulations prescribed by CFR Title 33 Part 208.11, the Field Working Agreement for CVP dams and reservoirs, and the Flood Control Manual for Friant Dam. Since the writing of the Flood Control Manual, operations at Friant Dam have been modified to include releases of Restoration Flows to meet flow targets at Gravelly Ford as part of the SJRRP (Reclamation 2006). Pursuant to the SJRRP's Restoration Flows Guidelines, Restoration Flows are not released in addition to flood flows and, generally, flood flows satisfy required flow targets (Reclamation 2013b). The Flood Control Manual states the following flood management objectives for Friant Dam and Millerton Lake (USACE 1955):

- Control the sum of flows from Friant Dam without exceeding 8,000 cfs below Cottonwood Creek and Little Dry Creek, or 6,500 cfs at the USGS gaging station "San Joaquin River near Mendota."

- Permit use of the maximum practical amount of storage space for conservation and other purposes without impairing the flood control functions.

According to the Flood Control Manual, flood management operation is determined daily, as described in the Flood Control Diagram (Chart A-11 of Flood Control Manual), which prescribes the required flood control space in Millerton Lake and gives the schedule for releasing water from the flood management space (Figure 12-1). Two types of flood management space and their characteristics are summarized as follows:

- **Rain flood space** – This space increases from zero on October 1 to 170 TAF on November 1, and decreases from 170 TAF on February 1 to 0 TAF on April 1. Water stored in rain flood space during this period is released as rapidly as possible without violating the flood management objective release. The Mammoth Pool Agreement allows for rain flood space in excess of 85 TAF to be replaced by an equal amount of space in Mammoth Pool from November 1 to February 1, if available. Mammoth Pool is a 123 TAF reservoir upstream from Millerton Lake.

- **Conditional space** – This space is required from February 1 to June 30 to help manage snowmelt runoff.

This variable space is predicated on filling the reservoir (if possible) by the end of the snowmelt season without exceeding downstream design flows. The required conditional space and supplemental releases on a given date are determined from the Flood Control Diagram. This diagram uses the following data: forecasted unimpaired runoff into Millerton Lake, amount of upstream storage available, and forecasted irrigation demand from that date to June 15 (after May 31, demand is estimated as forecasted irrigation demand for the next 15 days, or until August, whichever is less). Snowmelt runoff credit may be given to all reservoirs upstream from Friant Dam. This space is equal to the total space available in the upstream reservoirs minus the adjustments to upstream space given in Chart A-11 of the Flood Control Manual.

Use of the 170 TAF flood management reservation, as directed by the Flood Control Manual, provides for an objective release of 8,000 cfs. Downstream flow changes are limited to 500 cfs per hour for the safety of recreational users along the river, and to minimize damage to riverbanks from sloughing and erosion (USACE 1999). Flows at Friant Dam must be adjusted to account for flow entering the river below the dam so as not to exceed the 8,000 cfs design capacity.

Extended Study Area

San Joaquin River from Friant Dam to Merced River The design capacities for the various San Joaquin River reaches are given in Table 12-1. Design capacity was authorized as the amount of water that can pass through a given reach with a levee freeboard of 3 feet within the historical San Joaquin River and 4 feet of freeboard along the bypasses (except along the left side of the Eastside Bypass, which has 3 feet of design freeboard) (USACE 1993). Design capacities are generally considered to be safe carrying capacities, although some flood damages to adjacent land developments can occur when design flows are passed (USACE 1993). Seepage under and through levees, and backwatering of local storm drainage systems, can damage adjacent lands. Levee subsidence and sediment accumulation in various reaches has decreased channel capacities, increasing damage risk.

Table 12-1. Design Capacities of San Joaquin River and Bypasses

River/ Waterway	Upstream Extent	Downstream Extent	Levee Type	Design Capacity[1] (cfs)
San Joaquin River	Friant Dam	State Route 99	None	8,000
San Joaquin River	State Route 99	Gravelly Ford	None	8,000
San Joaquin River	Gravelly Ford	Chowchilla Bypass Bifurcation Structure	Project	8,000
San Joaquin River	Chowchilla Bypass Bifurcation Structure	Mendota Dam	Nonproject	2,500
San Joaquin River	Mendota Dam	Sack Dam	Nonproject	4,500
San Joaquin River	Sack Dam	Sand Slough Control Structure	Nonproject	4,500
San Joaquin River	Sand Slough Control Structure	Confluence with Mariposa Bypass	Nonproject	1,500
San Joaquin River	Confluence with Mariposa Bypass	Confluence with Bear Creek and Eastside Bypass	Project	10,000
San Joaquin River	Confluence with Bear Creek and Eastside Bypass	Confluence with Merced River	Project	26,000
Chowchilla Bypass	Chowchilla Bypass Bifurcation Structure	Confluence with Fresno River and Eastside Bypass	Project	5,500
Eastside Bypass	Fresno River	Sand Slough Bypass	Project	10,000–17,000
Eastside Bypass	Sand Slough Bypass	Mariposa Bypass Bifurcation Structure/Eastside Bypass Bifurcation Structure	Project	16,500
Eastside Bypass	Mariposa Bypass Bifurcation Structure/Eastside Bypass Bifurcation Structure	Confluence with San Joaquin River	Project	13,500–18,500
Sand Slough Bypass	Sand Slough Control Structure	Eastside Bypass	Project	3,000
Mariposa Bypass	Mariposa Bypass Bifurcation Structure	Confluence with San Joaquin River	Project	8,500
Kings River North	Fresno Slough Bypass	Mendota Pool	Nonproject	4,750

Note:
[1] From DWR Flood Channel Design Flows Diagram (DWR 1985).
Key:
cfs = cubic feet per second
Nonproject = not part of the State Plan of Flood Control
Project = State Plan of Flood Control facility

Friant Dam to Gravelly Ford From Friant Dam to Gravelly Ford, flows are predominantly influenced by releases from Friant Dam, and additionally by diversions and seepage losses below State Route 99. This section of the river is incised and there are no project or nonproject levees. Urban surface runoff into this portion of the San Joaquin River is limited because of stormwater management by the Fresno Metropolitan Flood Control District. All but 5 of the District's 161 drainage basins route stormwater to retention and detention facilities in the Fresno metropolitan area.

Gravelly Ford to Mendota Pool The San Joaquin River continues from Gravelly Ford for approximately 24 miles to the Mendota Pool. This portion marks the end of the incised channel, and the river is a meandering channel of low gradient. The Chowchilla Bypass Bifurcation Structure regulates flow within this portion of the San Joaquin River.

The California State Reclamation Board (1969) guidelines describe how the Lower San Joaquin River Flood Control Project is to be operated on this portion of the San Joaquin River:

- "The first increment of flow down the San Joaquin River may be routed through either the San Joaquin River or the Chowchilla Bypass. Up to 2,500 cfs shall normally be routed through the San Joaquin River insofar as it does not exceed the capacity of the river when added to the releases from Pine Flat Dam and the remaining increment flow" (Reclamation Board 1969). Excess water from the Kings River system, which enters the river through the James Bypass, has priority to available capacity in the San Joaquin River below the Mendota Pool.

- "Up to 5,500 cfs shall be passed through the Chowchilla Bypass Bifurcation Structure. A total flow of 8,000 cfs will normally be divided with up to 2,500 cfs passing through the San Joaquin River Control Structure and 5,500 cfs passing through the Chowchilla Canal Bypass Control Structure" (Reclamation Board 1969).

- "Should the flows exceed 8,000 cfs at the control structures or 10,000 cfs at the latitude of Mendota, the District will operate the control structures at their own discretion with the objective of minimizing damage to the flood control project and protected area" (Reclamation Board 1969). The LSJLD considers the latitude flow of Mendota to be the sum of flows in the San Joaquin River immediately downstream from the Chowchilla Bypass Bifurcation Structure, the James Bypass/Fresno Slough, and the Chowchilla Bypass at the latitude of Mendota.

LSJLD operates the Lower San Joaquin River Flood Control Project for safety purposes, taking into account channel capacity limitations and flows from the San Joaquin River,

James Bypass/Fresno Slough, and water supply deliveries to Mendota Pool. When flood flows in the San Joaquin River are between 0 cfs and 8,000 cfs upstream from the Chowchilla Bypass Bifurcation Structure, historical operations typically route up to 1,300 cfs to the San Joaquin River, with the remaining flow going into the Chowchilla Bypass.

Mendota Pool to Sack Dam This portion of the San Joaquin River flows 23 miles along a sandy channel from Mendota Dam to Sack Dam, where flows are diverted to the Arroyo Canal. The design channel capacity is 4,500 cfs. Significant bed lowering has been measured along this reach of the San Joaquin River; however, it is unknown to what extent this bed lowering is because of subsidence from groundwater overdraft, or human-induced sedimentation and hydrology modification within the channel. Kings River flood flows, via the James Bypass/Fresno Slough, also affect instream flow in the San Joaquin River, and have priority to use available conveyance capacity over upstream San Joaquin River flows. During large release events at Friant Dam, upper San Joaquin River flows can be diverted at the Chowchilla Bypass Bifurcation Structure to allow incremental flow from James Bypass into this portion of the San Joaquin River, as described in the Lower San Joaquin River Flood Control Project guidelines (Reclamation Board 1969).

Sack Dam to Sand Slough Control Structure From Sack Dam to the Sand Slough Control Structure, the San Joaquin River has a design capacity of 4,500 cfs.

Sand Slough Control Structure to Mariposa Bypass Between the Sand Slough Control Structure and Mariposa Bypass, the San Joaquin River has a design capacity of 1,500 cfs. The Sand Slough Control Structure is used to maintain this design capacity.

Operations have kept the Sand Slough Control Structure gates closed, diverting all flow to the Eastside Bypass over the last few decades (RMC 2007). Therefore, between the Sack Dam and the Mariposa Bypass, the San Joaquin River is dry until downstream agricultural return flows contribute to its baseflow.

Mariposa Bypass to Eastside Bypass Confluence The San Joaquin River has a design capacity of 10,000 cfs between the Mariposa Bypass and its confluence with the Eastside Bypass. This portion of the river conveys returned tributary and flood flows from the bypass system.

Eastside Bypass Confluence to Merced River Confluence The San Joaquin River extends approximately 18 miles from its confluence with the Eastside Bypass to its confluence with the Merced River. The design channel capacity is 26,000 cfs, and the channel receives flows from the San Joaquin River and Eastside Bypass.

San Joaquin River from Merced River to the Delta In this reach, the three main tributaries of the lower San Joaquin River include the Merced, Tuolumne, and Stanislaus rivers. Dams on the Merced and Tuolumne rivers are both privately owned and operated. New Melones Reservoir, which is owned and operated by Reclamation, regulates the Stanislaus River. Table 12-2 shows USACE design capacities for the San Joaquin River downstream from the Merced River confluence which guide reservoir operations for flood management.

Table 12-2. Design Capacity of Lower San Joaquin River and Tributaries Flood Control Project

San Joaquin River Reach	USACE Design Capacity (cfs)[1]
Merced River to Tuolumne River	45,000
Tuolumne River to Stanislaus River	46,000
Stanislaus River to Paradise Dam (at head of Paradise Cut)	52,000
Paradise Dam to Old River	37,000
Old River to Stockton Deep Water Ship Channel	22,000

Source: California Resources Agency 1976
Notes:
[1] Design capacity includes three feet of freeboard.
Key:
cfs = cubic feet per second
USACE = U.S. Army Corps of Engineers

Delta The Mokelumne and Calaveras rivers, and several eastside tributaries drain to the Delta. USACE dams on the Calaveras River (New Hogan Dam) and Littlejohns Creek (Farmington Dam) provide downstream flood protection. EBMUD dams on the Mokelumne River (Pardee and Camanche dams) provide downstream flood protection to the lower Mokelumne Basin. Because of the lack of flood management structures (such as levees), significant flooding around Stockton has been caused by high flows on the Calaveras River and Bear Creek. Table 12-3 shows the flood channel design flows of the eastside Delta tributaries.

Table 12-3. Flood Channel Design Flows of Eastside Delta Tributaries

River/Creek	Flood Channel Design Flows (cfs)
Littlejohns Creek downstream from Lone Tree Creek Confluence[1]	1,750
Duck Creek[1]	2,000
Mormon Slough upstream from Calaveras Creek Confluence[1]	12,500
Calaveras Creek downstream from Mormon Slough Confluence[1]	13,500
Bear Creek[1]	5,500
Mokelumne River upstream from Cosumnes River Confluence[2]	2,500

[1] *Source: DWR 1985*
[2] *Source: USACE 1997*
Key:
cfs = cubic feet per second

CVP and SWP Service Areas The CVP and SWP pumping facilities near Tracy are not operated for flood management. Also, the CVP and SWP service areas within the extended study area are not operated for flood management and are therefore not described in this section.

Environmental Consequences and Mitigation Measures

This section discusses environmental consequences on the flood management system associated with implementing the alternatives. The potential direct and indirect impacts on the flood management system and associated mitigation measures are summarized in Table 12-4. As shown in the table, the alternatives resulted in either no impact or less-than-significant impacts, requiring no mitigation.

Table 12-4. Summary of Impacts and Mitigation Measures for Flood Management

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
FLD-3: Place Within a 100-Year Flood Hazard Area Structures which would Impede or Redirect Flood Flows	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key: LTS = less than significant NI = no impact

Methods and Assumptions

The total flood storage capacity of the San Joaquin River upstream from Friant Dam was assumed to remain unchanged with the potential construction of Temperance Flat RM 274 Dam and Reservoir. The currently required total available flood control storage and operations rules at Millerton Lake were assumed to apply to the combined storage in Millerton Lake and Temperance Flat RM 274 Reservoir. Consequently, each action alternative would provide the same flood control storage space as under the existing *Friant Dam and Millerton Lake Report on Reservoir Regulation for Flood Control* (USACE 1980); only this space would be shared between the two reservoirs.

Temperance Flat RM 274 Reservoir could provide additional storage space in wet years, as the reservoir would likely not be full and the empty storage could be used to store additional flood flows that would have been released under the No Action Alternative. To quantify the flood reduction benefits of the action alternatives, simulated available monthly storage during wet years in Millerton Lake and Temperance Flat RM 274 Reservoir was extracted from the CalSim II model. For the No Action Alternative, available storage upstream from Friant Dam was assumed to be limited to Millerton Lake. For the action alternatives, available storage upstream from Friant Dam included Millerton Lake and Temperance Flat RM 274 Reservoir.

Flood releases from Friant Dam were also extracted from the CalSim II model for all alternatives and comprise releases required to maintain current flood control space in Millerton Lake and releases made in anticipation of imminent large snowmelt volumes that would be required to maintain flood control space requirements.

Criteria for Determining Significance of Effects

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and intensity of its impacts. Impacts on flood management resulting from the alternatives would be significant if the alternatives would cause any of the following:

- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam
- Substantially increase the rate or amount of surface runoff in a manner that would result in onsite or offsite flooding
- Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map
- Place structures that would impede or redirect flood flows within a 100-year flood hazard area

Topics Eliminated from Further Consideration

None of the action alternatives will place housing within a 100-year flood hazard area. This topic was therefore eliminated from further discussion.

Direct and Indirect Effects

This section summarizes the impacts related to flood management in the primary and extended study areas. Within this section, the impacts for Alternative Plans 1 through 5 were evaluated together, as they are expected to have the same impact on flood management in both the primary and extended study areas.

Impact FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Reservoir would not be constructed. The existing level of flood control in the primary study area would not change under the No Action Alternative, and no additional risk of loss, injury, or death would be caused by the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Action Alternatives Within the primary study area, the action alternatives would not expose people to a significant risk of loss, injury, or death as a result of flooding. During construction, cofferdams could be overtopped in a large flood

event or could fail, resulting in a flood wave into Millerton Lake, and potentially affecting surrounding people or structures.

There is also the potential that Temperance Flat RM 274 Dam could fail, resulting in a sudden release of stored water into Millerton Lake. Details regarding the flood carrying capacity of Temperance Flat RM 274 Dam and the cofferdams are provided in the description of the extended study area impact in the following section. The dam would be designed and constructed to current standards and specifications, including those related to dam safety, minimizing the probability of failure.

This impact would be **less than significant** under the action alternatives**.** Mitigation for this impact is not needed, and thus not proposed.

Extended Study Area

No Action Alternative The risk of failure of Friant Dam, and the associated potential for loss, injury, or death downstream, would not change under the No Action Alternative. Flood system improvements along the San Joaquin River below Friant Dam are anticipated under the No Action Alternative as part of the SJRRP, including modifications to San Joaquin River flow conveyance features below Friant Dam.

A flood routing study performed by Reclamation indicated that under the No Action Alternative, Friant Dam would be overtopped by 1.2 feet for 10 hours during the 500-year flood and by 11.2 feet for 62 hours during the Probable Maximum Flood (PMF), assuming the simulation began with Millerton Lake at the bottom of the flood control pool (Reclamation 2009a). The risk of failure of Friant Dam, and the associated potential for loss, injury, or death downstream, would not change under the No Action Alternative.

As channel capacity and levee improvements are made, releases from Friant Dam will increase to full Restoration Flows. As releases from Friant Dam increase to full Restoration Flows, Reclamation will take measures to avoid increases in the risk of flood damage or levee failure due to under-seepage, through-seepage, erosion, or land-side slope stability issues. Risk of flood damage or levee failure will be minimized by only increasing Restoration Flows when sufficient channel capacity exists, and by closely monitoring and performing maintenance and/or reducing Restoration

Flows as necessary to avoid erosion-related impacts (SJRRP 2012). Additionally, Reclamation will take measures to avoid impacts related to groundwater seepage, as described in the Seepage Monitoring and Management Plan (SJRRP 2013).

Under the SJRRP, channel modifications will be taken to provide full Restoration Flows, also resulting in reducing flood risk in the San Joaquin River.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, Temperance Flat RM 274 Dam and the construction of cofferdams would be designed and constructed to current standards and specifications, minimizing the probability of failure. The additional storage provided by Temperance Flat RM 274 Reservoir would reduce the magnitude and frequency of flood releases from Friant Dam and therefore lower the potential for loss, injury, or death involving flooding in the extended study area.

A flood routing study performed by Reclamation indicated that under the action alternatives, Temperance Flat RM 274 Dam would not be overtopped by the 500-year flood and would be overtopped by approximately 12 feet for 51 hours during the PMF (Reclamation 2010). During construction of Temperance Flat RM 274 Dam, a 25,000 cfs diversion tunnel would be constructed that would convey the 10-year flood past the cofferdams enclosing the construction area. Flood flows would still be conveyed to Millerton Lake, and the cofferdams would be able to withstand a 3-day duration, 150-year event before being overtopped (Reclamation 2013a). Temperance Flat RM 274 Dam and the cofferdams would be designed and constructed consistent with the latest standards and regulations to minimize the likelihood of a failure that could result in a large release of waters stored behind the dams.

Temperance Flat RM 274 Reservoir could provide additional storage space in Wet years, as the reservoir would likely not be full and the available storage could be used to store additional flood flows that would otherwise have been released under the No Action Alternative. The action alternatives are anticipated to provide several hundred TAF of additional storage in Wet years. The additional storage provided by Temperance Flat RM 274 Reservoir under the action alternatives would reduce the magnitude and frequency of flood releases to the extended

study area, as shown in Figure 12-4 (existing conditions) and Figure 12-5 (future conditions), and Table 12-5 (existing conditions) and Table 12-6 (future conditions).

Temperance Flat RM 274 Reservoir is expected to provide additional storage for flood management and provide a beneficial impact by reducing downstream flooding.

As previously mentioned, channel modifications undertaken by the SJRRP will further reduce flood risk in the San Joaquin River. The action alternatives would reduce the frequency, magnitude, and duration of Friant Dam flood releases. This in turn could reduce the risk of damage to SJRRP instream and floodplain investments, reduce the rate of downstream unmanaged sand migration and potentially reduce the rate/frequency of required sand removal at flow control structures, and increase flexibility for managing riparian recruitment flows and flexible flow periods.

Portions of the San Joaquin River between Friant Dam and the Merced River have historically experienced groundwater seepage to adjacent lands associated with flood flows. Groundwater seepage and associated rises in the groundwater table have the potential to cause waterlogging of crops and salt mobilization and accumulation in the crop root zone. Under the action alternatives, some surface water supply deliveries from Friant Dam would be diverted at Mendota Pool. These surface water supply deliveries would be subject to the expected channel capacity modification resulting from the implementation of the SJRRP. Total controlled releases from Friant Dam, including water supply releases prescribed in the action alternatives, would be within the channel capacity design modification included in the No Action Alternative, which would accommodate full Restoration Flows. Water supply deliveries to Mendota Pool under the action alternatives would be subject to prior water rights and consistent with the SJRRP Seepage Monitoring and Management Plan (SJRRP 2013). Therefore, groundwater seepage impacts are not anticipated to occur as a result of implementing the action alternatives.

The impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

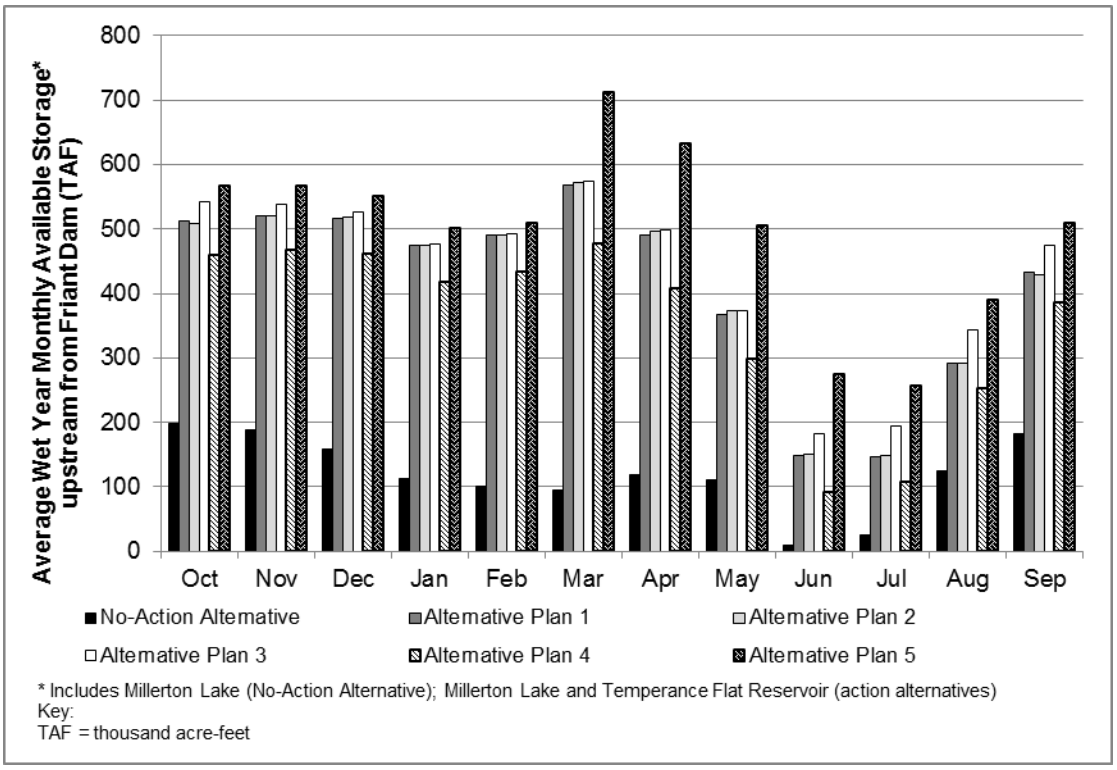


Figure 12-4. Average Available Wet Year Storage Under Existing Conditions

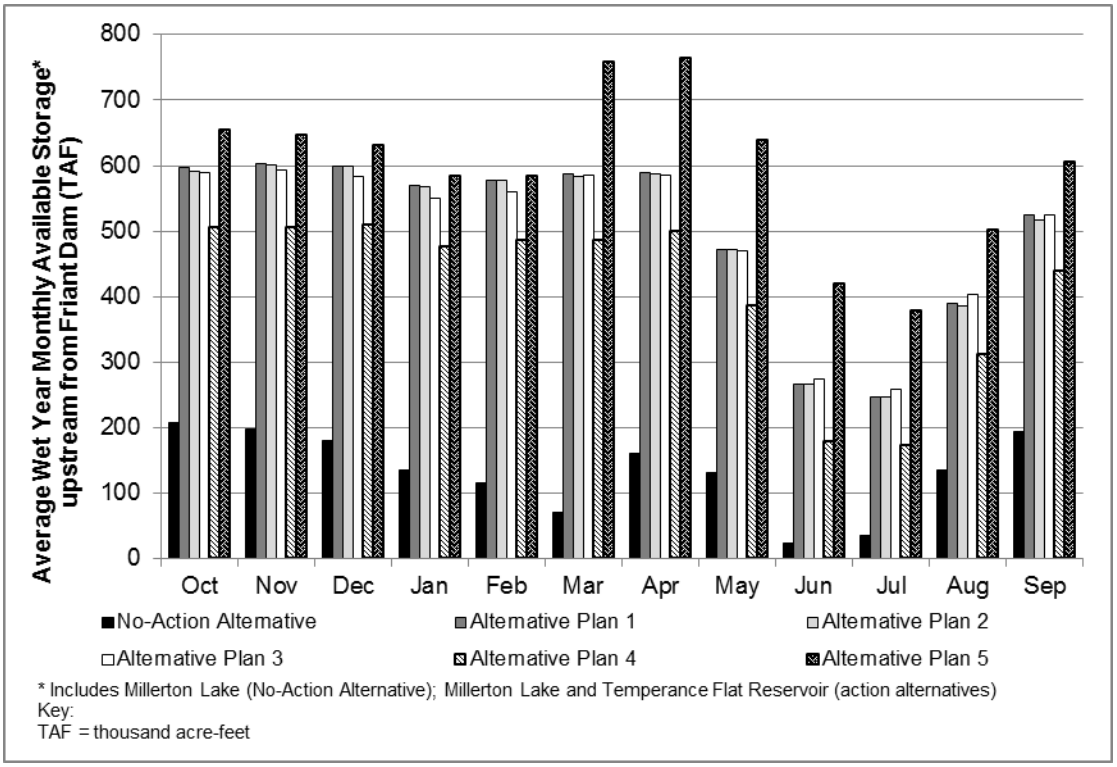


Figure 12-5. Average Available Wet Year Storage Under Future Conditions

Table 12-5. Simulated Flood Releases from Friant Dam Under Existing Conditions

Water Year	Total Flood Release from Friant Dam[1] (TAF) No Action Alternative	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 1	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 2	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 3	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 4	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 5
1922	98	-	-	-	-	-
1923	13	-	-	-	-	-
1924	-	-	-	-	-	-
1925	-	-	-	-	-	-
1926	-	-	-	-	-	-
1927	10	-	-	-	-	-
1928	-	-	-	-	-	-
1929	-	-	-	-	-	-
1930	-	-	-	-	-	-
1931	-	-	-	-	-	-
1932	-	-	-	-	-	-
1933	-	-	-	-	-	-
1934	-	-	-	-	-	-
1935	8	-	-	-	-	-
1936	125	-	-	-	-	-
1937	498	-	-	-	-	-
1938	1,338	641	634	616	758	610
1939	3	-	-	-	-	-
1940	38	-	-	-	-	-
1941	205	-	-	-	-	-
1942	55	-	-	-	-	-
1943	336	-	-	-	-	-
1944	-	-	-	-	-	-
1945	119	-	-	-	-	-
1946	26	-	-	-	-	-
1947	2	-	-	-	-	-
1948	-	-	-	-	-	-
1949	-	-	-	-	-	-
1950	-	-	-	-	-	-
1951	280	-	-	-	-	-
1952	459	-	-	-	-	-
1953	7	-	-	-	-	-
1954	-	-	-	-	-	-
1955	-	-	-	-	-	-
1956	407	-	-	-	-	-
1957	-	-	-	-	-	-
1958	357	-	-	-	-	-
1959	-	-	-	-	-	-
1960	-	-	-	-	-	-
1961	-	-	-	-	-	-
1962	0	-	-	-	-	-
1963	8	-	-	-	-	-
1964	-	-	-	-	-	-
1965	64	-	-	-	-	-
1966	9	-	-	-	-	-
1967	571	-	-	-	60	-
1968	-	-	-	-	-	-
1969	1,722	824	840	810	965	574
1970	11	-	-	-	-	-

Table 12-5. Simulated Flood Releases from Friant Dam Under Existing Conditions (contd.)

Water Year	Total Flood Release from Friant Dam[1] (TAF) No Action Alternative	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 1	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 2	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 3	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 4	Total Flood Release from Friant Dam[1] (TAF) Alternative Plan 5
1971	-	-	-	-	-	-
1972	-	-	-	-	-	-
1973	72	-	-	-	-	-
1974	96	-	-	-	-	-
1975	0	-	-	-	-	-
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	801	-	-	-	50	-
1979	72	-	-	-	-	-
1980	508	17	13	0	11	-
1981	1	-	-	-	-	-
1982	563	-	-	-	-	-
1983	2,482	2,218	2,242	2,177	2,302	2,314
1984	259	247	252	235	252	254
1985	-	-	-	-	-	-
1986	609	-	-	-	0	-
1987	-	-	-	-	-	-
1988	-	-	-	-	-	-
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	-	-	-	-	-	-
1992	-	-	-	-	-	-
1993	6	-	-	-	-	-
1994	-	-	-	-	-	-
1995	1,065	385	378	341	395	132
1996	153	19	14	68	28	93
1997	909	385	361	296	419	342
1998	920	227	197	163	276	249
1999	-	-	-	-	-	-
2000	0	-	-	-	-	-
2001	-	-	-	-	-	-
2002	-	-	-	-	-	-
2003	-	-	-	-	-	-

Source: Summarized from CalSim II 2005 simulations.

Note:

[1] Simulated flood releases include releases required to maintain current flood control space in Millerton Lake and releases made in anticipation of imminent large snowmelt volumes that would be required to maintain flood control space requirements.

Key:

TAF = thousand acre-feet

Table 12-6. Simulated Flood Releases from Friant Dam Under Future Conditions

Water Year	Total Flood Releases from Friant Dam[1] (TAF) No Action Alternative	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 1	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 2	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 3	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 4	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 5
1922	25	-	-	-	-	-
1923	9	-	-	-	-	-
1924	-	-	-	-	-	-
1925	-	-	-	-	-	-
1926	-	-	-	-	-	-
1927	-	-	-	-	-	-
1928	-	-	-	-	-	-
1929	-	-	-	-	-	-
1930	-	-	-	-	-	-
1931	-	-	-	-	-	-
1932	1	-	-	-	-	-
1933	-	-	-	-	-	-
1934	-	-	-	-	-	-
1935	-	-	-	-	-	-
1936	33	-	-	-	-	-
1937	346	-	-	-	-	-
1938	1,187	493	500	467	569	513
1939	-	-	-	-	-	-
1940	-	-	-	-	-	-
1941	155	-	-	-	-	-
1942	13	-	-	-	-	-
1943	173	-	-	-	-	-
1944	-	-	-	-	-	-
1945	91	-	-	-	-	-
1946	15	-	-	-	-	-
1947	0	-	-	-	-	-
1948	-	-	-	-	-	-
1949	-	-	-	-	-	-
1950	-	-	-	-	-	-
1951	253	-	-	-	-	-
1952	337	-	-	-	-	-
1953	3	-	-	-	-	-
1954	-	-	-	-	-	-
1955	-	-	-	-	-	-
1956	381	-	-	-	-	-
1957	-	-	-	-	-	-
1958	193	-	-	-	-	-
1959	-	-	-	-	-	-
1960	-	-	-	-	-	-
1961	-	-	-	-	-	-
1962	-	-	-	-	-	-
1963	5	-	-	-	-	-
1964	-	-	-	-	-	-
1965	41	-	-	-	-	-
1966	5	-	-	-	-	-
1967	437	-	-	-	-	-
1968	-	-	-	-	-	-
1969	1,558	642	647	625	787	403
1970	8	-	-	-	-	-

Table 12-6. Simulated Flood Releases from Friant Dam Under Future Conditions (contd.)

Water Year	Total Flood Releases from Friant Dam[1] (TAF) No Action Alternative	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 1	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 2	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 3	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 4	Total Flood Releases from Friant Dam[1] (TAF) Alternative Plan 5
1971	-	-	-	-	-	-
1972	-	-	-	-	-	-
1973	24	-	-	-	-	-
1974	66	-	-	-	-	-
1975	0	-	-	-	-	-
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	696	-	-	-	25	-
1979	19	-	-	-	-	-
1980	434	-	-	-	-	-
1981	-	-	-	-	-	-
1982	399	-	-	-	-	-
1983	2,318	1,899	1,907	1,870	2,052	1,822
1984	233	221	226	217	227	229
1985	-	-	-	-	-	-
1986	452	-	-	-	-	-
1987	-	-	-	-	-	-
1988	-	-	-	-	-	-
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	-	-	-	-	-	-
1992	-	-	-	-	-	-
1993	8	-	-	-	-	-
1994	-	-	-	-	-	-
1995	922	246	245	233	323	14
1996	85	-	-	0	-	0
1997	811	298	300	269	318	316
1998	723	59	59	13	112	59
1999	-	-	-	-	-	-
2000	-	-	-	-	-	-
2001	-	-	-	-	-	-
2002	-	-	-	-	-	-
2003	-	-	-	-	-	-

Source: Summarized from CalSim II 2030 simulations

Note:

[1] Simulated flood releases include releases required to maintain current flood control space in Millerton Lake and releases made in anticipation of imminent large snowmelt volumes that would be required to maintain flood control space requirements.

Key:

TAF = thousand acre-feet

Impact FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be constructed; therefore, there would no changes to local drainage patterns, interior drainage, ponding, or other site specific flooding issues.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives are not expected to increase runoff from tributary streams or the main stem of the San Joaquin River; however total runoff to RM 274 could increase by contributions from the area of project features due to the removal of vegetation and the increase in impermeable surfaces. Because implementation of BMPs would minimize increases in runoff to RM 274, alterations to the drainage pattern of the primary study area under the action alternatives would not result in new or increased onsite or offsite flooding.

Construction of Temperance Flat RM 274 Dam and Reservoir will change the drainage pattern of the San Joaquin River and tributaries draining into the reservoir. When water levels in the reservoir are high and regional flooding is occurring, sediment from the uplands would be deposited as deltas where streams enter the reservoir. When Temperance Flat RM 274 Reservoir levels are low, streams will downcut these delta deposits. However, because the majority of streams are ephemeral or intermittent, there is expected to be little sediment transport into Temperance Flat RM 274 Reservoir. All water that currently drains to RM 274 would still drain to RM 274 under the action alternatives.

Within the primary study area, the action alternatives would include construction areas, a batch plant, staging areas, construction access roads, a waste pile, a borrow pit, and operations and transmission facilities. Runoff from these areas would be reduced through the use of BMPs that may include earth dikes and drainage swales, stream bank stabilization, silt fencing, detention basins, fiber rolls, sandbag barriers, straw bale barriers, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances. Because implementation of

BMPs would minimize increases in runoff to RM 274, alterations to the drainage pattern of the primary study area under the action alternatives would not result in onsite or offsite flooding.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, residual impacts associated with construction of the Temperance Flat RM 274 Dam would not occur. Implementation of the SJRRP will alter local drainage patterns, and could create interior drainage, ponding, or other site-specific flooding issues. The SJRRP will take actions to avoid interior drainage issues of proposed levees or other hydraulic structures (SJRRP 2012).

This impact would be **less than significant** under the No Action Alternative.

Action Alternative The action alternatives will not alter the course of the San Joaquin River or alter the rate or amount of surface water runoff downstream from Friant Dam. Likewise, increased runoff from construction-related activities and permanent facilities related to the Temperance Flat RM 274 Reservoir is expected to have only residual impacts in the extended study area because of use of BMPs in the primary study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Impact FLD-3: Place Within a 100-Year Flood Hazard Area Structures which would Impede or Redirect Flood Flows

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam and Reservoir would not be constructed. No new structures would be constructed within the primary study area that would have the potential to impede or redirect flood flows.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, Temperance Flat RM 274 Reservoir would inundate portions of ephemeral creeks between Millerton Lake and Kerckhoff Dam. Temperance Flat RM 274 Dam would be constructed to pass the PMF. Some structures, including Kerckhoff Powerhouse and Kerckhoff Powerhouse No. 2, as well as campground facilities, would be inundated. However, these facilities would be decommissioned and/or relocated before inundation.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, reservoir operations for downstream flood management objectives would not change.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, reservoir operations for downstream flood management objectives would not change. Each action alternative would provide the same required flood control space, spread between Millerton Lake and Temperance Flat RM 274 Reservoir, as under the existing *Friant Dam and Millerton Lake Report on Reservoir Regulation for Flood Control* (USACE 1980). No structures downstream from Friant Dam would be placed within the 100-year flood hazard area that would impede or redirect flood flows as a result of the action alternatives.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Mitigation Measures

No mitigation is required for Impacts FLD-1, FLD-2, or FLD-3 in the primary and extended study areas under the action alternatives, as there would be no impact or these impacts would be less than significant for all action alternatives.

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Chapter 13
Hydrology – Groundwater

This chapter describes the affected environment for groundwater, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. It focuses primarily on identified groundwater basins that occur in the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

This section describes the affected environment related to groundwater resources in the San Joaquin River and Tulare Lake hydrologic regions (see Figure 13-1). Both of these regions have historically relied greatly on groundwater extracted from the San Joaquin Valley Groundwater Basin.

The San Joaquin River Hydrologic Region consists of surface water basins draining into the San Joaquin River system, from the Cosumnes River Basin on the north through the southern boundary of the San Joaquin River Basin (DWR 2009). In addition to the San Joaquin Valley Groundwater Basin, the San Joaquin River Hydrologic Region also includes Yosemite Valley, Los Banos, and Creek Valley groundwater basins (DWR 2009). The Yosemite, Los Banos, and Creek Valley groundwater basins are discrete, peripheral basins, unconnected to the San Joaquin Valley Groundwater Basin, and will not be further discussed in this chapter.

The Tulare Lake Hydrologic Region is a closed drainage basin at the southern end of the San Joaquin Valley, south of the San Joaquin River Basin, encompassing surface water basins draining to the Kern Lake bed, Tulare Lake bed, and Buena Vista Lake bed (DWR 2009). The Tulare Lake Hydrologic Region includes 12 distinct groundwater basins and 7 subbasins of the San Joaquin Valley Groundwater Basin Groundwater use in this hydrologic region has historically accounted for 41 percent of the total annual water supply in the region and represents 35 percent of all groundwater use in the State (DWR 2009).

The primary study area, including the area of project features, the Temperance Flat Reservoir Area, and Millerton Lake, are all outside of mapped alluvial groundwater basins as defined by DWR. Groundwater in those areas occurs primarily in fractured bedrock, and in-depth understanding of the resource (e.g., from detailed field studies) does not exist (Millerton Area Watershed Coalition 2003). It is expected that any groundwater wells that do exist in the primary study area are used for domestic purposes.

The focus of this chapter is the San Joaquin Valley Groundwater Basin, whose subbasins encompass most of the extended study area, including the San Joaquin River downstream from Friant Dam, the San Joaquin River from the Merced River confluence to the Delta, the Delta, and much of the CVP/SWP water service areas. The San Joaquin Valley Groundwater Basin is the primary groundwater basin in the San Joaquin River and Tulare Lake hydrologic regions and makes up the southern two-thirds of the 400-mile-long, northwest trending asymmetric trough of the Central Valley regional aquifer system in the southern extent of the Great Valley Geomorphic Province (Page 1986). The San Joaquin Valley Groundwater Basin is bounded to the west by the Coast Ranges, to the south by the San Emigidio and Tehachapi mountains, to the east by the Sierra Nevada, and to the north by the Delta and Sacramento Valley (DWR 2003).

Nine subbasins of the San Joaquin Valley Groundwater basin are located in the San Joaquin River Hydrologic Region (including Eastern San Joaquin, Modesto, Turlock, Merced, Chowchilla, Madera, Delta-Mendota, Tracy, and Cosumnes) and seven subbasins (including Kings, Westside, Pleasant Valley, Kaweah, Tulare Lake, Tule, and Kern County) are in the Tulare Lake Hydrologic Region (DWR 2003). Detailed site-specific information on all groundwater subbasins in the extended study area is limited and is not uniformly available or always current; but where available, such information is included in this chapter.

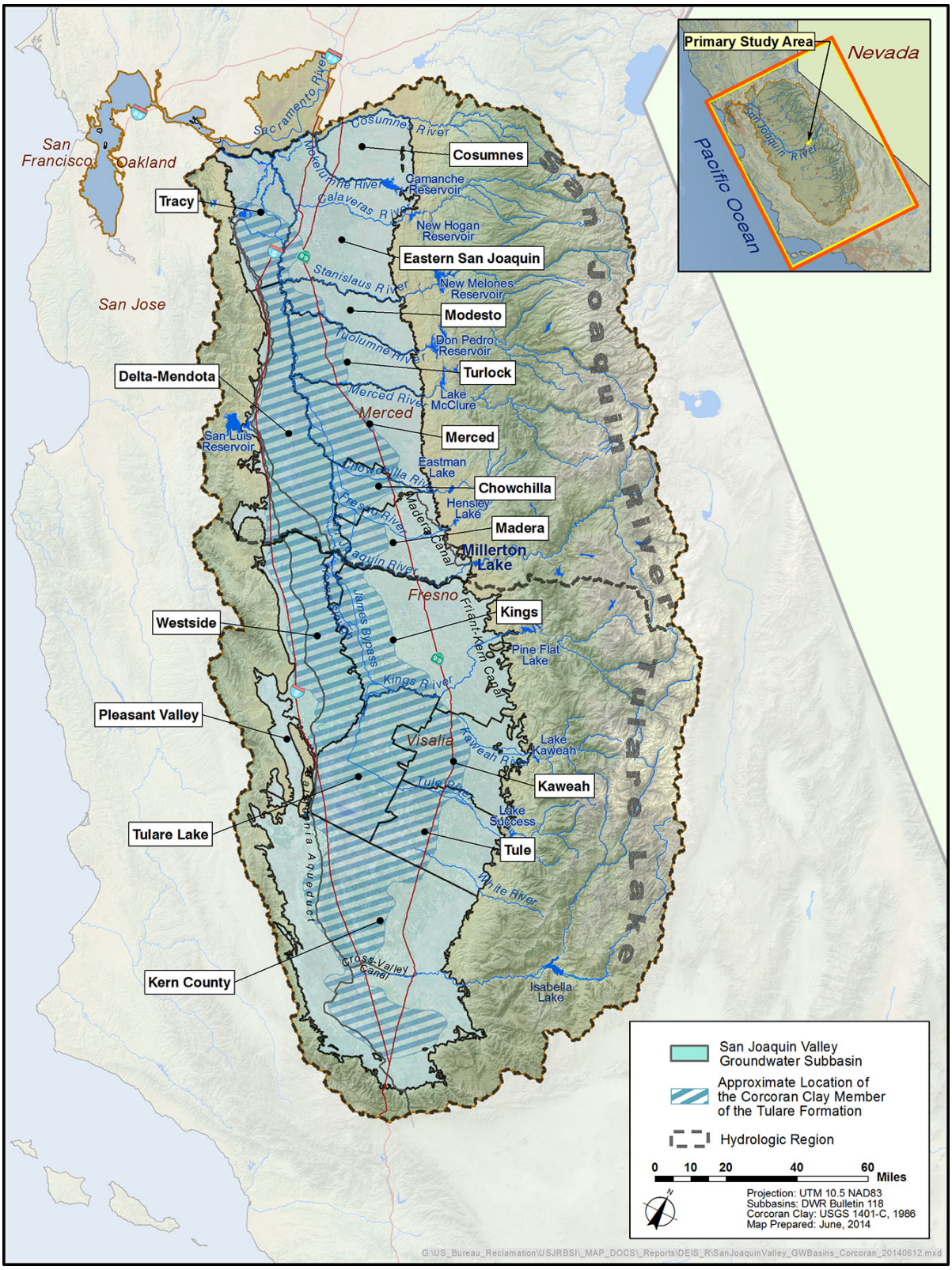


Figure 13-1. Subbasins of the San Joaquin Valley Groundwater Basin

Groundwater Resources of the San Joaquin River Hydrologic Region

This section describes regional and subbasin hydrogeology, groundwater storage and production, groundwater levels, land subsidence, groundwater quality, agriculture subsurface drainage, and seepage and water-logging in the portion of the San Joaquin Valley Groundwater Basin within the San Joaquin River Hydrologic Region.

Hydrogeology

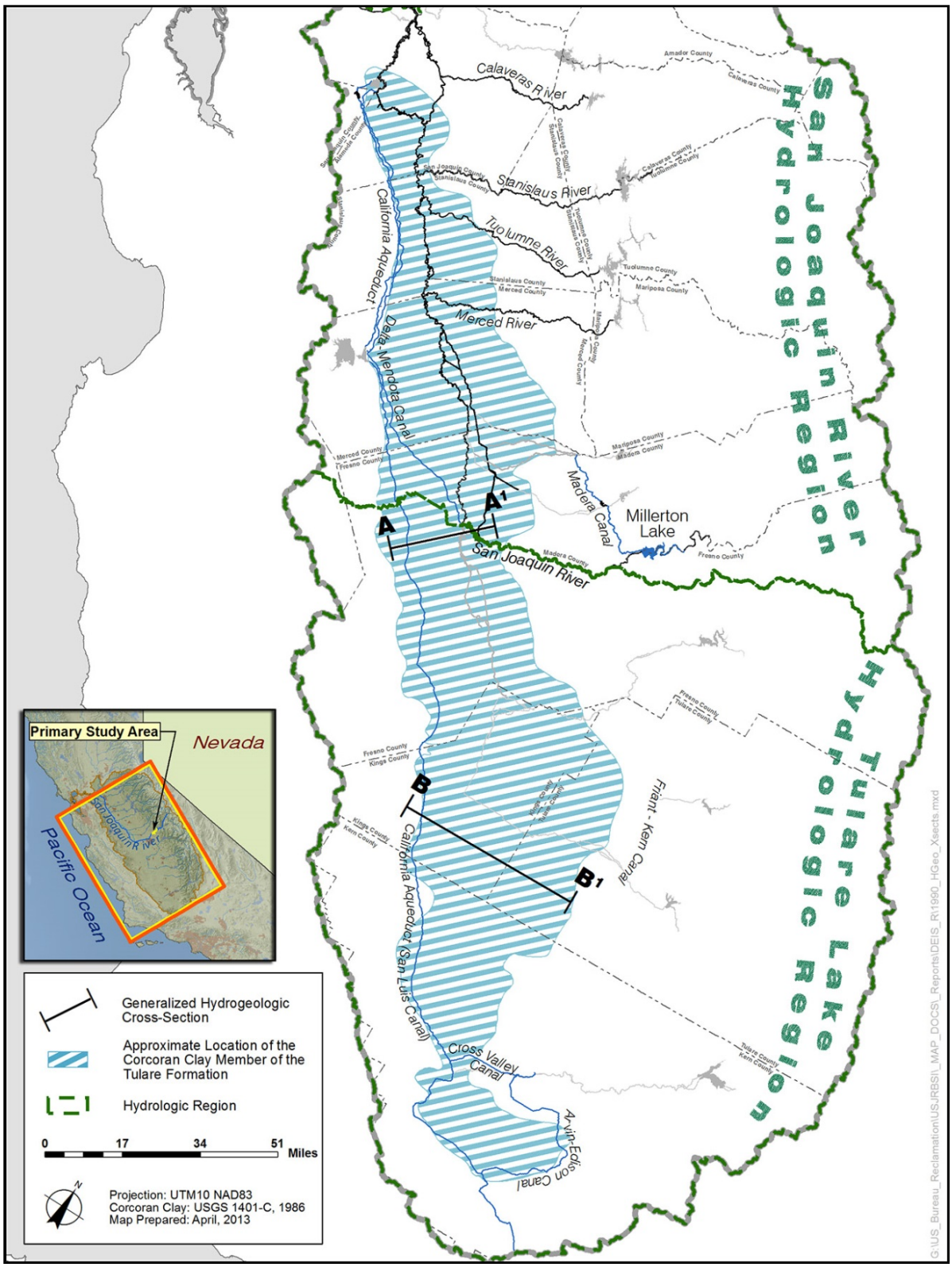
The following sections describe regional hydrogeology and subbasin hydrogeology in the San Joaquin River Hydrologic Region.

Regional Hydrogeology As reported in the Draft CVPIA Programmatic EIS (Reclamation 1997), groundwater in the San Joaquin River Hydrologic Region historically flowed from the valley flanks to the axis of the valley during predevelopment conditions, then north toward the Delta. In the 1920s, development of deep-well turbine pumps and increased availability of electricity led to expansion of agriculture which ultimately led to declining groundwater levels between 1920 and 1950 (DWR 2003).

Groundwater pumping and recharge from imported irrigation water have resulted in a change in regional flow patterns. Flow largely occurs from areas of recharge toward areas of lower groundwater levels because of groundwater pumping (Bertoldi et al. 1991). Vertical movement of water in the aquifer has been altered in this region as a result of thousands of wells constructed with perforations above and below the confining unit (Corcoran Clay) where present, providing a direct hydraulic connection (Bertoldi et al. 1991).

The San Joaquin Valley is located in an asymmetric structural trough in the Central Valley, and it has accumulated up to 6 vertical miles of sediment, including marine and continental rocks and deposits (Page 1986). The eastern side of the valley is underlain by granitic and metamorphic rocks that slope gently from the outcrops of the Sierra Nevada. The western side and part of the eastern side of the valley are underlain by a mafic and ultramafic (high in mafic minerals including those containing high concentrations of magnesium and iron) complex that is also part of the Sierra Nevada. The continental and marine rocks deposited in the San Joaquin Valley range in thickness from tens of feet to more than 2,000 feet (Page 1986).

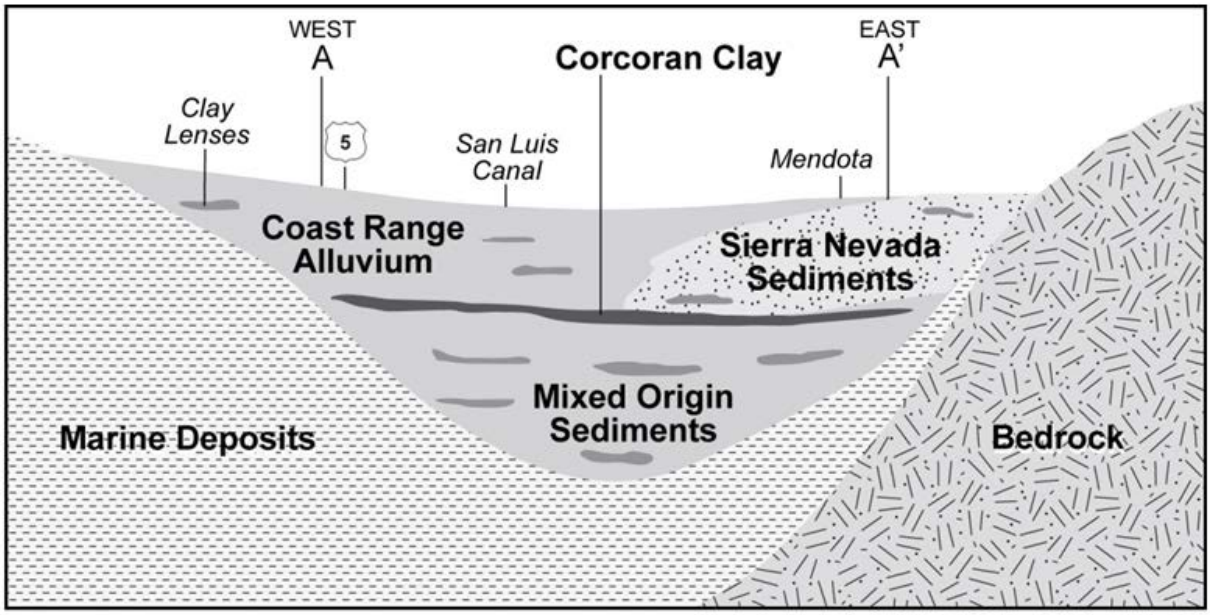
The aquifer system of the San Joaquin Valley Groundwater Basin is divided into two major aquifers: an unconfined-to-semiconfined aquifer above the Corcoran Clay (E-clay) and a confined aquifer beneath the Corcoran (Mitten et al. 1970, Williamson et al. 1989). The unconfined-to-semiconfined aquifer can generally be divided into three hydrogeologic units based on the source of the sediment: Coast Ranges alluvium, Sierra Nevada sediments, and flood-basin deposits (see Figure 13-2 and Figure 13-3). The Tulare Lake Hydrologic Region also contains Tulare Lake sediments, which demonstrate the presence of several dry lakebeds in the region.



Source: Modified from Page 1986 and Reclamation et al. 1990a

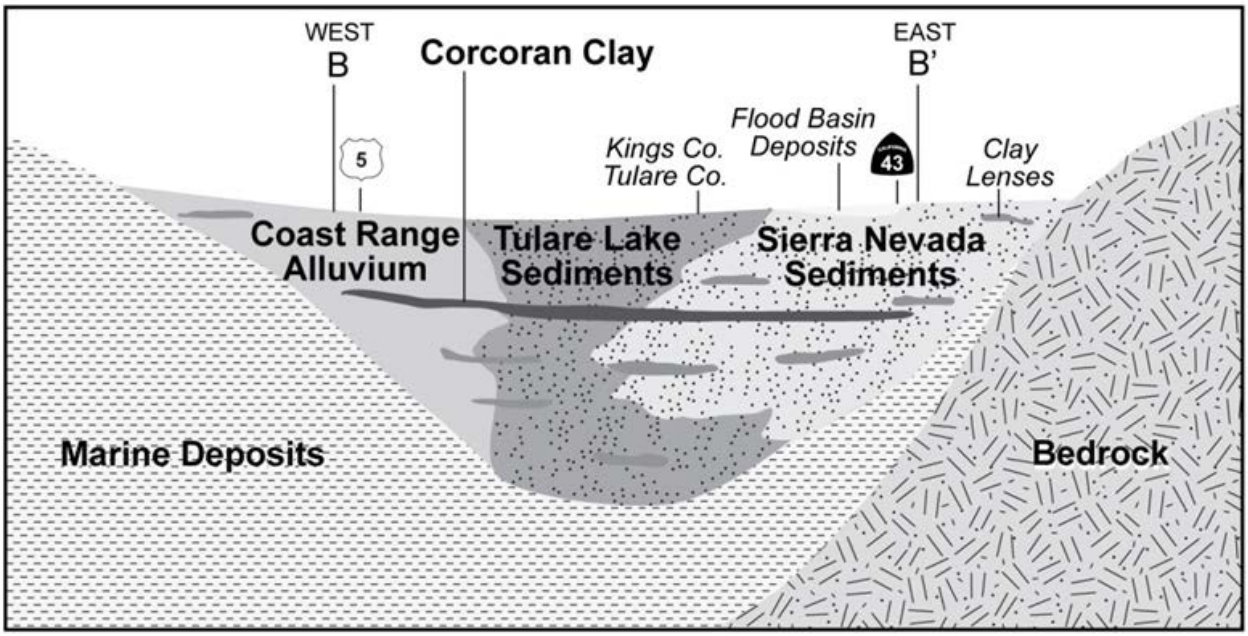
Figure 13-2. Approximate Boundary of Corcoran Clay and Transect Lines for Hydrogeologic Cross Sections

San Joaquin River Hydrologic Region



NOT TO SCALE

Tulare Lake Hydrologic Region



NOT TO SCALE
Source: Reclamation et al. 1990a

Figure 13-3. Generalized Hydrogeologic Cross Sections in San Joaquin River and Tulare Lake Hydrologic Regions

The alluvial deposits from the Coast Ranges are derived largely from the erosion of marine rocks from the Coast Ranges. These

deposits are up to 850 feet thick along the western edge of the valley and taper off to the east as they approach the center of the valley floor (Belitz and Heimes 1990). The alluvial deposits contain a large proportion of silt and clay, are high in salts, and also contain elevated concentrations of selenium and other trace elements.

The Sierra Nevada sediments on the eastern side of the region are derived primarily from granitic rock and consist of predominantly well-sorted micaceous sand (Miller et al. 1971). These deposits make up most of the total thickness of sediments along the valley axis and gradually thin to the west until pinching out near the western boundary. The Sierra Nevada sediments are relatively permeable with hydraulic conductivities three times the conductivities of deposits from the Coast Ranges (Belitz and Heimes 1990).

The flood-basin deposits are relatively thin and were derived in recent time from sediments of the Coast Ranges to the west and from sediments of the Sierra Nevada to the east. These deposits occur along the center of the valley floor and consist primarily of moderately to densely compacted clays ranging between 5 and 35 feet thick (Belitz and Heimes 1990).

On a regional scale, the Corcoran Clay (E-clay) member of the Tulare Formation divides the groundwater system. The Corcoran Clay ranges from 0 to 160 feet thick, and is found between 80 feet deep near Chowchilla, to 400 feet below the land surface to the southwest (Mitten et al. 1970). The confined aquifer is overlain by the Corcoran Clay and consists of mixed origin sediments.

The unconfined to semiconfined aquifer system of the San Joaquin Valley has historically been recharged by mountain rain and snowmelt along the valley margins (McBain and Trush 2002). Recharge has generally occurred by stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. As agricultural practices expanded in the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems used to convey this water. Recharge of the lower confined aquifer consists of subsurface inflow from the valley floor and foothill areas to the east of the eastern boundary of the Corcoran Clay. Present information indicates that the clay layers, including the Corcoran Clay, are not continuous in some areas, and some seepage from the semiconfined aquifer above does occur through the confining layer. It has been

reported that the hydraulic head in the semiconfined aquifer was less than that in the confined aquifer, and the pressure differential has led to an upward gradient (artesian condition), allowing groundwater to discharge at the surface to the river and valley (McBain and Trush 2002).

Subbasin Hydrogeology The primary water-bearing units of the San Joaquin Valley Groundwater Basin subbasins in the San Joaquin River Hydrologic Region (see Figure 13-1) are described by DWR in California's Groundwater – Bulletin 118 (DWR 2003). The water-bearing formations of the Tracy and Delta-Mendota subbasins in the northwestern portion of the San Joaquin Valley Groundwater Basin consist of continental deposits of Late Tertiary to Quaternary age, and include the Tulare Formation, older alluvium, flood-basin deposits, and younger alluvium (DWR 2003). Water-bearing formations of the Delta-Mendota Subbasin also include terrace deposits. Deposits in the subbasins range in thickness from a few hundred feet at the foothills of the Coast Ranges to approximately 3,000 feet along the eastern edge of the subbasins.

Table 13-1. Net Changes in Annual Groundwater Storage for Water Years 1998 Through 2005

Water Year	Net Change in Annual Storage (TAF)
1998	-444
1999	-1,858
2000	-96
2001	-1,260
2002	-1,839
2003	-992
2004	-2,976
2005	-1,251

Source: DWR 2009

Key:
TAF = thousand acre-feet

To the east, the Cosumnes Subbasin also consists of continental deposits of similar age and Miocene/Pliocene Volcanics of the Mehrten Formation. The older alluvium of the Cosumnes Subbasin consists of sediments of the Modesto, Riverbank, Victor, and Laguna formations. South of the Cosumnes Subbasin, the Eastern San Joaquin Subbasin consists of alluvium and the Modesto/Riverbank formations, flood-basin deposits, the Laguna Formation, and the Mehrten Formation

(DWR 2003). Water-bearing deposits of the Modesto, Turlock, and Merced subbasins consist of consolidated and unconsolidated sedimentary deposits of the Ione, Valley Springs, and Mehrten formations. The Chowchilla and Madera subbasins consist of unconsolidated water-bearing deposits of Pleistocene and Holocene age. The unconsolidated deposits consist of continental deposits of Tertiary and Quaternary age.

Groundwater Storage and Production

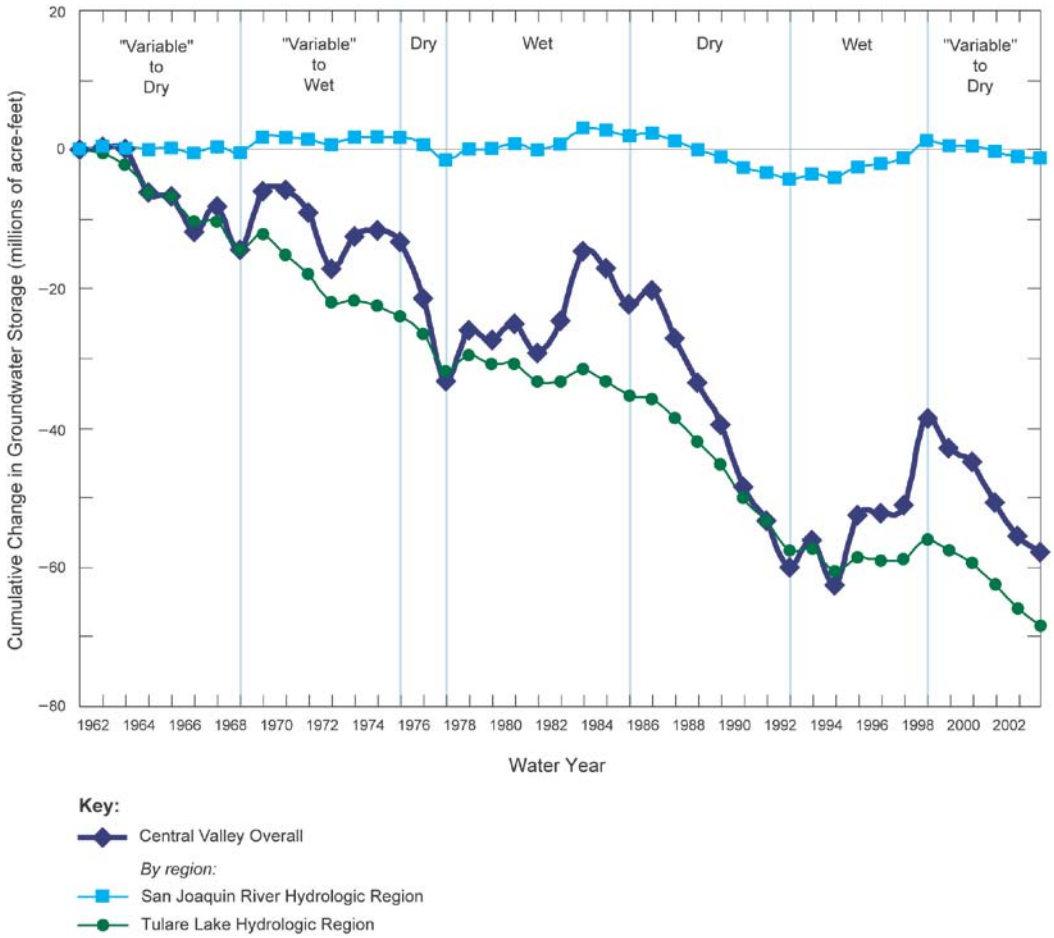
The following sections describe historical and existing groundwater storage and production conditions in the San Joaquin River Hydrologic Region.

Groundwater Storage Using the Central Valley Hydrologic Model (CVHM), the USGS simulated historical cumulative change in groundwater storage in the Central Valley, including the San Joaquin River and Tulare Lake hydrologic regions (see Figure 13-4) (Faunt 2009). Groundwater storage in the San Joaquin Valley reached a low point in 1978 in response to the 1976-through-1977 drought. However, by the early 1980s, groundwater storage had returned to pre-drought conditions. Groundwater storage declined again as a result of the drought from 1987 through 1992, which resulted in continued declines in groundwater storage in 1991 and 1992 to levels lower than recorded during the previous low in 1978. Results from the USGS CVHM study of simulated annual recharge and discharge between 1962 and 2003 indicate an estimated net loss of 57.7 MAF from aquifer storage in the Central Valley (Faunt 2009). Table 13-1 presents the net changes in groundwater storage for Water Years 1998 through 2005 (DWR 2009).

Analysis of data from the Gravity Recovery and Climate Experiment satellite mission from October 2003 to March 2010 indicates a 20.3 cubic kilometer (approximately 16.5 MAF) loss of groundwater storage in the Central Valley (Sacramento and San Joaquin river basins, including the Tulare Basin) (Famiglietti et al. 2011).

For the San Joaquin River Hydrologic Region, DWR Bulletin 160-93 estimated the available groundwater storage capacity to be 24 MAF. DWR's definition of usable storage capacity is based on aquifer properties (i.e., permeability), groundwater quality, and economic considerations such as the cost of well drilling and energy costs (DWR 1994). DWR Bulletin 160-93 defined perennial yield as "…the amount of groundwater that can be extracted without lowering groundwater levels over the

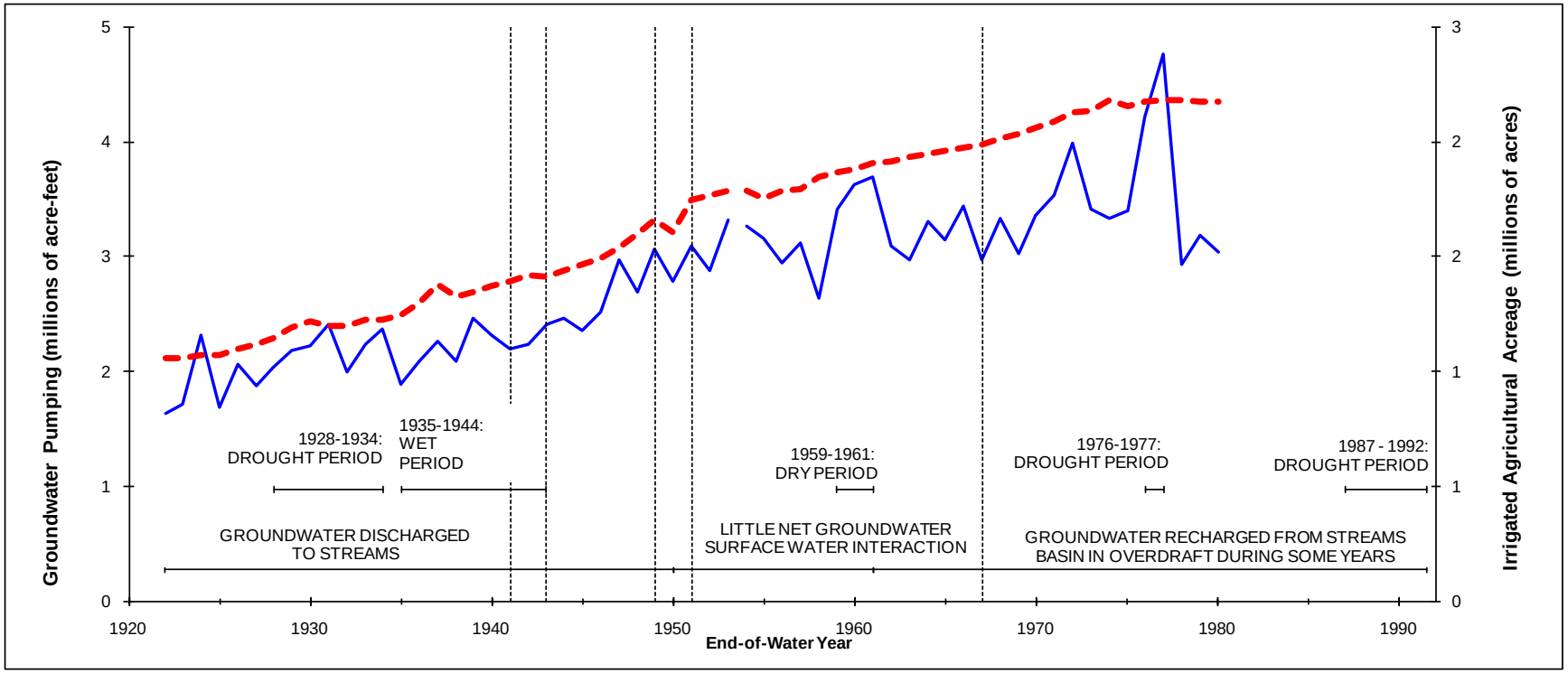
long-term" and determined perennial yield to be 3.3 MAF (DWR 1994). This estimated perennial yield is directly dependent on the amount of recharge received by the groundwater basin, which can change over time.



Source: Faunt 2009

Figure 13-4. Simulated Cumulative Change in Groundwater Storage by Water Year for the Central Valley and San Joaquin River and Tulare Lake Hydrologic Regions from 1962 Through 2003

Groundwater Production Figure 13-5 illustrates the close correlation between increasing agricultural acreage and increasing groundwater production in the San Joaquin River Hydrologic Region from 1922 through 1980 using data developed as part of the Central Valley Ground-Surface Water Model (GSM) (Reclamation et al. 1990b). Table 13-2 highlights the timeline of events that have affected groundwater production in the San Joaquin River Hydrologic Region for the period shown in Figure 13-5.The data presented in Figure 13-5 extend through 1980; however, a recent study by USGS (Faunt 2009) reports simulated groundwater pumping for the whole Central Valley using CVHM from 1962 through 2003, as illustrated in Figure 13-6.



Source: Reclamation 1997

Note:

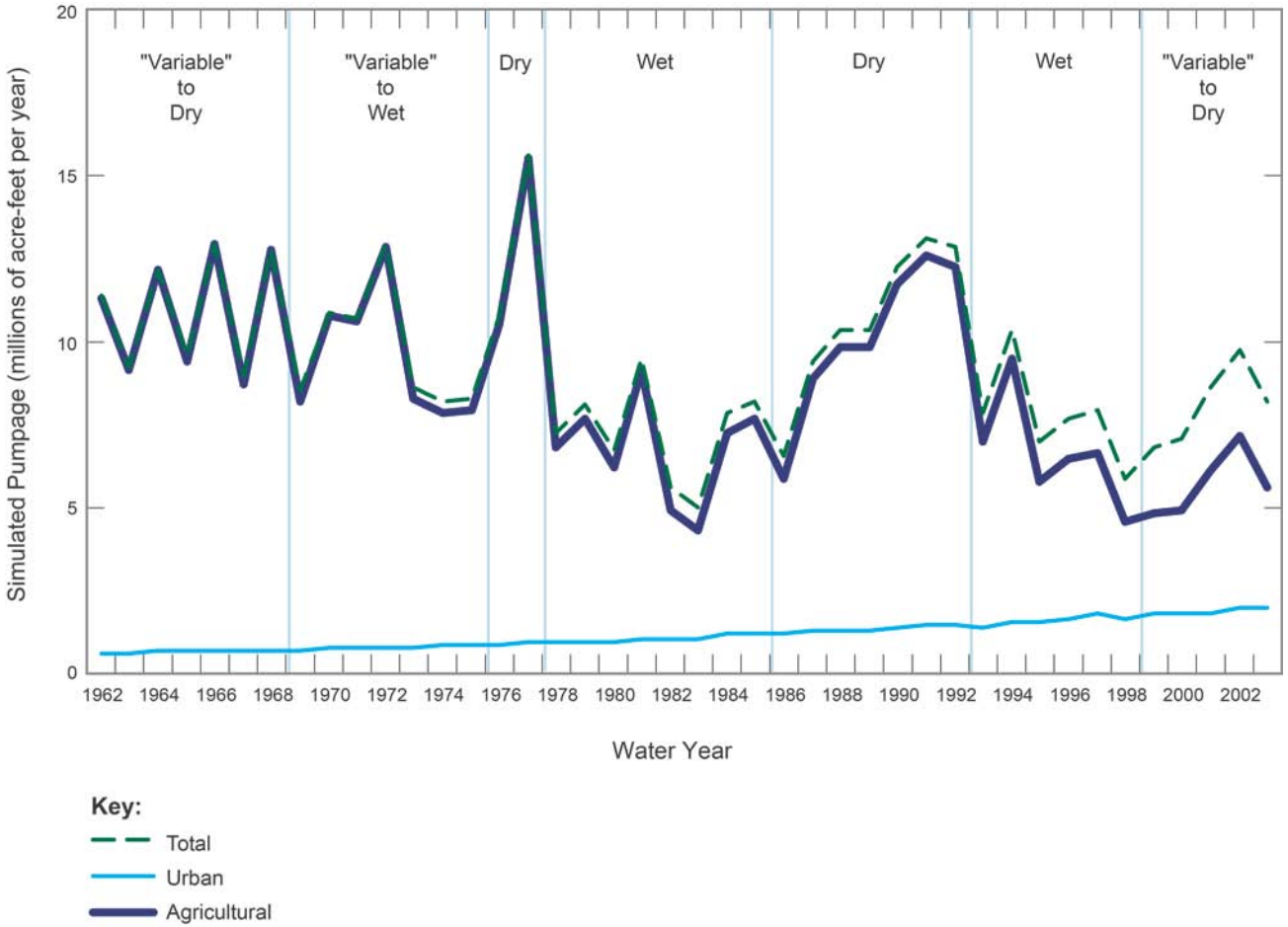
Data available for 1922 through 1980. Data developed as part of the Central Valley Ground-Surface Water Model (Reclamation et al. 1990b).

Legend:

Irrigated Agricultural Acreage

Groundwater Pumping

Figure 13-5. Historical Annual Groundwater Pumping and Irrigated Agricultural Acreage for San Joaquin River Hydrologic Region from 1922–1980



Source: Faunt 2009

Figure 13-6. Simulated Groundwater Pumping in Central Valley from 1962–2003

Table 13-2. Timeline of Historical Events Affecting Groundwater Production in the San Joaquin River Hydrologic Region

Date	Historical Event
1928–1934	Drought Period
1935–1944	Wet Period
1941	Friant Dam Online
1943	Madera Canal Online
1949	Friant-Kern Canal Online
1951	Delta-Mendota Canal Online
1967	San Luis Dam/Canal Online
1967	California Aqueduct Online
1967	Oroville Dam Online
1976–1977	Drought Period
1987–1992	Drought Period

The groundwater pumping data presented in Figure 13-5 are based on estimated pumping, water demands, and historical surface water supplies. The agricultural acreage data used in the analysis were based on DWR estimates developed as part of depletion studies. Annual groundwater pumping in the San Joaquin Hydrologic Region from 1922 through 1980 ranged between 1.6 MAF in 1922 and 4.7 MAF in 1977. Groundwater pumping in the San Joaquin Hydrologic Region and the whole Central Valley rose steadily through the 1970s, but varied greatly depending on hydrologic conditions, and reached a peak during the 1976-through-1977 drought period. Hydrologic conditions for the years immediately following the drought (1978, 1979, and 1980) were relatively wet, which allowed for a reduction in pumping following the drought period because more surface water was available.

As illustrated in Figure 13-6, reduced surface water deliveries and critically dry hydrologic conditions during the 1987-through-1992 drought period also resulted in increased pumping in the 1990s. In 1990, an estimated 3.5 MAF of groundwater were pumped from the San Joaquin River Hydrologic Region. The groundwater pumped from the region in 1990 exceeded the estimated perennial yield by approximately 200 TAF (DWR 1994). Groundwater extractions in the San Joaquin Valley during the first 5 years of the 1987-through-1992 drought exceeded recharge by 11 MAF, causing land subsidence in some areas (DWR 2005b). All of the subbasins in the San Joaquin River Hydrologic Region experienced some overdraft (DWR 1994). Groundwater

overdraft describes the condition of a basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions (DWR 2005b). At a 1995 level of development, annual average groundwater overdraft was estimated at about 240 TAF in the San Joaquin River Hydrologic Region (DWR 1998).

Although a comprehensive assessment of overdraft in California's subbasins has not been completed since 1980, the *California Water Plan Update 2009* reports that three of the subbasins in the San Joaquin River Hydrologic Region (Chowchilla, Eastern San Joaquin, and Madera) are in critical overdraft conditions (DWR 2009).

Following the 1987-through-1992 drought, USGS simulated a reduction in groundwater pumping in the Central Valley during a Wet hydrologic period from 1993 through 1998 (Faunt 2009). Groundwater pumping in the Central Valley began to increase in 1998 at the start of a variable to Dry hydrologic period, as illustrated in Figure 13-6.

Typical production in the subbasins in the San Joaquin River Hydrologic Region is shown in Table 13-3 (DWR 1998, 2003). Burt developed estimates of gross irrigation well pumping for some of the Friant Division contractors for 1987 through 2003 (Burt 2005). Gross irrigation well pumping is not equivalent to net groundwater extraction volumes because inefficiencies associated with pumping a groundwater well are not accounted for with this estimation method. In the San Joaquin River Hydrologic Region, Burt estimated gross groundwater pumping for the Chowchilla Water District (WD), Gravelly Ford WD, and Madera ID (2005). Information was not available for other Friant Division contractors in the San Joaquin River Hydrologic Region, including Fresno County Water Works No. 18 and Hidden Lakes Estates. Table 13-4 summarizes average annual gross groundwater pumping by some Friant Division contractors, as described above.

Table 13-3. Typical Annual Groundwater Production in San Joaquin River Hydrologic Region

Subbasin	Extraction (TAF/year)
Chowchilla	260
Delta-Mendota	510
Madera	570
Merced	560
Modesto	230
Turlock	450

Source: DWR 1998 and 2003
Key:
TAF = thousand acre-feet

Table 13-4. Average Annual Gross Groundwater Pumping for Friant Division Contractors in San Joaquin River Hydrologic Region

District	Average Gross Groundwater Pumping (TAF/year) 1987–1992	Average Gross Groundwater Pumping (TAF/year) 1987–1999	Average Gross Groundwater Pumping (TAF/year) 1987–2003
Chowchilla WD	137	104	107
Gravelly Ford WD	25	20	20
Madera ID	215	157	165

Source: Burt 2005
Key:
ID = Irrigation District
TAF = thousand acre-feet
WD = Water District

Estimates of gross groundwater pumping for Friant Division long-term contractors in Table 13-4 potentially overestimate actual groundwater pumping, but no historical pumping records were publicly available to validate the estimates. Because these estimates are based on cropping patterns, changes to the crops in production could result in changes to gross groundwater pumping estimated in more recent years.

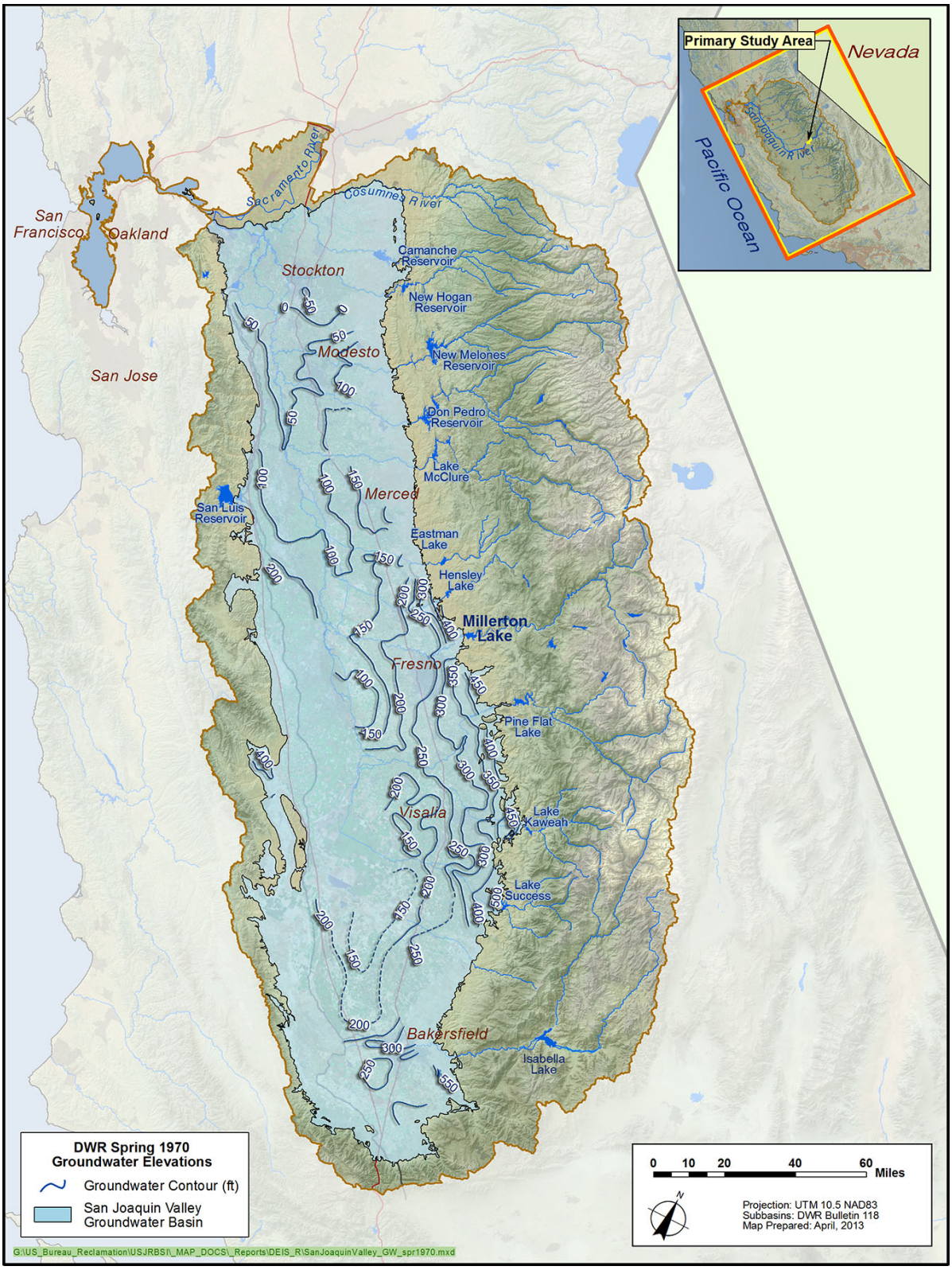
Groundwater Levels

Between 1920 and 1950, expansion of agricultural practices caused declines in groundwater levels in many areas of the San Joaquin River Hydrologic Region. Along the east side of the region, declines have ranged between 40 and 80 feet since predevelopment conditions (estimated conditions for 1860) (Williamson et al. 1989). Groundwater levels declined substantially in Chowchilla, Madera, western Kings, Pleasant

Valley, Tule, and Kern counties, which depended heavily on groundwater for irrigation (Williamson et al. 1989). However, in 1950, the Friant-Kern Canal began delivering surface water to part of the eastern side of the San Joaquin Valley and, as a result, water-level declines reversed because of the decrease in groundwater pumping (Williamson et al. 1989).

Beginning in the 1940s, water levels declined along the west side of the San Joaquin River Hydrologic Region, dropping more than 30 feet by 1960. Groundwater levels in deeper wells drilled into the confined aquifer of northwestern Fresno County were recorded as ranging from 200 feet below msl to sea level in spring 1960 (reported by Reclamation 1997). Groundwater levels in this area were recorded as ranging between 200 feet and 100 feet below msl by spring 1970. In central San Joaquin County, groundwater levels reached 50 feet below msl in spring 1970, which led to saline groundwater intrusion problems for the City of Stockton (Reclamation 1997). Pre-drought groundwater levels in spring 1970 in the San Joaquin River and Tulare Lake hydrologic regions are presented in Figure 13-7.

Beginning in 1967, surface water from the California Aqueduct became the primary source of irrigation supply to the area south of Mendota, replacing groundwater as the primary source (Belitz and Heimes 1990). Groundwater levels in the unconfined-to-semiconfined aquifer were impacted by drought conditions that occurred in 1976 and 1977, and were lower between spring 1970 (Figure 13-7) and spring 1980, but had recovered to near pre-drought levels by the end of 1980 (Reclamation 1997). The decrease in groundwater pumping allowed time for the confined aquifer to recover from extensive pumping. Between 1967 and 1984, the hydraulic head in the confined aquifer rose between 200 and 300 feet along the western boundary of the Study Area in Fresno County (Belitz and Heimes 1990). The confined aquifer groundwater levels in northwestern Fresno County and western Merced County increased up to 100 feet by spring 1980.



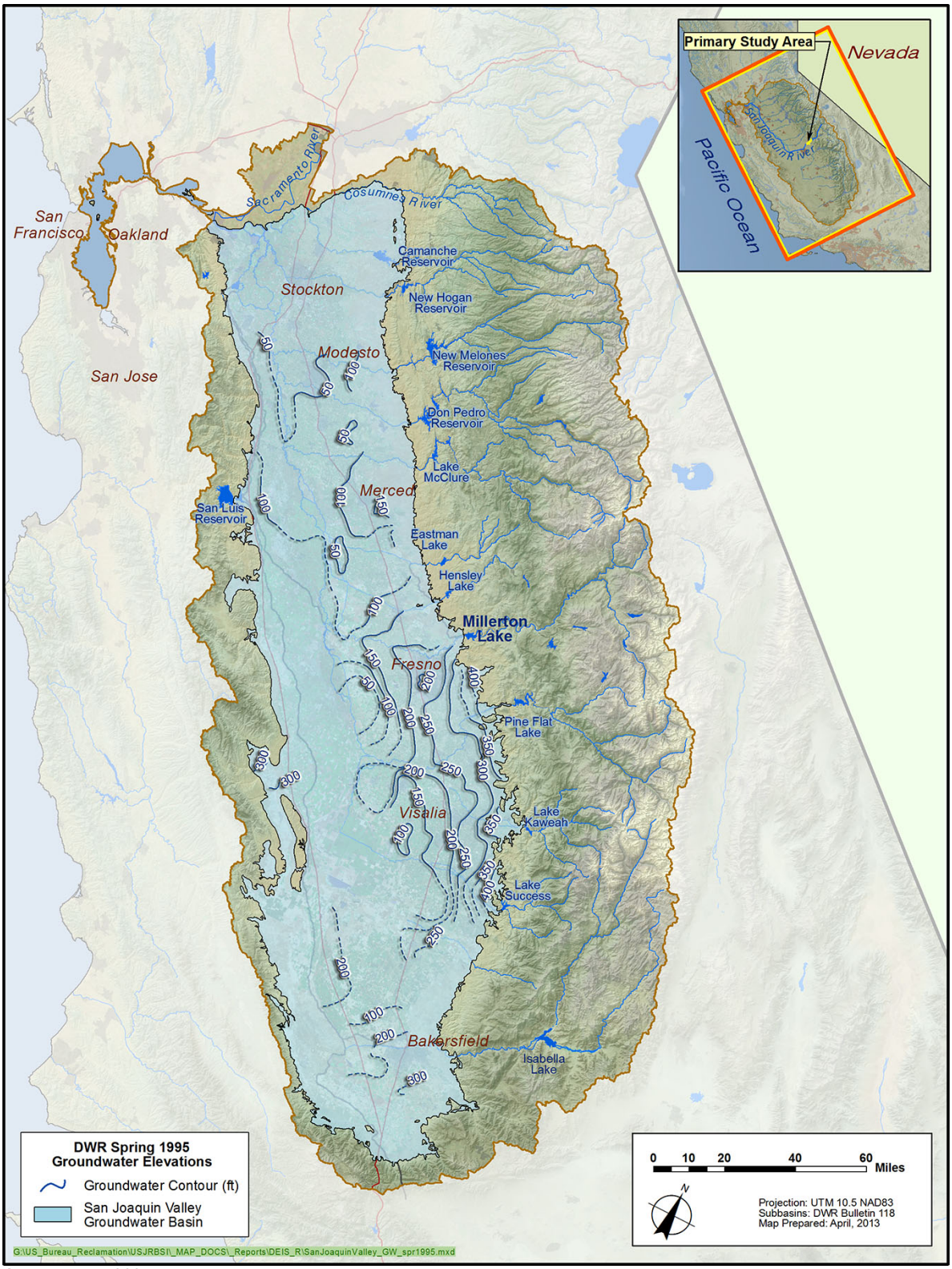
Source: DWR 2007b

Figure 13-7. Groundwater Elevations in Spring 1970, San Joaquin Valley Groundwater Basin

During the drought of the late 1980s and early 1990s (1987 through 1992), surface water deliveries to WDs in the San Joaquin Valley were substantially lower than water demands , resulting in increased groundwater pumping of the unconfined-to-semiconfined and confined units of the aquifer system in the San Joaquin Valley Groundwater Basin (Groundwater Management Technical Committee 1999, Reclamation 1997). A regional response to the drought was evident in the basin, with water levels in the central and eastern portions declining by 20 to 30 feet (Westlands WD 1995). Following the drought, groundwater depression areas were present on the east side of the San Joaquin River Hydrologic Region in Merced and Madera counties, where groundwater was less than 50 feet above msl. Groundwater levels declined on the eastern side of the San Joaquin River Hydrologic Region until 1995 (DWR 2003).

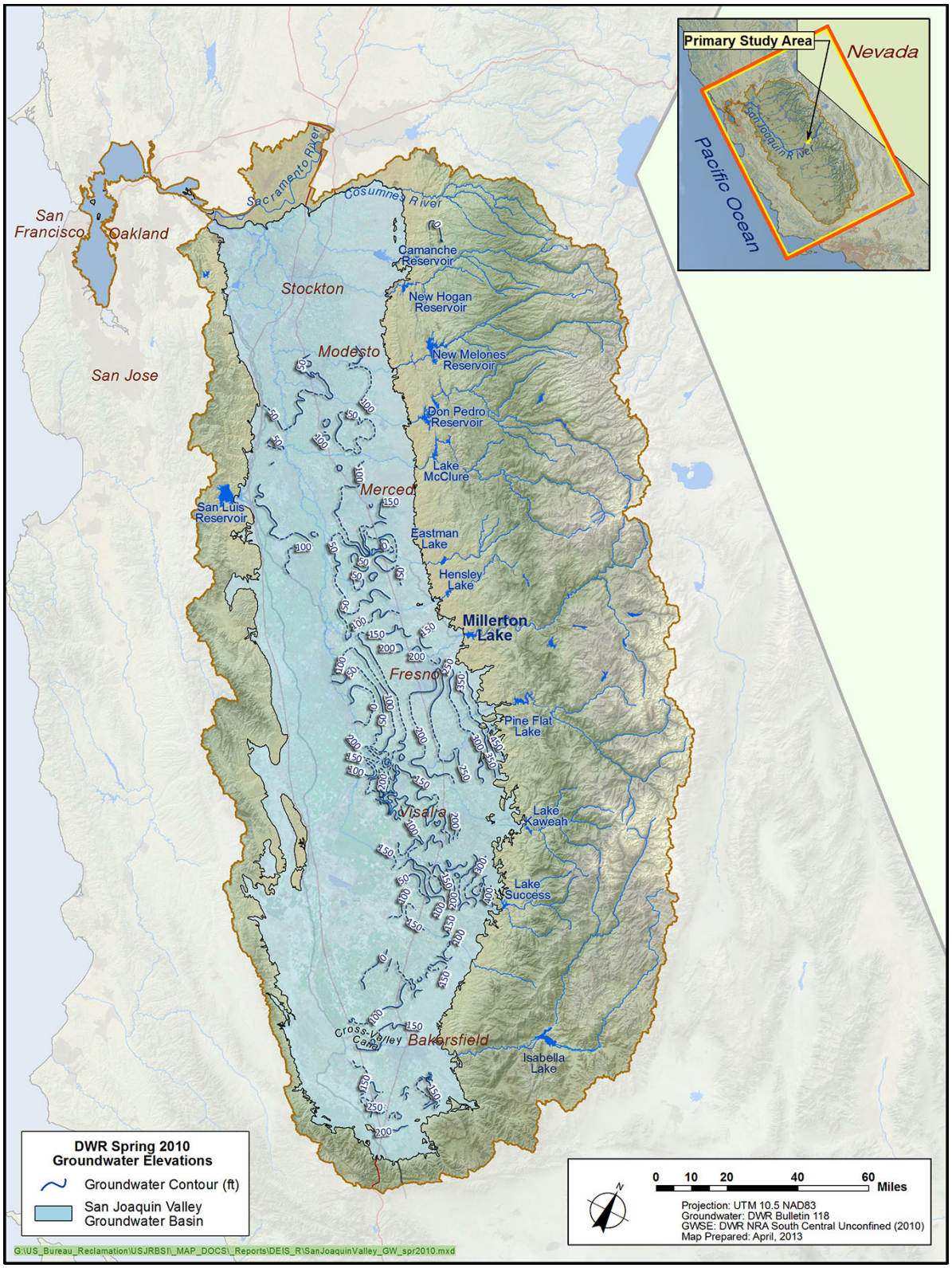
Post-drought conditions in the basin in 1995 are presented in Figure 13-8. The groundwater contours illustrated in Figure 13-8 depict groundwater elevations in the unconfined-to-semiconfined aquifers of the San Joaquin Valley Groundwater Basin.

Figure 13-9 presents the most recent (spring 2010) publically available groundwater-level conditions in the San Joaquin River and Tulare Lake hydrologic regions, as reported by DWR (DWR 2012). These groundwater contours illustrate groundwater elevations in the unconfined to semiconfined aquifers of the San Joaquin Valley. The groundwater elevations indicate that the San Joaquin Valley Groundwater Basin had substantially recovered from the previous drought (1987 through 1992). Table 13-5 summarizes the ranges in groundwater elevations in the unconfined aquifer reported on the groundwater basin contour maps available on the DWR Web site.



Source: DWR 2007c

Figure 13-8. Groundwater Elevations in Spring 1995, San Joaquin Valley Groundwater Basin



Source: DWR 2012

Figure 13-9. Groundwater Elevations in Spring 2010, San Joaquin Valley Groundwater Basin

Table 13-5. Spring 2010 Unconfined Aquifer Contour Map Groundwater Elevations in Subbasins of San Joaquin River Hydrologic Region

Subbasin	Range in Groundwater Elevations (feet above msl)	
Chowchilla	10	130
Delta-Mendota	30	130
Madera	10	200
Merced[1]	0	170
Modesto[2]	30	120
Turlock	20	110

Source: DWR 2012

Notes:

[1] Elevations generally increased from west to east towards the Sierra Nevada, with localized cones of depression.

[2] Elevations increased from west to east towards the Sierra Nevada.

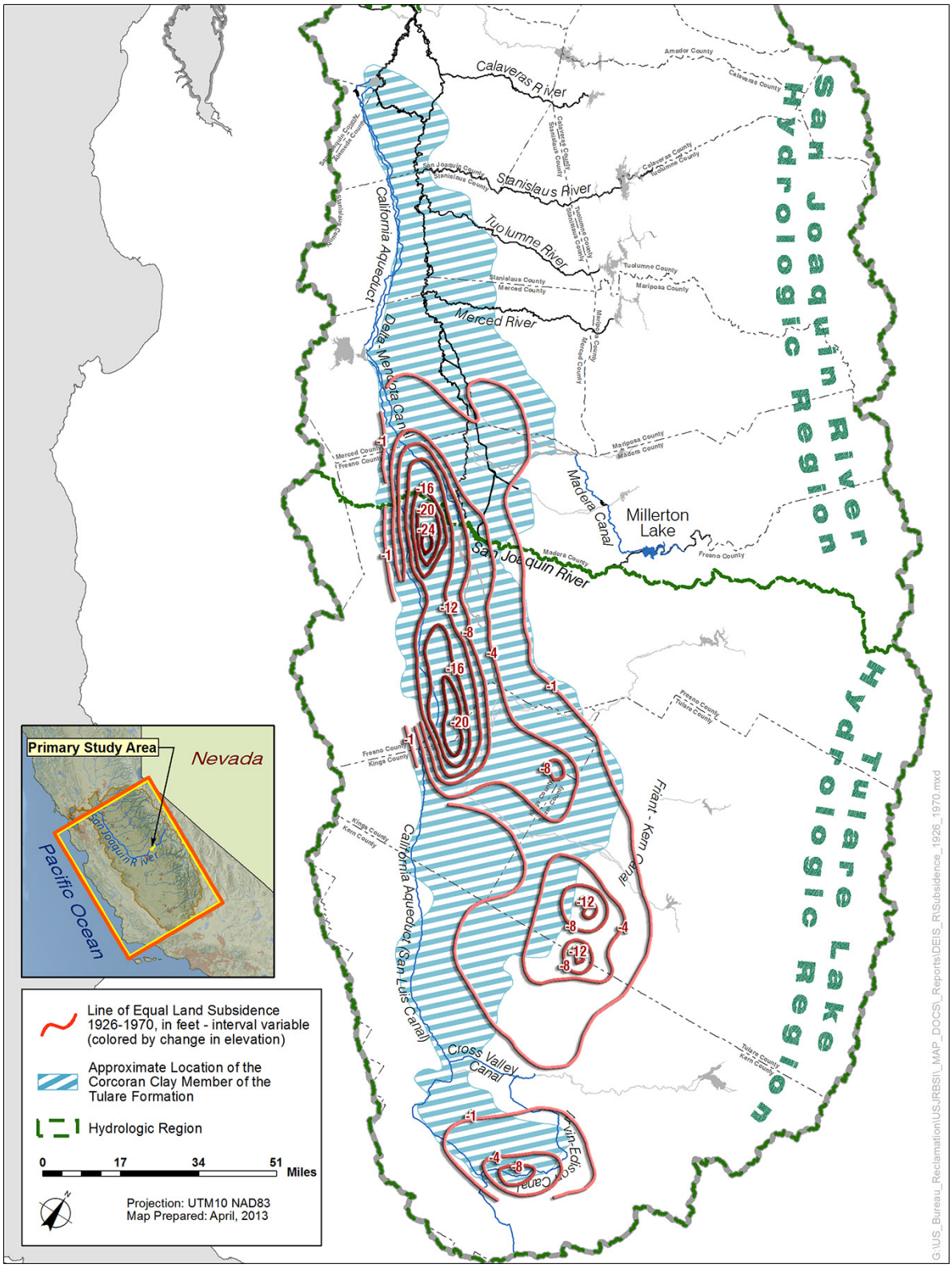
Key:

msl = mean sea level

Land Subsidence

Four types of land subsidence occur in the San Joaquin Valley: aquifer-system compaction due to groundwater-level decline, near-surface hydrocompaction, subsidence due to fluid withdrawal from oil and gas fields, and subsidence caused by deep-seated tectonic movements (Ireland et al. 1984). The first two types are the primary causes of subsidence in the region; therefore, the latter two types of subsidence are not discussed below (subsidence due to tectonic movement is discussed in Chapter 11, “Geology and Soils”). Land subsidence contours in the San Joaquin River and Tulare Lake hydrologic regions from 1926 through 1970 are shown in Figure 13-10.

Aquifer-System Compaction Groundwater-level decline resulting in compaction of aquifer sediments has been one of the primary causes of land subsidence in the San Joaquin Valley Groundwater Basin. In the mid-1920s, land subsidence began to occur as a result of increased groundwater pumping for irrigation of crops (Ireland 1986). By the mid-1970s, the maximum land subsidence in the San Joaquin Valley Groundwater Basin exceeded 28 feet (Poland et al. 1975). The decline in groundwater levels in the Central Valley caused at least 1 foot of land subsidence across more than 5,200 square miles, affecting nearly half of the irrigated land in the San Joaquin River and Tulare Lake hydrologic regions by 1977 (Ireland 1986). The most seriously affected areas were located in the southern and western parts of the Central Valley.



Source: Williamson et al. 1989

Figure 13-10. Land Subsidence in the San Joaquin River and Tulare Lake Hydrologic Regions from 1926 to 1970

In the late 1960s and early 1970s, surface water was imported via canals, and the California Aqueduct began importing supplies to the subsiding areas, reducing groundwater pumping and reducing new land subsidence in the western and southern portions of the San Joaquin Valley Groundwater Basin (Ireland 1986). However, drought conditions during 1976 and 1977 resulted in high groundwater pumping rates, inducing land subsidence in areas where it had been observed previously. Significant land subsidence was detected again in the San Joaquin Valley Groundwater Basin due to increased groundwater pumping during the 1987-through-1992 drought. Land subsidence was also reported between 1984 and 1996 along the DMC. Subsidence in this area affected operations of the Mendota Dam and Sack Dam and, consequently, the conveyance of flows in the San Joaquin River (Sneed et al. 2013). Land subsidence measured by DWR between 1990 and 1995 of up to 2 feet was reported along the California Aqueduct in Westlands WD (Reclamation 1997). Land subsidence in the San Joaquin River and Tulare Lake hydrologic regions occurred primarily in western Fresno County, but extended from Merced County to Kings County. Maximum land subsidence levels in the Central Valley were recorded in this area of the San Joaquin Valley Groundwater Basin. In parts of northwestern Fresno County, land subsidence levels as great as 30 feet have been measured (Ireland et al. 1984).

Because of the slow drainage of fine-grained deposits, subsidence at a particular time is typically more closely related to past groundwater-level changes than to current change. In the San Joaquin Valley Groundwater Basin, groundwater extraction increased until large amounts of surface water were imported through various canals. Although water levels in the area started to rise, the rate of subsidence began to decrease 3 years after the groundwater levels began to recover (Reclamation 1997).

Recent changes in groundwater use within the extended study area are thought to have caused subsidence between the Eastside Bypass and San Joaquin River near Sack Dam. SLCC reported subsidence of Sack Dam at rates exceeding 0.5 feet per year, as well as a cumulative subsidence of approximately 4.5 feet along the Eastside Bypass from 2008 to 2013 (SLCC 2013). Both CCID and SLCC are working with growers in the western portion of Madera County to develop potential solutions to subsidence in those areas that directly impact Sack

Dam and other physical infrastructure (Exchange Contractors 2013 and CCID 2012).

A 2013 study by the USGS that examined the period from 2003 to 2010 found a large subsidence feature centered south of the town of El Nido (Sneed et al. 2013). The feature, defined by the area experiencing 0.06 feet (20 millimeters) or more of subsidence, extended 50 miles (80 kilometers) east to west (from Check 17 on the DMC to the town of Madera) and 25 miles (40 kilometers) north to south (from near Merced to near Mendota). According to the study, a maximum 1.77 feet (540 millimeters) of subsidence was observed during 2008 to 2010.

Near-Surface Hydrocompaction Hydrocompaction occurs when moisture-deficient deposits, which can be unconsolidated, porous semiarid, or arid, lose strength after wetting. The wetting process results in a decrease in volume and an increase in density, which occur when dry deposits become wet and spontaneously slump, crack, or collapse (Prokopovich undated). A few areas, totaling about 210 square miles, on the western and southern ends of the San Joaquin Valley have been affected by near-surface hydrocompaction (Williamson et al. 1989). Subsidence in these areas has been reported to be from 5 to 15 feet (Poland and Evenson 1966).

Groundwater Quality

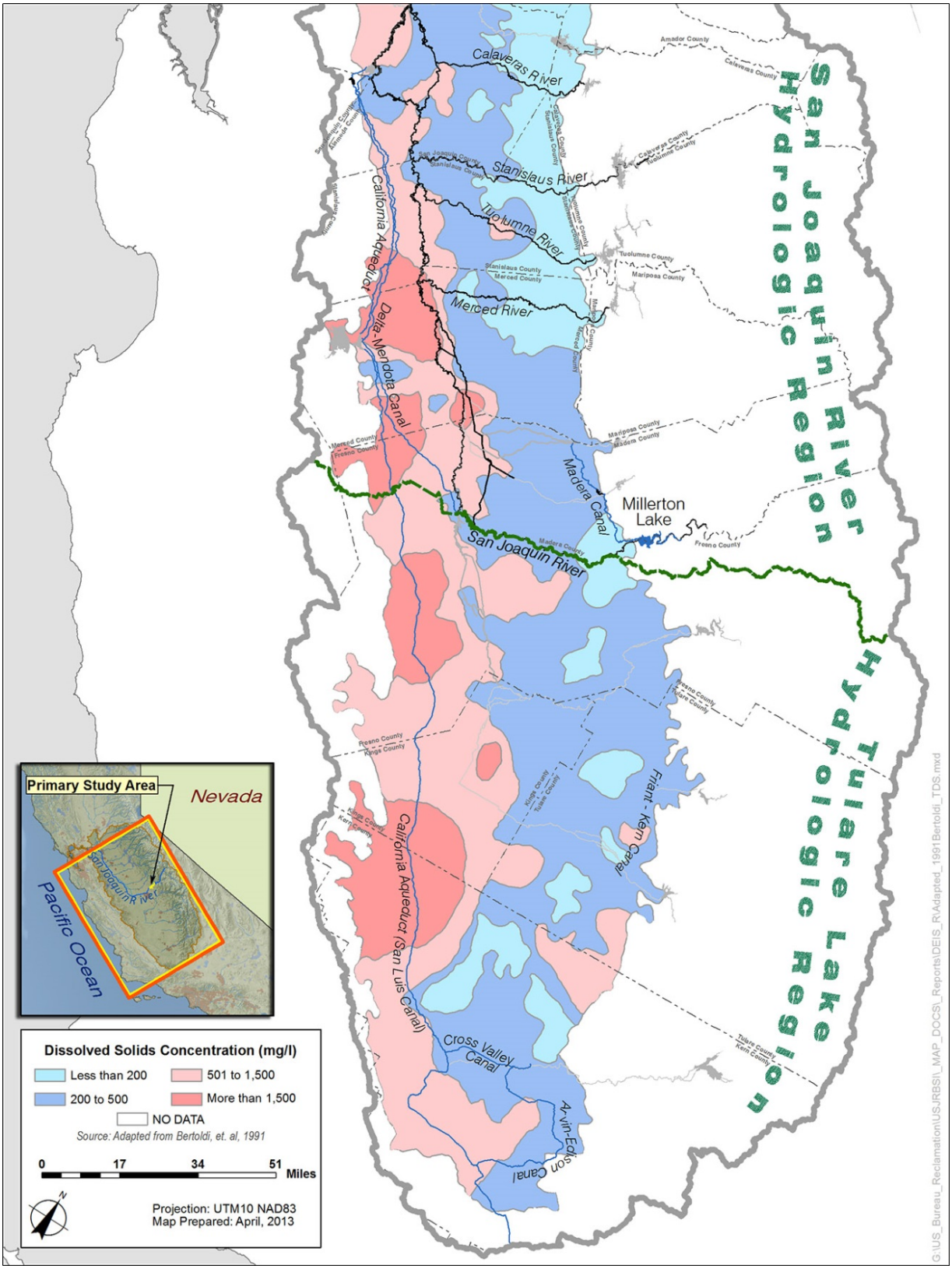
Groundwater quality in the San Joaquin Valley Groundwater Basin varies considerably. In general, groundwater quality is suitable for most urban and agricultural uses, with the exception of localized problematic areas in the San Joaquin River Hydrologic Region (DWR 2003). Primary constituents of concern include total dissolved solids (TDS), boron, chloride, nitrates, arsenic, selenium, dibromochloropropane (DBCP), radon, and uranium, which are discussed in this section

Detailed groundwater quality studies have been conducted sporadically on a localized scale, often as a result of regulatory requirements, throughout the San Joaquin Valley Groundwater Basin. USGS released groundwater quality data collected as part of the Groundwater Ambient Monitoring Assessment (GAMA) program for the Northern San Joaquin Basin GAMA and the Central Eastside San Joaquin Basin GAMA study areas (USGS 2005). The Northern San Joaquin Basin GAMA study area includes the Tracy, Eastern San Joaquin, and Cosumnes subbasins, and the USGS defined Uplands area including portions of the Cosumnes and Eastern San Joaquin subbasins (Bennett et al. 2006). The Central Eastside San Joaquin Basin

GAMA study area includes the Modesto, Turlock, and Merced subbasins, which are located in Stanislaus and Merced counties (Landon and Belitz 2008). In the future, greater quantitative and qualitative regional groundwater quality understanding is anticipated for the remaining areas of both the San Joaquin River Hydrologic Region and the Tulare Lake Hydrologic Region through use of USGS GAMA data.

Total Dissolved Solids TDS concentrations vary considerably throughout the San Joaquin River Hydrologic Region but, in general, concentrations are highest along the west side of the region. These higher concentrations are a result of recharged streamflow originating from marine deposits in the west, and the concentration of salt due to evaporation and poor drainage in the center of the hydrologic region (DWR 2003). On the west side of the Central Valley, TDS concentrations generally exceed 500 mg/L, and are in excess of 2,000 mg/L along portions of the western margin of the valley (Bertoldi et al. 1991). Figure 13-11 illustrates TDS concentrations in the entire Central Valley Groundwater Basin. TDS concentrations above the secondary maximum contaminant level (MCL) of 500 mg/L have been reported in the Tracy, Merced, Modesto, and Turlock subbasins (Bennett et al. 2006, Landon and Belitz 2008).

Boron Boron is an essential micronutrient found at low concentrations in irrigation water (Bertoldi et al. 1991). However, boron is toxic to most crops at concentrations exceeding 4.0 mg/L (Bertoldi et al. 1991). Boron concentrations above the California Department of Public Health (CDPH) notification limit (NL) of 1,000 micrograms per liter (µg/L) have been documented in the northwestern portion of the San Joaquin River Hydrologic Region in the Tracy Subbasin, extending from the northernmost edge of the valley west of the San Joaquin River to the Kings-Fresno county line (Bertoldi et al. 1991, DWR 2003, Landon and Belitz 2008). DWR reported that it has identified localized areas with “high” concentrations of boron in the Delta-Mendota, Modesto, and Turlock subbasins (DWR 2003).



Source: Adapted from Bertoldi et al. 1991

Figure 13-11. Total Dissolved Solids Concentrations in Central Valley Groundwater Basin

Chloride Chloride concentrations can be toxic to crops typically at concentrations higher than 700 mg/L. However, salinity usually is the primary toxin to plants before chloride alone reaches toxic levels. In the northwest and north-central portion of the San Joaquin River Hydrologic Region, along the course of the San Joaquin River and adjacent lowlands, chloride concentrations are typically highest. High chloride in shallow groundwater is predominantly caused by an upward flow of saline-concentrated groundwater (Bertoldi et al. 1991). DWR reported that areas of elevated chloride concentrations have been identified in localized areas of the Tracy, Modesto, Turlock, Merced, Chowchilla, and Madera subbasins (DWR 2003). Chloride concentrations have been reported above the secondary MCL of 250 mg/L in the Modesto and Tracy subbasins (Landon and Belitz 2008, Bennett et al. 2006).

Nitrates Nitrates are prevalent typically in shallow, younger groundwater throughout the San Joaquin River Hydrologic Region as a result of disposal of human and animal waste products and fertilizers. Higher nitrate concentrations, ranging from 5 to 30 mg/L, may adversely affect select crops. The MCL for nitrate in drinking water is 10 mg/L. Elevated concentrations of nitrate have been reported in the Tracy, Delta-Mendota, Modesto, Turlock, Merced, Chowchilla, and Madera subbasins (DWR 2003). Nitrate concentrations have been reported above the MCL in the Merced, Modesto, and Turlock subbasins (Landon and Belitz 2008). One recent study tracking historical nitrogen balances suggests that major reductions in nitrogen loadings from California agriculture will be required to safeguard groundwater quality (Rosenstock et al. 2014).

Arsenic Arsenic is widely detected and naturally occurring in the San Joaquin Valley deposits (Burrow et al. 2004, Izbicki et al. 2008). Arsenic concentrations have been reported above the MCL of 10 µg/L in the Merced, Turlock, Modesto, Eastern San Joaquin, and Tracy subbasins (Bennett et al. 2006, Landon and Belitz 2008).

Selenium In the southwestern portion of the San Joaquin River Hydrologic Region, selenium can be found as a naturally occurring element in soils and groundwater, and is considered nontoxic to humans and animals below the MCL of 0.05 mg/L. However, the southwestern portion of this hydrologic region has been the subject of extensive selenium studies because of the high rate of waterfowl mortality and embryo malformations in birds nesting in selenium-enriched drainage areas. A median

concentration of 10 to 11 mg/L was highest in the central and southern parts of the hydrologic region (south of Los Banos and south of Mendota) (Bertoldi et al. 1991).

Dibromochloropropane The most notable agricultural groundwater contaminant in the hydrologic region is DBCP. DBCP is a soil fumigant and known carcinogen that is now banned, but was extensively used on grapes and cotton (DWR 2003). The presence of this pesticide coincides with agricultural land-use patterns and is prevalent in groundwater at levels above 0.0005 mg/L north of Merced and Stockton. DBCP is typically observed in shallow, younger groundwater recharged after 1980 in areas occupied by orchards and vineyards, where DBCP was commonly used (Bertoldi et al. 1991). DBCP has been reported above the MCL of 0.0002 mg/L in the Merced, Turlock, Cosumnes, and Eastern San Joaquin subbasins (Bennett et al. 2006, Landon and Belitz 2008). DWR reported that elevated concentrations of DBCP have also been found in localized areas in the Modesto and Madera subbasins (DWR 2003).

Radon Radon, a naturally occurring radioactive element, has received more attention in recent years because of adverse health effects documented in human occupancy areas, such as basements or cellars. No current water quality standards exist for this element; however, the proposed MCL for radon-222 is 300 picocuries per liter (pCi/L). Radon concentrations have been reported above the proposed MCL in the Merced, Modesto, Turlock, Eastern San Joaquin, and Tracy subbasins (Bennett et al. 2006, Landon and Belitz 2008).

Uranium Uranium is naturally occurring in the eastern San Joaquin Valley, having been derived from granitic rocks of the Sierra Nevada. Uranium concentrations in groundwater have exceeded Federal and State drinking water standards in the eastern San Joaquin Valley for the last 20 years. Uranium concentrations have been reported above the MCL, 20 picocuries per liter, with most of the reports of exceedance of the MCL within Modesto, Fresno, and Bakersfield (Jurgens et al. 2009).

Agriculture Subsurface Drainage

Inadequate drainage and salt accumulation have been persistent problems for irrigated agricultural lands along the west side and in parts of the east side of the San Joaquin River Hydrologic Region for more than a century. The most extensive problems exist on the west side of the San Joaquin

River and Tulare Lake hydrologic regions. The drainage problems developed as a result of imported water from human-made infrastructure, naturally occurring saline soils, and distinctive geology that prevents natural drainage.

Soils on the west side of the San Joaquin River Hydrologic Region are derived from marine sediments that make up the Coast Ranges and are high in salts and trace elements. Irrigation of these soils has mobilized salts and trace elements and facilitated their movement into the shallow groundwater. Much of the irrigation has been with imported water, which has resulted in inadequate drainage, rising groundwater, and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainage water frequently contains high concentrations of salts and trace elements (Reclamation et al. 1990a). Events affecting drainage conditions on the west side of the San Joaquin Valley are described in Table 13-6.

Subsurface drainage problems extend along the western side of the San Joaquin River and Tulare Lake hydrologic regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions of this hydrologic region, natural drainage conditions are inadequate to remove the quantities of deep percolation that accrue to the water table where the upper, semiconfined aquifer is shallow. Therefore, groundwater levels often encroach on the root zone of agricultural crops, and subsurface drainage must be supplemented by constructed facilities for irrigation to be sustained. Present problem areas were defined in the San Joaquin Valley Drainage Program (SJVDP) (DWR 2005a) as locations where the water table is within 5 feet of the ground surface at any time during the year. Potential problem areas were defined in the SJVDP at locations where the water table is between 5 and 20 feet below the ground surface (DWR 2005a). To better understand the problem areas, water-level data were collected, beginning in 1991, from a network of monitoring wells in designated study areas to establish acreage areas of particular depth-to-water intervals (DWR 2005a).

Few wells pump from this shallow depth to groundwater zone because of high salinity concentrations. The term “salinity” is referred to here as the salt content of solutions containing dissolved mineral salts. Salinity is commonly measured as either TDS in parts per million (ppm) or electrical conductivity (EC) in microsiemens per centimeter (µS/cm). Salinity levels in shallow groundwater in the San Joaquin River Hydrologic

Region range from approximately 1,500 to 48,000 µS/cm (DWR 2005a).

Table 13-6. Events Affecting Drainage Conditions on West Side of San Joaquin Valley

Year	Event
1870s	Widespread planting of grain on the western side of the San Joaquin Valley. Crops irrigated with water from the San Joaquin and Kings rivers. Poor natural drainage, rising groundwater, and increasing soil salinity results in the removal or abandonment of farm land in production.
1900–1950	Heavy pumping of groundwater results in overdrafts and widespread land subsidence.
1951	CVP water transported through the Delta-Mendota Canal to irrigate 600,000 acres of land in the northern San Joaquin Valley. This water primarily replaces and supplements San Joaquin River water diverted at Friant Dam to the southern San Joaquin Valley.
1960	SWP authorized. San Luis Unit of the CVP authorized, which mandates construction of an interceptor drain to collect irrigation drainage water and transport it to the Delta. Reclamation's feasibility report for the San Luis Unit describes the drain as an earthen ditch that would drain 96,000 acres.
1962	Reclamation changes plans for the drain to a concrete-lined canal to drain 300,000 acres.
1964	Reclamation adds a regulating reservoir to the drain plans to temporarily retain drainage.
1965	Concerns raised about the potential effects of the discharge of untreated agricultural drainage water in the Delta and San Francisco Bay. A rider added to CVP appropriations act by Congress in 1965 that requires the final point of discharge of the interceptor drain for the San Luis Unit to conform to water quality standards set by California and EPA.
1968	CVP San Luis Unit and the SWP begin delivering water to approximately 1,000,000 acres of agricultural lands in southern San Joaquin Valley. Construction of San Luis Drain begins. Kesterson Reservoir becomes part of a new National Wildlife Refuge managed jointly by Reclamation and USFWS.
Mid-1970	Reclamation decides to use the drainage reservoir to store and evaporate drainage water until the drainage canal to the Delta is completed.
1975	The first phase of Kesterson Reservoir, 85 miles of the main drain, and 120 miles of collector drains completed. Budget and environmental concerns halt work on the reservoir and drain. Reclamation, DWR, and the State Water Board form the SJVDP to find a solution to valley drainage problems. Group recommends completing the drain to a discharge point in the Delta near Chipps Island.
1981	Reclamation begins a special study to fulfill requirements for a discharge permit from the State Water Board.
1983	Selenium poisoning identified as the probable cause of deformities and mortalities of migratory waterfowl at Kesterson Reservoir.
1984	The SJVDP is established as a joint Federal and State effort to investigate drainage and related problems and identify possible solutions.
1985	The Secretary of the Interior halts the discharge of subsurface drainage water to Kesterson Reservoir.
1986	Feeder drains to the San Luis Drain and reservoir plugged.
1988	Kesterson Reservoir closed. Vegetation plowed under and low-lying areas filled. Contamination-related problems similar to Kesterson appear in parts of the Tulare Lake Hydrologic Region. Wildlife deformities and mortalities observed at several agricultural drainage evaporation ponds.
1990	SJVDP submits final report.

Source: Reclamation et al. 1990a.

Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DWR = California Department of Water Resources
EPA = U.S. Environmental Protection Agency
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SJVDP = San Joaquin Valley Drainage Program
SWP = State Water Project
State Water Board = State Water Resources Control Board
USFWS = U.S. Department of the Interior, Fish and Wildlife Service

Toxic and potentially toxic trace elements in some soil and shallow groundwater on the western side of the San Joaquin River and Tulare Lake hydrologic regions are also of concern. These trace elements greatly complicate the disposal of subsurface drainage waters. Elements of primary concern are selenium, boron, molybdenum, and arsenic. Selenium is of greatest concern because of the wide distribution and known toxicity of selenium to aquatic animals and waterfowl, and was the only trace element sampled for in 2001 (DWR 2005a). The three areas in the western San Joaquin Valley with the highest concentrations of selenium are (1) alluvial fans near Panoche and Cantua creeks in the central western valley, (2) an area west of the town of Lost Hills, and (3) the Buena Vista Lake bed area (DWR 2005a).

Seepage and Waterlogging

Seepage and waterlogging of crops along the lower reaches of the San Joaquin River have historically been issues. High periodic streamflows and local flooding combined with shallow groundwater near the San Joaquin River, and in the vicinity of its confluence with major tributaries, have resulted in seepage-induced waterlogging damage to low-lying farmland (Reclamation 1997). During flood-flow events, lateral seepage and structural stability issues with existing project and nonproject levees have been identified (RMC 2003, 2007).

In the western portion of the Stanislaus River watershed, groundwater pumping has historically been used to control high groundwater levels and seepage-induced waterlogging conditions. The seepage-induced waterlogging places neighboring crops and farmland at risk and prevents cultivation of the land until summer, placing annual crop production at risk. Concern has been raised that San Joaquin River flows in excess of 16,000 cfs at Vernalis can result in seepage-induced waterlogging damage of adjacent low-lying farmland in the south Delta area (Reclamation 1997).

Conditions that generally govern whether seepage may occur are shown schematically in Figure 13-12, Figure 13-13, and Figure 13-14. Figure 13-12 depicts a condition under which vertical infiltration and lateral seepage could occur into surrounding lands. Figure 13-13, like Figure 13-12, depicts physical characteristics for which vertical infiltration and lateral seepage could occur if soil conditions were favorable, because the surface water elevation in the river is greater than the surrounding ground surface elevation. The conditions illustrated in Figure 13-13 would require site-specific review of

the shallow soil conditions beneath the river and along the levees to verify that impermeable features existed that would prevent vertical infiltration and lateral seepage from occurring. Figure 13-14 depicts physical characteristics where lateral seepage would not be expected to occur.

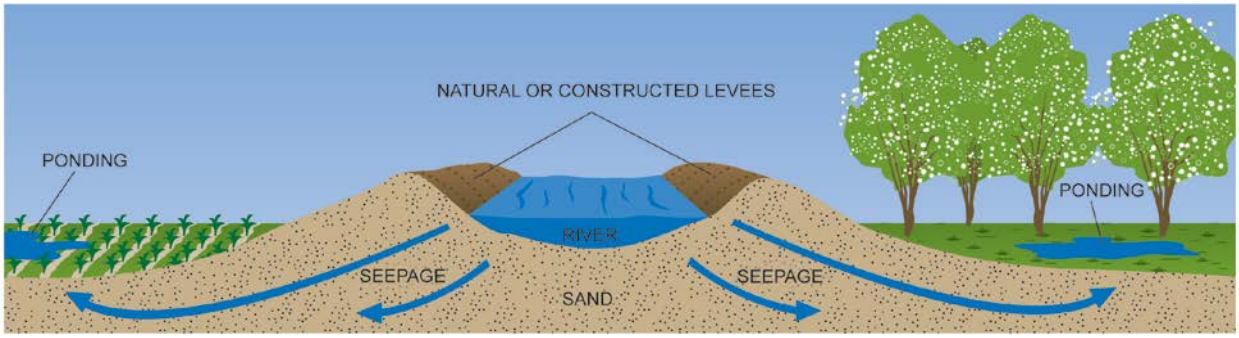


Figure 13-12. River Surface Elevation above Adjacent Land Surface Elevation

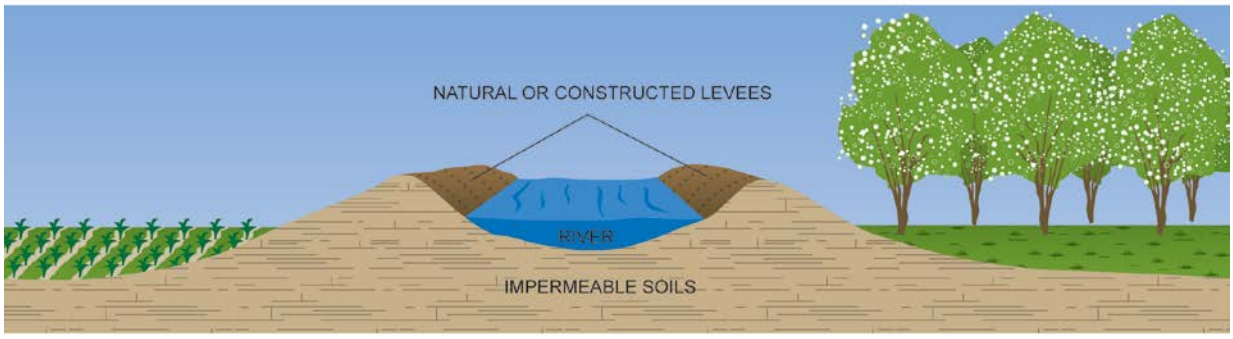


Figure 13-13. Physical Barrier to Subsurface Flow Prevents Seepage

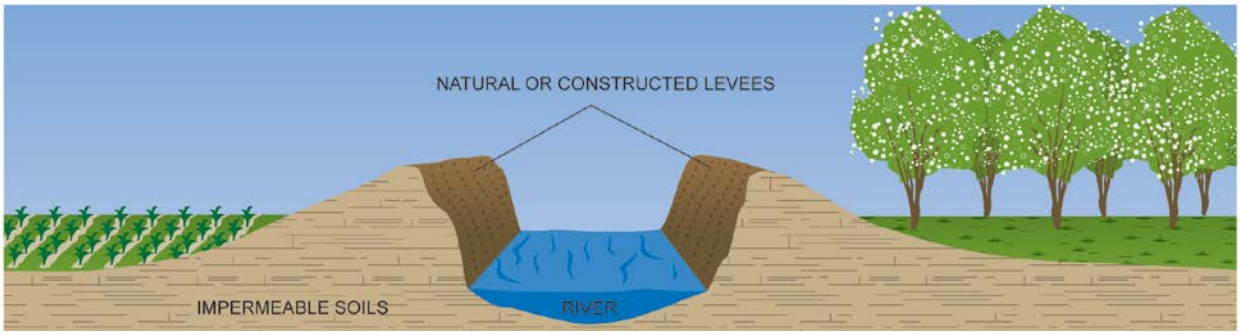


Figure 13-14. River Surface Elevation below Adjacent Land Surface Elevation

Reclamation currently monitors shallow groundwater within the Restoration Area as part of its Seepage Management Plan (SMP) for the SJRRP. The SMP describes Reclamation's monitoring and operating guidelines for reducing Restoration Flows to the extent necessary to address any material adverse impacts caused by Restoration Flows in the San Joaquin River identified by the SJRRP groundwater monitoring program and the prioritization of potential seepage impact areas for projects to increase channel capacity. The SJRRP currently (as of April 9, 2014) monitors over 200 groundwater wells within the Restoration Area; most are screened between 10 feet and 25 feet to monitor shallow groundwater conditions (K. Harrison, personal communication, April 9, 2014). Thresholds for actions to reduce flows are established for each well based primarily on agricultural practices (root zone and capillary fringe) and historical groundwater levels (SJRRP 2013).

Groundwater Resources of Tulare Lake Hydrologic Region

This section describes regional and subbasin hydrogeology, groundwater storage and production, groundwater levels, land subsidence, groundwater quality, agriculture subsurface drainage, and seepage and water-logging in the Tulare Lake Hydrologic Region.

Hydrogeology

The following sections describe regional hydrogeology and subbasin hydrogeology in the Tulare Lake Hydrologic Region.

Regional Hydrogeology Arid conditions and early agricultural development (pre-1900s) in the Tulare Lake Hydrologic Region have caused groundwater-level declines, changes in stream-aquifer dynamics. Under predevelopment conditions, groundwater-surface water interactions were very dynamic and depended on hydrologic conditions. Rapid growth in the agricultural sector in the Tulare Lake Hydrologic Region has resulted in groundwater development with increased groundwater pumping and subsequent groundwater-level declines. In some areas of critical overdraft, such as in Kings and Kern counties, a complete disconnection between groundwater and overlying surface water systems has occurred.

The semiconfined aquifer in the Tulare Lake Hydrologic Region contains the same hydrogeologic units as the San Joaquin River Hydrologic Region (alluvial deposits of the Coast Ranges, Sierra Nevada sediments, and flood-basin deposits), but the region also contains Tulare Lake sediments in

the axis of the valley (see Figure 13-3). The Corcoran Clay layer occurs at depths between 300 and 900 feet below ground surface in the Tulare Lake Hydrologic Region. The confined aquifer is overlain by the Corcoran Clay, but consists of the same hydrogeologic units as the unconfined-to-semiconfined aquifer. The Tulare Lake Hydrologic Region has semiconfined aquifer conditions to the west above the Corcoran Clay layer, and on the east side of the region where the clay is not present. Tulare Lake sediments present in the axis of the San Joaquin Valley have similar characteristics to flood-basin deposits present in the San Joaquin River Hydrologic Region (Figure 13-3).

The semiconfined aquifer in the Tulare Lake Hydrologic Region is recharged by seepage from streams and canals, infiltration of applied water, and subsurface inflow. Precipitation is a source of recharge to the semiconfined aquifer only in Wet years (Reclamation 1997). Seepage from streams and canals is highly variable and depends on annual hydrologic conditions. Some of the water recharged to the semiconfined aquifer seeps through the confining clay layers, including the Corcoran Clay, which are discontinuous in some areas. Lateral flow from the semiconfined aquifer also recharges the lower confined aquifer.

Subbasin Hydrogeology

The unconfined-to-semiconfined and confined groundwater aquifer in the Kings and Westside subbasins consists of Tertiary and Quaternary age unconsolidated continental deposits. The Quaternary deposits consist of older alluvium, lacustrine and marsh deposits, younger alluvium, and flood-basin deposits. The lacustrine and marsh deposits are part of the Corcoran Clay Member of the Tulare Formation (DWR 2003). To the south, the Kaweah Subbasin aquifers are made up of unconsolidated deposits of Pliocene, Pleistocene, and Holocene age. The deposits comprise arkosic sediments derived from the Sierra Nevada on the eastern side of the subbasin and are generally unconfined-to-semiconfined. The arkosic sediments consist of continental deposits, older alluvium, and younger alluvium. The unconsolidated deposits in the western portion of the subbasin near the Tulare Lake beds are confined below the Corcoran Clay and consist of flood deposits and lacustrine and marsh deposits that interfinger with the east side deposits (DWR 2003). To the south of the Kaweah Subbasin, the Pleasant Valley Subbasin consists of unconfined Holocene age alluvium, the Plio-Pleistocene Tulare Formation, and possibly part of the uppermost San Joaquin Formation.

South of the Kaweah Subbasin, the unconfined-to-semiconfined and confined aquifers of the Tule Subbasin comprise continental deposits of Tertiary to Quaternary age. The continental deposits consist of flood-basin deposits, younger alluvium, older alluvium, the Tulare Formation, and undifferentiated continental deposits (DWR 2003). West of the Tule Subbasin, the unconfined-to-semiconfined aquifer of the Tulare Lake Subbasin includes younger and older alluvium, flood-basin deposits, lacustrine and marsh deposits, and continental deposits. The younger alluvium is a very permeable, interstratified unit consisting of well-sorted clay, silt, sand, and gravel that is largely above the water table. The older alluvium is moderately permeable and consists of poorly sorted clay, silt, sand, and gravel, and yields large quantities of water to wells (DWR 2003). In the southernmost portion of the Tulare Lake Hydrologic Region in the San Joaquin Valley Groundwater Basin, the Kern County Subbasin consists primarily of unconfined-to-semiconfined and confined continental deposits of Tertiary and Quaternary age. The deposits, from oldest to youngest, include the Olcese and Santa Margarita formations, the Tulare Formation, the Kern River Formation, older alluvium/stream deposits, younger alluvium, and flood-basin deposits (DWR 2003).

Groundwater Storage and Production

The following sections describe historical and existing groundwater storage and production conditions in the Tulare Lake Hydrologic Region.

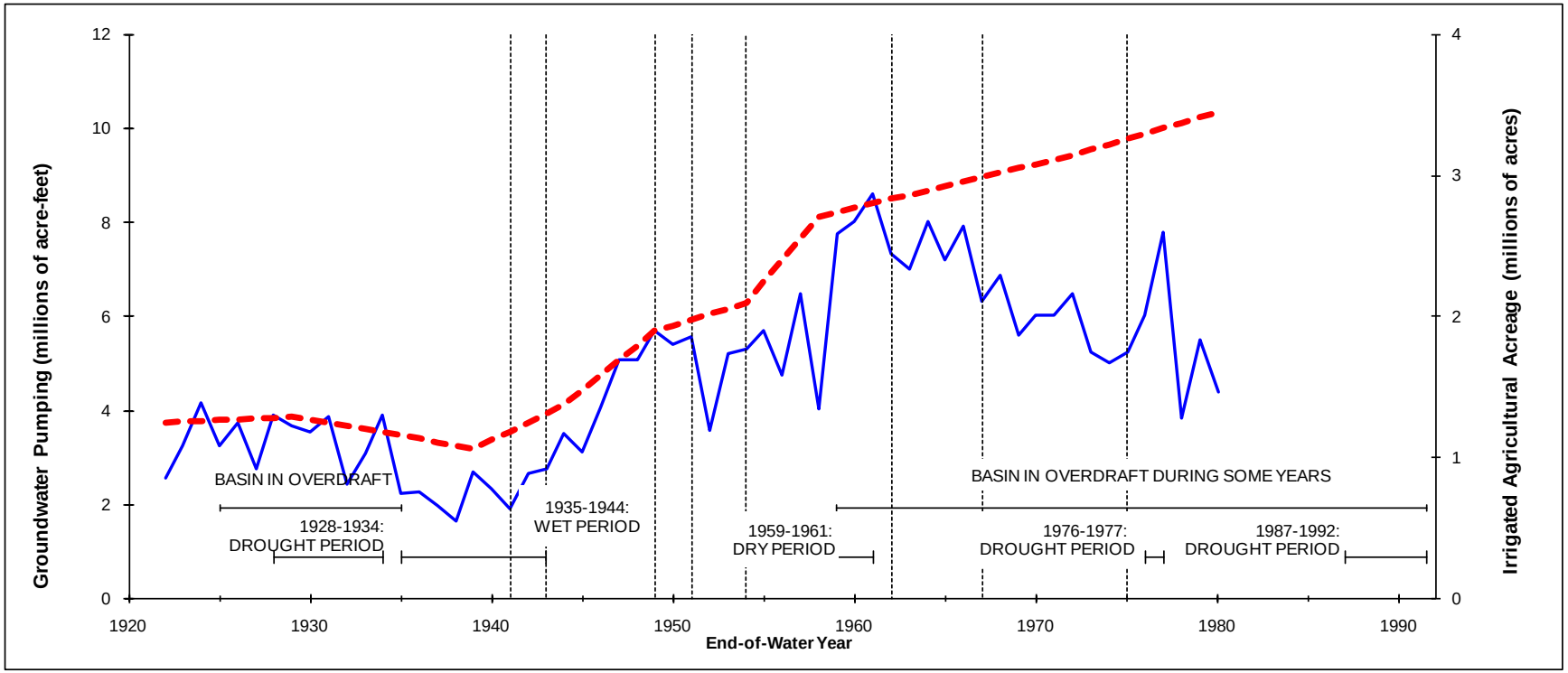
Groundwater Storage Usable groundwater storage capacity within the Tulare Lake Hydrologic Region was estimated to be 28 MAF in 1993 (DWR 1994). The perennial yield of the Tulare Lake Hydrologic Region was estimated by DWR to be 4.6 MAF, and was considered directly dependent on the amount of recharge received by the groundwater basin (DWR 1994).

Figure 13-4 illustrates changes in groundwater storage from 1962 through 2003 for the Central Valley, including the San Joaquin River and Tulare Lake hydrologic regions, as simulated using CVHM (Faunt 2009). These groundwater storage fluctuations represent average regional fluctuations that likely occurred in the San Joaquin Valley Groundwater Basin.

According to DWR Bulletin 160-09, the net change in groundwater storage for Water Years 1998 to 2005 was predominantly negative, ranging from -4,002 TAF to 263 TAF

(DWR 2009). According to DWR Bulletin 160-05 (DWR 2005b), five subbasins (Kings, Tulare, Kern County, Kaweah, and Tule) in the Tulare Lake Hydrologic Region are in critical overdraft conditions.

Groundwater Production Agricultural development in the Tulare Lake Hydrologic Region began in the 1800s, and by 1922, more than 1.2 million acres of land were used for agriculture. Groundwater has been the primary source of irrigation water for the region. Figure 13-15 illustrates changes in groundwater pumping and irrigated agricultural acreage for the Tulare Lake Hydrologic Region from 1922 to 1980 (the source for the data was discussed in the San Joaquin River Hydrologic Region, Groundwater Storage and Production section). Annual groundwater pumping ranged from 2 MAF in the 1920s and 1930s to 8 MAF in the 1960s. Groundwater pumping increased from the 1920s through 1949, when surface water deliveries began via the Friant-Kern Canal to the east side of the region. Groundwater pumping continued to increase through the early 1960s until local surface water facilities, import of CVP water from the San Luis Division, and SWP water from the California Aqueduct resulted in a reduction in regional groundwater pumping. In the mid-1970s following construction of the Cross Valley Canal, additional CVP supplies were imported to the southern half of the Tulare Lake Hydrologic Region. This reduction in groundwater pumping worked to reduce overdraft conditions in the region. However, an increase in groundwater pumping occurred in the late 1980s and early 1990s in response to reduced surface water deliveries during the drought period of 1987 to 1992. Table 13-7 highlights the timeline of events that have affected groundwater production in the Tulare Lake Hydrologic Region for the period shown in Figure 13-15. Figure 13-6 illustrates simulated groundwater pumping for the entire Central Valley, including the San Joaquin River and Tulare Lake hydrologic regions, from 1962 to 2003.



Source: Reclamation 1997.

Note:

Data available from 1922 to 1980. Data developed as part of the Central Valley Ground-Surface Water Model (Reclamation et al, 1990b)

Legend:

Groundwater Pumping

Irrigated Agricultural Acreage

Figure 13-15. Historical Annual Groundwater Pumping and Irrigated Agricultural Acreage for Tulare Lake Hydrologic Region from 1922 Through 1980

Table 13-7. Timeline of Historical Events Affecting Groundwater Production in Tulare Lake Hydrologic Region

Date	Historical Event
1928–1934	Drought Period
1935–1944	Wet Period
1943	Friant Dam Online
1949	Friant-Kern Canal Online
1954	Isabella Dam Online
1956	Madera Canal Online
1959–1961	Dry Period
1962	Success Dam Online, Terminus Dam Online
1967	San Luis Dam/Canal Online
1967	California Aqueduct Online
1967	Oroville Dam Online
1975	Cross Valley Canal Online
1976–1977	Drought Period
1987–1992	Drought Period

Groundwater pumped in the Tulare Lake Hydrologic Region accounts for about 33 percent of the total annual water supply in the region, represents 35 percent of all groundwater use in the State, and 10 percent off all agricultural and urban water use in the State (DWR 2005a).

In 1990, an estimated 5.2 MAF of groundwater was pumped from the Tulare Lake Hydrologic Region (DWR 1994). This was approximately 630 TAF greater than the estimated perennial yield of the region (DWR 1994).

Typical groundwater production within the subbasins in the Tulare Lake Hydrologic Region is presented in Table 13-8 (DWR 1998). As discussed in the San Joaquin River Hydrologic Region section, Burt estimated gross irrigation well pumping for some of the Friant Division contractors between 1987 and 2003 (Burt 2005). The estimated gross groundwater pumping for numerous WDs and IDs in the Tulare Lake Hydrologic Region is shown in Table 13-9 (Burt 2005). Gross pumping estimates for Friant Division M&I users, including the City of Fresno, City of Orange Cove, City of Lindsay, and Fresno County Water Works District Number 18, were not available (Burt 2005). The City of Fresno reports that using 250 wells, the Water Division of the City of Fresno pumps approximately 146 million gallons or 448 acre-feet of water per

day, which is roughly equivalent to 164 TAF/year (City of Fresno 2009).

Table 13-8. Average Annual Groundwater Production in Tulare Lake Hydrologic Region

Subbasin	Extraction (TAF/year)
Kings	1,790
Kern	1,400
Kaweah	760
Tulare Lake	670
Tule	660
Westside	210
Pleasant Valley	100

Source: DWR 1998, 2003
Key:
TAF/year = thousand acre-feet per year

Table 13-9. Average Annual Gross Groundwater Pumping for Friant Division Contractors in Tulare Lake Hydrologic Region

District	Average Gross Groundwater Pumping (TAF/year)		
	1987–1992	1987–1999	1987–2003
Arvin-Edison WSD	207	184	190
Delano-Earlimart ID	53	35	33
Exeter ID	27	22	22
Fresno ID	224	135	123
Garfield ID	0.3	0.3	0.3
International ID	1	0.6	0.6
Ivanhoe ID	21	17	17
Lewis Creek WD	1	0.9	1
Lindmore ID	44	36	36
Lindsay-Strathmore ID	13	12	13
Lower Tule River ID	203	131	137
Orange Cove ID	44	41	42
Porterville ID	31	26	26
Saucelito ID	25	18	17
Shafter-Wasco ID	74	62	60
Southern San Joaquin MUD	93	72	66
Stone Corral ID	9	9	9
Tea Pot Dome WD	3	2	2

Table 13-9. Average Annual Gross Groundwater Pumping for Friant Division Contractors in Tulare Lake Hydrologic Region (contd.)

District	Average Gross Groundwater Pumping (TAF/year)		
	1987–1992	1987–1999	1987–2003
Terra Bella ID	14	13	13
Tulare ID	181	102	98

Source: Burt 2005
Key:
ID = Irrigation District
MUD = Municipal Utilities District
TAF/year = thousand acre-feet per year
WD = Water District
WSD = Water Storage District

Groundwater Levels

Groundwater-level declines in shallow wells in central Fresno County have been substantial, beginning in the early 1940s and decreasing approximately 50 to 100 feet through the 1980s (Williamson et al. 1989). Large groundwater-level declines occurred in the southwestern corner of the Westside Subbasin until the late 1960s. Beginning in 1967, groundwater levels declined more than 100 feet but made a near full recovery because of decreases in pumping in response to surface water supplies imported through the San Luis Canal (Williamson et al. 1989).

Groundwater levels in the lower confined aquifer in the west side of the Tulare Lake Hydrologic Region declined as much as 400 feet from predevelopment to the 1960s (Williamson et al. 1989). Groundwater levels measured in the Tulare Lake Subbasin fluctuated and, in general, increased by more than 24 feet in some areas during the 10-year period of spring 1978 to spring 1988 (DWR 2003). The Tulare Lake bed area has experienced the greatest groundwater-level fluctuations, including both increases and decreases (DWR 2003).

Figure 13-7 presents groundwater contours of the semiconfined aquifer in spring 1970, adapted from DWR's spring 1970 map (DWR 2007b). Groundwater levels in the semiconfined aquifer of the Tulare Lake Hydrologic Region generally decreased during the 10-year period of spring 1970 to spring 1980. The semiconfined groundwater aquifer levels decreased as much as 50 feet in the same 10-year period in portions of Fresno, Kings, Kern, and Tulare counties.

The 1987-through-1992 drought resulted in increased groundwater pumping due to deficiencies in surface water deliveries. Water levels declined by 20 to 30 feet throughout most of the central and eastern parts of the San Joaquin Valley (Westlands WD 1995).

Groundwater conditions in the semiconfined aquifer for spring 1995 are shown in Figure 13-8. Following the 1987-through-1992 drought, groundwater levels in the San Joaquin Valley continued to decline. In spring 1993, a groundwater-level contour map of the San Joaquin Valley showed depression areas resulting from groundwater withdrawals in the mid-valley area near the center of Fresno County, near the City of Fresno, along the county border between Tulare and Kings counties, in southwestern Kings County, and in parts of Kern County. Groundwater conditions in spring 1995 indicate that groundwater levels in the unconfined-to-semiconfined aquifer were beginning to recover.

Groundwater conditions in the unconfined aquifers of the San Joaquin Valley Groundwater Basin for spring 2010 are illustrated in Figure 13-9. The groundwater elevation contours in Figure 13-9 were adapted from the spring 2010 contour map of the unconfined aquifers available on the DWR Web site (DWR 2012). The groundwater elevation contours indicate that groundwater levels had nearly recovered to pre-drought conditions in the basin. Table 13-10 summarizes the ranges in groundwater elevations reported on the groundwater subbasin contour maps of the unconfined-to-semiconfined aquifer in the Tulare Lake Hydrologic Region for spring 2010.

Table 13-10. Spring 2010 Unconfined Aquifer Contour Map Groundwater Elevations in Subbasins of Tulare Lake Hydrologic Region

Subbasin	Range in Groundwater Elevations (feet above msl)	
Kaweah[1]	50	400
Kern County	0	230
Kings[1]	0	450
Pleasant Valley[3]	250	400
Tulare Lake[4]	100	220
Tule[5]	30	500
Westside[2]	40	300

Source: DWR 2012

Notes:

[1] Elevations increased from west to east towards the Sierra Nevada

[2] Last map available in 1996

[3] Last map available in 2004

[4] Only available in northern part of subbasin

[5] Elevations increased from west to east

Key:

msl = mean sea level

Land Subsidence

Figure 13-10 shows land subsidence contours from 1926 through 1970 for the San Joaquin River and Tulare Lake hydrologic regions. The Arvin-Maricopa area is 700 square miles, and is located 20 miles south of Bakersfield, mostly in Kern County. Two confining beds, the A-clay and the C-clay, underlie the area; the C-clay is the more extensive of the two beds. Maximum land subsidence in the Arvin-Maricopa area exceeds 9 feet. Land subsidence in parts of the Arvin-Maricopa area has also been influenced by oil and gas withdrawal and near-surface hydrocompaction. The Tulare-Wasco area between Fresno and Bakersfield in the Tulare Lake Hydrologic Region experienced land subsidence that exceeded 12 feet between 1926 and 1970 (Williamson et al. 1989). Additional information on land subsidence is available in the Groundwater Resources of San Joaquin River Hydrologic Region section on land subsidence.

Groundwater Quality

Similar to the San Joaquin River Hydrologic Region, groundwater quality in the Tulare Lake Hydrologic Region varies considerably throughout the area, but in general, is suitable for most urban and agricultural uses (DWR 2003). Primary constituents of concern on a regional level include TDS, boron, nitrates, arsenic, selenium, DBCP, radon, and uranium. USGS GAMA program data are currently available for the Southeast San Joaquin Valley and the Kern County

Subbasin study areas in the Tulare Lake Hydrologic Region (Burton and Belitz 2008, Shelton et al. 2008). The Southeast San Joaquin Valley study area, as defined by the GAMA study, includes portions of Fresno, Tulare, and King counties, which in turn include the Kings, Kaweah, Tulare Lake, and Tule subbasins (Burton and Belitz 2008).

Total Dissolved Solids TDS concentrations vary considerably in the Tulare Lake Hydrologic Region and depend on the depth to groundwater. In general, TDS concentrations exceeding the secondary MCL of 500 mg/L are primarily found along the west side and trough portions of this hydrologic region. Along the west side, these higher concentrations are a result of recharged streamflow originating from marine deposits. In the trough, or center portions, the concentrations are a result of the buildup of salt because of evaporation and poor drainage (DWR 2003). These higher concentrations above the Corcoran Clay layer limit groundwater use as an agricultural water supply in the western portion of Fresno and Kings counties. TDS concentrations have been reported above the MCL of 500 mg/L in the Kaweah, Kings, and Kern County subbasins (Burton and Belitz 2008, Shelton et al. 2008). Elevated concentrations of TDS have been reported in the Westside, Pleasant Valley, and Kern County subbasins (DWR 2003).

TDS concentrations for the entire Central Valley are discussed in the San Joaquin River Hydrologic Region groundwater quality section, and are shown in Figure 13-11 (this figure does not show vertical variations in TDS).

Boron High concentrations of boron have been reported in the southern portion of the Tulare Lake Hydrologic Region and in the northernmost edge of the greater San Joaquin Valley west of the San Joaquin River to the Kings-Fresno county line (Bertoldi et al. 1991). Elevated concentrations of boron have been reported in the Kings and Westside subbasins (DWR 2003). Boron concentrations above the CDPH NL of 1,000 µg/L have been reported in Tulare Lake Subbasin (Burton and Belitz 2008).

Nitrates Nitrates are prevalent typically in shallow younger groundwater throughout the Tulare Lake Hydrologic Region as a result of disposal of human and animal waste products and the applications of fertilizers. Higher nitrate concentrations, ranging from 5 to 30 mg/L, may adversely affect select crops. The MCL for nitrate (as nitrogen) in drinking water is 10 mg/L.

Areas of higher nitrate concentrations have been observed near the town of Shafter, and concentrations exceeding the MCL of 10 mg/L have been documented in areas south of Bakersfield and the greater Fresno metropolitan area, indicating surface contamination (DWR 2003). Elevated concentrations of nitrate have also been found in the Kings, Kaweah, Tule, and Kern County subbasins (DWR 2003). Recently, nitrate concentrations were reported above the MCL of 10 mg/L in groundwater in the Kings and Kern County subbasins (Burton and Belitz 2008, Shelton et al. 2008). As previously mentioned, one recent study tracking historical nitrogen balances suggests that major reductions in nitrogen loadings from California agriculture will be required to safeguard groundwater quality (Rosenstock et al. 2014).

Arsenic Arsenic concentrations have been reported above the MCL of 10 µg/L in groundwater in the southwestern corner of the Tulare Lake Hydrologic Region, particularly in the Kern Subbasin near Bakersfield (State Water Board 1991). Arsenic levels above the MCL have also been reported in the Kings, Tulare Lake, and Tule subbasins (Burton and Belitz 2008).These high-level areas of arsenic often occur locally and appear to be associated with lake bed deposits.

Selenium In the western portion of the Tulare Lake Hydrologic Region, selenium can be found as a naturally occurring element where soils are formed from marine sediments of the Coast Ranges (DWR 2007a). Selenium concentrations reported from a location on the Kern Lake bed are above the MCL of 50 µg/L (DWR 2007a).

Dibromochloropropane The most notable agricultural groundwater contaminant in the Tulare Lake Hydrologic Region is DBCP. The presence of this pesticide coincides with land-use patterns and is prevalent in groundwater at levels above 0.0005 mg/L near Bakersfield and Fresno. DBCP is typically observed in shallow, younger groundwater recharged after 1980 in areas occupied by orchards and vineyards, where DBCP was commonly used (Bertoldi et al. 1991). DBCP has been reported above the MCL of 0.2 µg/L in the Kings, Tule, and Kern County subbasins (Burton and Belitz 2008, Shelton et al. 2008).

Radon No current water quality standards exist for radon, a naturally occurring radioactive element; however, the proposed MCL for radon-222 is 300 pCi/L. Radon has been reported above the MCL, but below the alternative MCL of 4,000

pCi/L, in the Kings, Kaweah, Tule, Tulare Lake, and Kern County subbasins (Burton and Belitz 2008, Shelton et al. 2008). The alternative MCL would be applicable if the State were to develop a multimedia program to address radon risks in indoor air program to address radon risks in indoor air.

Uranium Uranium is naturally occurring in the eastern San Joaquin Valley, and is derived from granitic rocks of the Sierra Nevada. Uranium concentrations in groundwater have been reported above the MCL in Bakersfield (Jurgens et al. 2009).

Agricultural Subsurface Drainage

As described for the San Joaquin River Hydrologic Region, salinity and trace elements in some soil and shallow groundwater on the western side of the Tulare Lake Hydrologic Region are also of concern. In the Tulare Lake Hydrologic Region, the San Joaquin Valley Groundwater Basin is an internally drained and closed basin. It has no appreciable surface or subsurface outflow, except in extremely wet years. Salts (generally measured as TDS) are introduced into the basin with imported water supplies. In addition, many of the naturally occurring geologic deposits along the western portion of the region are of marine origin and, therefore, have high salt content. A number of regulated point sources discharge treated wastewater into the region's surface waters, including municipal sewage treatment plants and food processing, manufacturing, and oil and gas facilities (DWR 2009).

Seepage and Waterlogging

The northern boundary of the Tulare Lake Hydrologic Region is defined by the San Joaquin River. Seepage problems identified influence local groundwater conditions in the Kings Subbasin in the Tulare Lake Hydrologic Region (see Figure 13-12 through Figure 13-14). See the Groundwater Resources of San Joaquin River Hydrologic Region section, above, for additional discussion on seepage and waterlogging along the San Joaquin River.

Environmental Consequences and Mitigation Measures

This section describes environmental consequences on groundwater resources associated with implementing the alternatives. It also describes potential mitigation measures associated with impacts on groundwater resources that are significant or potentially significant. The potential direct and indirect effects to groundwater and associated mitigation measures are summarized in Table 13-11.

Table 13-11. Summary of Impacts and Mitigation Measures for Groundwater

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
GRW-1: Change in Groundwater Levels	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS		LTS
GRW-2: Change in Groundwater Quality	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS		LTS

Key:
B = beneficial
LTS = less than significant
NI = no impact
PS = potentially significant
PSU = potentially significant and unavoidable

Methods and Assumptions

The analysis presented in this section is qualitative and based on the premise that increased surface water deliveries would result in reduced groundwater pumping and, similarly, that reductions in surface water deliveries would be offset by increased groundwater pumping. Quantitative relationships between groundwater pumping and groundwater-level change were developed by Dr. Ken Schmidt (2005) and are discussed in the Modeling Appendix. However, these relationships, known as the Schmidt Tool, have only been developed for portions of the Friant Division of the CVP and cannot be applied to the entire extended study area.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on groundwater would be significant if project implementation would result in a change in groundwater level or quality that would adversely affect users, as indicated by the following:

- A change in groundwater level resulting in long-term overdraft conditions for the groundwater basin.
- A change groundwater quality resulting in substantially adverse impacts to designated beneficial uses of groundwater.

Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

Topics Eliminated from Further Consideration

Groundwater resources in the primary study area, to the extent they exist, are not well documented or well understood. The primary study area is outside of the mapped groundwater basins defined by DWR in Bulletin 118 (2003). Groundwater present in the primary study area is expected to occur in fractured rock. As such, any impacts in that area would be highly dependent on the fracture properties (e.g., aperture, interconnectedness) and would be highly variable in space due to the discontinuous nature of fracture networks. Because of the speculative nature of impacts to groundwater resources in the primary study area, these impacts are not considered in the impact assessment below.

Potential for seepage along the San Joaquin River as result of the implantation of the No Action Alternative or action alternatives is also not considered in the impact assessment below. Impacts from potential seepage along the San Joaquin River are discussed in Chapter 12, "Hydrology – Flood Management."

Direct and Indirect Effects

The following section describes potential environmental consequences of the alternatives.

Impact GRW-1: Change in Groundwater Levels

Extended Study Area

No Action Alternative Under the No Action Alternative, the current state of overdraft and declining groundwater levels in portions of the extended study area would continue.

Simulated deliveries of surface water to various users would change, as shown in Table 13-12. While simulated deliveries to some groups increased (e.g., total SWP SOD), simulated deliveries in other areas decreased. Averaged over all years, simulated deliveries to Friant Division agricultural users decreased by 56 TAF/year and simulated deliveries to CVP SOD users decreased by 35 TAF/year. While the simulated reductions represent only a small fraction of estimated average future deliveries (1,055 and 2,323 TAF/year, respectively, for Friant Division agricultural and CVP SOD contractors), they indicate a potential for increased groundwater extraction, contributing to the current state of overdraft and declining water levels in portions of the extended study area.

This impact would be **potentially significant** under the No Action Alternative.

Alternative Plan 1 As documented in the Modeling Appendix, Alternative Plan 1 would result in a reduction in average simulated CVP SOD deliveries of 11 TAF per year relative to the No Action Alternative. Reduction of surface water deliveries may be offset by groundwater pumping, although other options (e.g., land fallowing or obtaining water on the transfer market) would also be available. The simulated reduction of 11 TAF/year would be less than 0.5 percent of the total deliveries to CVP SOD users. The impact of reduced surface water deliveries on groundwater levels would not likely be measurable.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," changes in San Joaquin River flow volumes and timing would be within typical historical ranges for the action alternatives. Flows in Wet years would be reduced when Temperance Flat RM 274 Reservoir captures flood flows, but flows in other year types would generally increase. The overall impact of these flow changes is not likely to adversely impact groundwater levels for near-river users.

This impact would be **less than significant** under Alternative Plan 1. Mitigation for this impact is not needed, and thus not proposed.

Table 13-12. Long-Term Average Annual Change in Deliveries (TAF) for No Action Alternative as Compared with Existing Conditions[1]

WY Type San Joaquin Index [2]	Change in System-wide Delivery	Total Friant Division Ag	Class 1	Class 2	Section 215	Total SWP SOD	SWP Ag SOD	SWP M&I SOD	Total CVP SOD[2]	CVP Ag SOD	CVP M&I SOD
Wet	493	(54)	(1)	(6)	(47)	552	43	510	(5)	(7)	0
Above Normal	111	(82)	(0)	(31)	(51)	213	12	201	(20)	(7)	(0)
Below Normal	89	(60)	(10)	(41)	(9)	140	2	139	9	24	(0)
Dry	(25)	(40)	(20)	(14)	(6)	81	(8)	89	(66)	(48)	(1)
Critical	(132)	(46)	(43)	(0)	(3)	17	(10)	27	(104)	(77)	(5)
All Years	**151**	**(56)**	**(13)**	**(16)**	**(27)**	**243**	**12**	**231**	**(35)**	**(23)**	**(1)**

Note:

[1] Changes in deliveries as simulated with CalSim II March 2012 Benchmark with future (2030) level of development and 82 year hydrologic period of record from October 1921 to September 2003.

[2] San Joaquin Year Type or 60-20-20 Year Type –This water year classification system is based on the historical and forecasted unimpaired inflows of the Stanislaus, Tuolumne, Merced, and San Joaquin rivers to the San Joaquin River Basin, as defined in State Water Board Decision 1641. The classification consists of five year types: Wet, Above Normal, Below Normal, Dry, and Critical. Average for all years is weighted average based on proportion of each year type out of 82-year period of record.

Key:
Ag = agricultural
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SOD = south-of-Delta
SWP = State Water Project
TAF = thousand acre-feet
WY = water year

Alternative Plans 2 through 4 As documented in the Modeling Appendix, Alternative Plans 2 through 4 resulted in increased average simulated surface water deliveries to Friant agricultural, SWP SOD, and CVP SOD users. Increased surface water deliveries would reduce the need to pump groundwater relative to the No Action Alternative.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," changes in San Joaquin River flow volumes and timing would be within typical historical ranges for the action alternatives. Flows in Wet years would be reduced when Temperance Flat RM 274 Reservoir captures flood flows, but flows in other year types would generally increase. The overall impact of these flow changes is not likely to adversely impact groundwater levels for near-river users.

This impact would be **less than significant and beneficial** under Alternative Plans 2 through 4. Mitigation for this impact is not needed, and thus not proposed.

Alternative Plan 5 As documented in the Modeling Appendix, Alternative Plan 5 would result in a reduction in average simulated total SWP SOD deliveries of 10 TAF per year relative to the No Action Alternative. Reduction of surface water deliveries may be offset by groundwater pumping, although other options (e.g., land fallowing or obtaining water on the transfer market) would also be available. The simulated reduction of 10 TAF/year would be less than 0.4 percent of the total deliveries to SWP SOD users. The impact of reduced surface water deliveries on groundwater levels would not likely be measurable.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," changes in San Joaquin River flow volumes and timing would be within typical historical ranges for the action alternatives. Flows in Wet years would be reduced when Temperance Flat RM 274 Reservoir captures flood flows, but flows in other year types would generally increase. The overall impact of these flow changes is not likely to adversely impact groundwater levels for near-river users.

This impact would be **less than significant** under Alternative Plan 5. Mitigation for this impact is not needed, and thus not proposed.

Impact GRW-2: Change in Groundwater Quality

Extended Study Area

No Action Alternative Under the No Action Alternative, the current state of overdraft declining groundwater levels in portions of the extended study area would continue. This in turn could lead to upwelling of poorer quality groundwater.

This impact would be **potentially significant** under the No Action Alternative.

Alternative Plan 1 As described for Impact GRW-1, Alternative Plan 1 would result in reduced CVP SOD deliveries and could result in increased groundwater pumping. However, the simulated reduction in surface water deliveries is less than 0.5 percent of the total deliveries to CVP SOD users. Changes to groundwater quality from this small change would not likely be measureable.

This impact would be **less than significant** under Alternative Plan 1. Mitigation for this impact is not needed, and thus not proposed.

Alternative Plans 2 Through 4 As described for Impact GRW-1, Alternative Plans 2 through 4 would reduce the need to pump groundwater relative to the No Action Alternative. Reduced groundwater pumping could reduce upwelling of poor quality groundwater and could slow or reverse the historical degradation of groundwater quality.

This impact would be **less than significant and beneficial** under Alternative Plans 2 through 4. Mitigation for this impact is not needed, and thus not proposed.

Alternative Plan 5 As described for Impact GRW-1, Alternative Plan 5 would result in reduced total SWP SOD deliveries and could result in increased groundwater pumping. However, the simulated reduction in surface water deliveries is less than 0.4 percent of the total deliveries to SWP SOD users. Changes to groundwater quality from this small change would not likely be measureable.

This impact would be **less than significant** under Alternative Plan 5. Mitigation for this impact is not needed, and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 13-11

No mitigation is required for Impacts GRW-1 or GRW-2 within the extended study area under the action alternatives, as these impacts would be less than significant or less than significant and beneficial.

Chapter 14
Surface Water Supplies and Facilities Operations

This chapter describes the affected environment for surface water supplies and facilities operations, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents both information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274) and the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The affected environment for surface water supplies and facilities operations encompasses the entire study area, including the San Joaquin River, the Delta, and CVP and SWP water service areas. Implementing the action alternatives would change surface water supplies and facilities operations of the San Joaquin River from Friant Dam to the Delta, in the Delta, and in CVP and SWP water service areas.

Flows in the San Joaquin River downstream from Friant Dam are affected by water projects operating on the river's tributaries, imports to the river from other regions, diversions out of the river, return flows, and Friant Dam operations. Flows have most recently been affected by release of Interim Flows, which began in 2009, and Restoration Flows, which began in 2014. This section includes historical San Joaquin River flow information from the last several decades, as well as information on flows beginning with the 2009 water year. Post-2009 flows are most representative of the affected environment.

Primary Study Area

The following is a description of surface water supplies and facilities operations in the primary study area. The primary study area includes surface water supplies and facilities in the area of project features (Temperance Flat RM 274 Reservoir

Area) and Millerton Lake, which are discussed in the respective sections below.

Temperance Flat Reservoir Area

The San Joaquin River upstream from and including Millerton Lake above RM 274 drains approximately 1,675 square miles and has an annual average unimpaired runoff of 1,818 TAF (Water Year 1901–2011), with a range of 362 to 4,642 TAF. Upstream from RM 274, Kerckhoff Dam is located at RM 292.5. The San Joaquin River flows through the gorge from Kerckhoff Dam to Kerckhoff No.2 Powerhouse, and then becomes Millerton Lake. Several reservoirs exist in the upper San Joaquin River watershed, used primarily for hydropower generation. Operation of these reservoirs affects the timing of inflow to the Temperance Flat Reservoir Area and Millerton Lake, but would not substantially affect Temperance Flat RM 274 Dam operations. Table 14-1 lists the Reclamation water rights on the San Joaquin River at Friant Dam.

Table 14-1. U.S. Department of the Interior, Bureau of Reclamation Water Rights on the San Joaquin River at Friant Dam

Application	A000023	A000234	A001465	A005638	Combined Maximum
Application Date	3/27/1915	1/19/1916	9/26/1919	7/30/1927	--
Permit	000273	011885	011886	011887	--
Permit Date	5/3/1917	6/29/1959	6/29/1959	6/29/1959	--
License	001986	--	--	--	--
License Date	10/17/1939	--	--	--	--
Maximum Diversion (cubic feet per second)	373	3,000	3,000	5,000	6,500 (A234, A1465, A5638)
Maximum Storage (AF/year)	--	500,000	500,000	1,210,000	2,210,000
Maximum Use (AF/year)	44,340	2,124,487	2,124,487	3,917,478	--
Direct Diversion Season	4/1 – 7/1	2/1 – 10/31	2/1 – 10/31	2/1 – 10/31	--
Storage Season	--	11/1 – 8/1	11/1 – 8/1	11/1 – 8/1	--
Purposes of Use	Municipal, Domestic, Irrigation, Incidental Domestic, Stockwatering, Preservation and Enhancement of Fish and Wildlife, Recreational	Municipal, Domestic, Irrigation, Incidental Domestic, Stockwatering, Preservation and Enhancement of Fish and Wildlife, Recreational	Municipal, Domestic, Irrigation, Incidental Domestic, Stockwatering, Preservation and Enhancement of Fish and Wildlife, Recreational	Municipal, Domestic, Irrigation, Incidental Domestic, Stockwatering, Preservation and Enhancement of Fish and Wildlife, Recreational	--

Table 14-1. U.S. Department of the Interior, Bureau of Reclamation Water Rights on the San Joaquin River at Friant Dam (contd.)

Application	A000023	A000234	A001465	A005638	Combined Maximum
Places of Use	Gross area of 5,431,000 acres as shown on Maps 214-212-37, 214-208-3331, 1785-202-14, and 1785-202-50 (all authorized purposes); San Joaquin River and designated bypass system from Friant Dam to the Sacramento-San Joaquin River Delta (Delta) and through the Delta Channels to the Jones and Banks Pumping Plants, as shown on Map 1785-202-50 (Recreational, Fish and Wildlife).	Gross area of 5,431,000 acres as shown on Maps 214-212-37,214-208-3331, 1785-202-14, and 1785-202-50 (all authorized purposes); San Joaquin River and designated bypass system from Friant Dam to the Sacramento-San Joaquin River Delta (Delta) and through the Delta Channels to the Jones and Banks Pumping Plants, as shown on Map 1785-202-50 (Recreational, Fish and Wildlife); Millerton Reservoir (Stockwatering, Recreational)	Gross area of 5,431,000 acres as shown on Maps 214-212-37, 214-208-3331,1785-202-14, and 1785-202-50 (all authorized purposes); San Joaquin River and designated bypass system from Friant Dam to the Sacramento-San Joaquin River Delta (Delta) and through the Delta Channels to the Jones and Banks Pumping Plants, as shown on Map 1785-202-50 (Recreational, Fish and Wildlife); Millerton Reservoir (Stockwatering, Recreational)	Gross area of 5,431,000 acres as shown on Maps 214-212-37, 214-208-3331,1785-202-14, and 1785-202-50 (all authorized purposes); San Joaquin River and designated bypass system from Friant Dam to the Sacramento-San Joaquin River Delta (Delta) and through the Delta Channels to the Jones and Banks Pumping Plants, as shown on Map 1785-202-50 (Recreational, Fish and Wildlife); Millerton Reservoir (Stockwatering, Recreational)	--

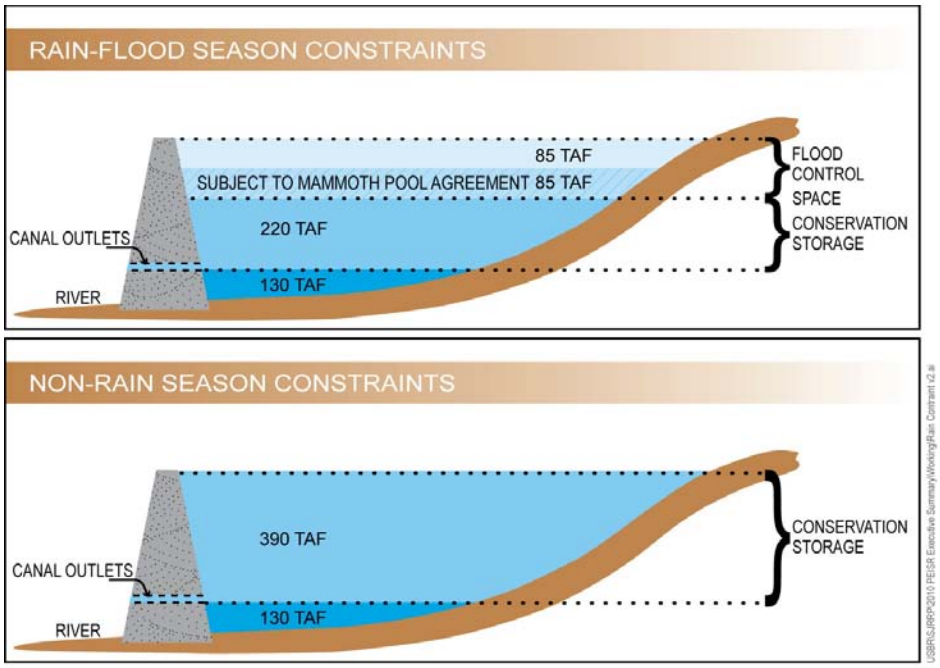
Source: State Water Board 2014
Key:
-- = not applicable
AF = acre-feet
State Water Board = California State Water Resources Control Board

Millerton Lake

Millerton Lake was formed by Friant Dam in 1942. It is the largest reservoir, by volume and surface area, on the San Joaquin River. Big Sandy Creek, Fine Gold Creek, and several ephemeral streams flow directly into Millerton Lake. Friant Dam is a 319-foot-high concrete gravity dam. Outlets to the Madera Canal (elevation 448.6) are located on the right abutment; outlets to the Friant-Kern Canal (elevation 466.6) are located on the left abutment. The spillway consists of an ogee overflow section, chute, and stilling basin at the center of the dam. The spillway is controlled by one 18-foot-high by 100-foot-wide drum gate, and two comparably sized Obermeyer gates. A river outlet works (elevation 382.6) is located to the left of the spillway within the lower portion of the dam. Information regarding power features on Friant Dam is found in Chapter 20, "Power and Energy."

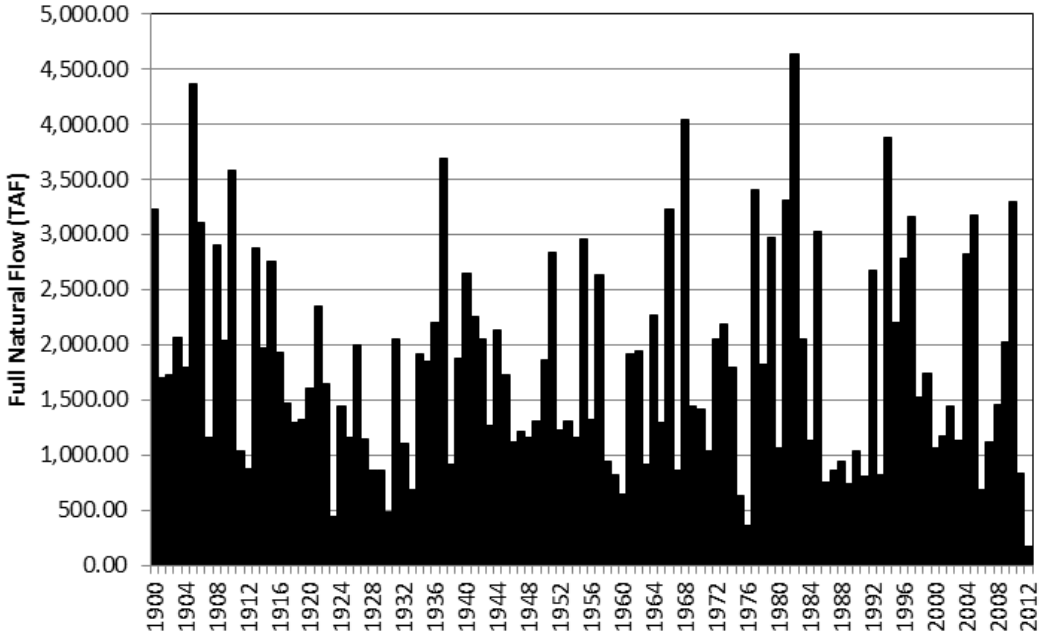
When full, the reservoir extends 16 miles up into the river canyon from Friant Dam, located at RM 267.6, and has more than 41 miles of shoreline. Millerton Lake has a volume of 524 TAF, a surface area of 4,905 acres, and an elevation of 580.6 feet above msl (NAVD 1988 datum) at top of active storage. At top of active storage, the reservoir has a maximum depth of 287 feet. Figure 14-1 shows a conceptual representation of an active conservation space of 390 TAF during April through September, when there is little risk of rain floods. Inactive storage is 130 TAF. During the rainy season of October through March, up to 170 TAF of space in Millerton Lake is maintained for rain flood management (USACE 1980). Under present operating rules, up to 85 TAF of the flood management storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool, located on the San Joaquin River upstream from Millerton Lake. Chapter 12, "Hydrology – Flood Management," discusses water releases made for flood management purposes at Friant Dam in detail.

Figure 14-2 shows the historical annual unimpaired runoff for the gage directly below Friant Dam.



Key:
TAF = thousand acre-feet
Note: Reservoir volumes are approximate

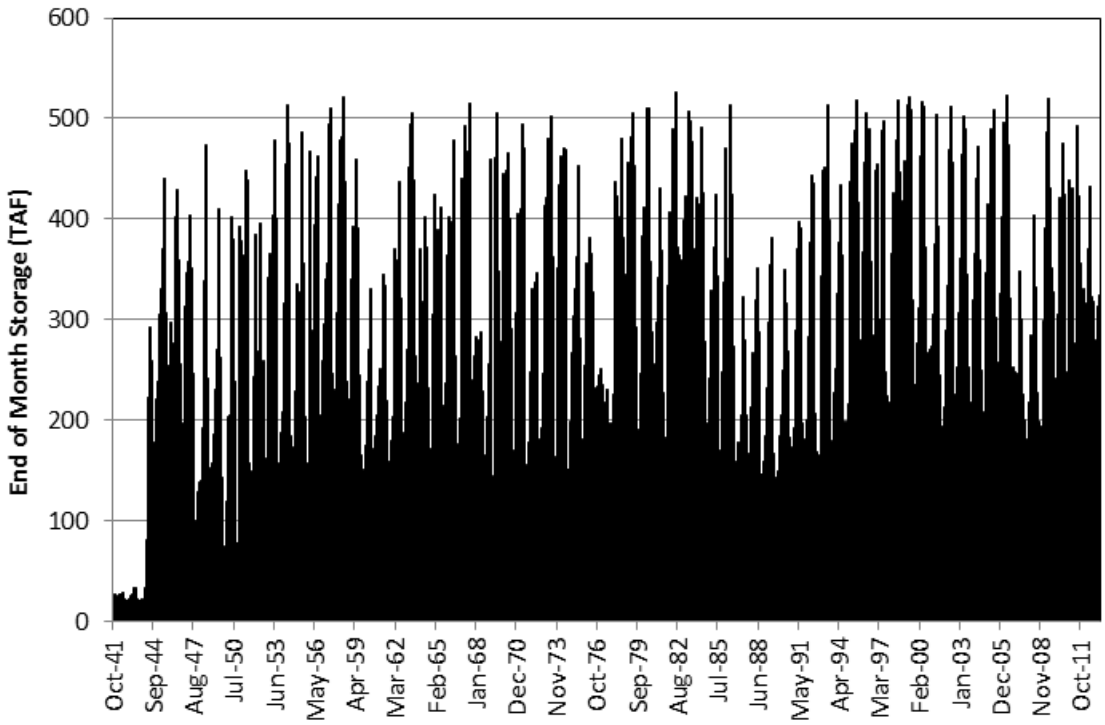
Figure 14-1. Conceptual Representation of Millerton Lake Storage Requirements



Source: DWR 2013a, Gage ID SJF
Key:
TAF = thousand acre-feet

Figure 14-2. Historical Annual Unimpaired Runoff Below Friant Dam, by Water Year

Millerton Lake is operated as an annual reservoir, in that most water supplies available in a given year are allocated with the expectation of delivery. Stored water carried over from a previous year usually occurs when water users request it, but is done so at Reclamation's discretion. Median reservoir water-level ranges from elevation 564 in late spring to elevation 497 in late summer. Figure 14-3 shows historical end-of-month storage of Millerton Lake.



Source: DWR 2013a, Gage ID MIL
Key:
EOM = End-of-Month
TAF = thousand acre-feet

Figure 14-3. Historical Millerton Lake End-of-Month Storage, Water Years 1941–2012

Water deliveries, principally for irrigation, are made through outlet works to the Friant-Kern and Madera canals, completed in 1949 and 1944, respectively. A river outlet works is located within the dam's lower portion. Additional physical data pertaining to Friant Dam and Millerton Lake are presented in Table 14-2. River releases are made to comply with Holding Contract requirements, which are contracts between Reclamation and riparian water right holders between Friant Dam and Gravelly Ford. Consistent with the Holding Contracts, Reclamation makes river releases to maintain

streamflow of at least 5 cfs past each Holding Contract control point, with the last being near Gravelly Ford. Contract water deliveries are further described below, for the CVP and SWP water service areas. Under current conditions, San Joaquin River releases are also made downstream from Friant Dam in accordance with the Settlement and the Act.

Table 14-2. Pertinent Physical Data – Millerton Lake and Friant Dam

Millerton Lake			
Elevation[1]		*Unimpaired Flows of Friant Dam*	
Minimum operating level[2]	468.7 feet above msl	Average annual runoff (1901–2012)	1,800,530 acre-feet
Top of active storage	580.6 feet above msl	Average flow	2,491 cfs
Spillway flood pool	587.6 feet above msl	Minimum average daily inflow (October 10, 1977)	0 cfs
Area		Maximum average daily inflow (December 23, 1955)	61,700 cfs
Minimum operating level[2]	2,108 acres	Maximum instantaneous inflow (December 23, 1955)	97,000 cfs
Top of active storage	4,905 acres	Maximum average daily outflow (June 6, 1969)	12,400 cfs
Spillway flood pool	5,085 acres	Minimum average daily outflow (October 20, 1940)	5.5 cfs
Drainage area	1,675 square miles		
Storage Capacity			
Minimum operating level[2]	130,740 acre-feet		
Top of active storage	524,250 acre-feet		
Spillway flood pool	559,300 acre-feet		
Friant Dam (concrete gravity) and Outlet Works			
Elevation[1]/ Height		*River Outlets*	
Elevation, top of parapet	587.6 feet above msl	Number and elevation[1]	4 at 382.6 feet above msl
Freeboard above spillway flood pool	3.25 feet	Size	110-inch diameter with 96-inch hollow jet valves
Elevation, crown of roadway	583.8 feet above msl		
Max height, foundation to crown of roadway	319 feet	Capacity at minimum pool	12,400 cfs
Total concrete in dam and appurtenances	2,135,000 cubic yards	Capacity at top of active storage	16,400 cfs
Dam Crest Length		*Madera Outlets and Canal*	
Left abutment, non-overflow section	1,478 feet	Outlet number and elevation[1]	2 at 448.6 feet above msl
Overflow river section	332 feet	Size	91-inch diameter with 86-inch needle valve
Right abutment, non-overflow section	1,678 feet	Canal length	35.9 miles
Total length	3,488 feet		
Width of crest at elevation 581.25	20.0 feet	Canal operating capacity below Friant Dam	1,000 cfs
Crest Gates (1 drum and 2 Obermeyer)		Canal operating capacity at terminus of canal	625 cfs
Number and size	3 at 100 feet by 18 feet		
Top elevation when lowered[1]	562.6 feet above msl		
Top elevation when raised[1]	580.6 feet above msl	*Friant-Kern Outlets and Canal*	
Spillway (gated ogee)		Outlet number and elevation[1]	4 at 466.6 feet above msl
Gross length	332 feet	Size	110-inch diameter w/ 96-inch hollow jet valve
Net length	300 feet		
Crest elevation[1]	562.6 feet above msl	Canal length	151.8 miles
Discharge capacity (height = 18.0 feet)	83,160 cfs	Canal operating capacity below Friant Dam	5,000 cfs
Design flood peak inflow	197,000 cfs	Canal operating capacity at terminus of canal	2,000 cfs
Design flood peak outflow	158,500 cfs		

Source: USACE 1980, with elevations revised to NAVD 1988
Notes:
[1] Elevations are given in North American Vertical Datum (NAVD) 1988.
[2] Minimum operating level generally corresponds with elevation of Friant-Kern Canal outlets.
Key:
cfs = cubic feet per second
msl = mean sea level

Extended Study Area

This section describes surface water supply and facility operations in the extended study area, which includes the San Joaquin River from Friant Dam to Merced River and from Merced River to the Delta, the Delta, and the CVP and SWP water service areas.

San Joaquin River from Friant Dam to Merced River

This section describes water operations within the extended study area for five distinct river reaches (including seven subreaches), and several flood bypasses. A map of the river reaches and flood bypass system is provided in Chapter 5, "Biological Resources – Fisheries and Aquatic Resources." Flood bypasses are discussed in further detail in Chapter 12, "Hydrology – Flood Management."

Reach 1 Reach 1 conveys continuous flows through an incised, gravel-bedded channel to Gravelly Ford, forming part of the boundary between Fresno and Madera counties. Releases are made at Friant Dam (Figure 14-4) to comply with Holding Contract requirements along Reach 1 and to meet the requirements of the SJRRP. Streamflow of at least 5 cfs for Holding Contracts is maintained past the last diversion near Gravelly Ford, with no Holding Contract requirements for streamflow into Reach 2.

The objective release from Friant Dam into Reach 1 is 8,000 cfs. Reach 1 of the San Joaquin River is hydraulically connected to 190 acres of sand and aggregate mining pits, with an additional 1,170 acres of pits in the surrounding floodplain (McBain and Trush 2002). These pits can attenuate flow and increase evaporation through ponding. There are no storage facilities in Reach 1. Ten major road crossings in this reach can affect flow stage (McBain and Trush 2002). Agricultural return flows in Reach 1 are minor, but have reached up to 300 cfs on occasion (EPA 2007). Stormwater runoff from the Fresno metropolitan area is managed by the Fresno Metropolitan Flood Control District. All but 5 of the District's 161 drainage basins route stormwater to retention and detention facilities, limiting the urban surface runoff into Reach 1.

Reach 1 is subdivided into two subreaches, 1A and 1B, at State Route (SR) 99. These subreaches are described below.

Reach 1A Flows within Reach 1A are predominantly influenced by releases from Friant Dam, along with diversions and seepage losses. Mining pits in Reach 1 are primarily

located in Reach 1A. Eighty-four water diversions are located along this reach, some of which are active on a regular basis. Cottonwood Creek and Little Dry Creek, two intermittent streams, join the San Joaquin River in Reach 1A. Cottonwood Creek, draining 35.6 square miles, flows in from the north near the base of Friant Dam. Little Dry Creek, draining 57.9 square miles, joins the San Joaquin River from the south approximately 8 miles downstream from Friant Dam. Flows in Little Dry Creek can be augmented from Big Dry Creek Dam and Reservoir, a 30 TAF flood control reservoir operated by the Fresno Metropolitan Flood Control District (McBain and Trush 2002). Flows from these two creeks must be included in the 8,000 cfs Reach 1A objective release when determining releases from Friant Dam.

Since 1949, Reclamation has made average annual releases of approximately 117 TAF from Friant Dam to the San Joaquin River to comply with Holding Contract requirements upstream from Gravelly Ford. Since 2009, Reclamation has also made releases for the SJRRP, which has increased average annual releases. Additional river flows occur during years when releases are made to the San Joaquin River for flood management purposes which can range up to 25,000 cfs (see Chapter 12, “Hydrology – Flood Management”). Releases made from Friant Dam for water diversions typically range from 40 cfs to 250 cfs (McBain and Trush 2002). Table 14-3 lists the streamflow gages located in or near this reach segment, their period of record, average streamflow, and maximum daily average flow. Figure 14-4, Figure 14-5, Figure 14-6, and Figure 14-7 show monthly average flows at the gages.

Table 14-3. Streamflow Gages in San Joaquin River Reach 1A

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)[2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River release from Friant Dam	MIL	267.6	1,675	1975–2012	926	25,556 (January 4, 1997)
San Joaquin River below Friant Dam	11251000	266.0	1,676	1975–2011[3]	1,241	36,800 (January 3, 1997)
Cottonwood Creek near Friant Dam	CTK	NA	35.6	1975–2012	9	783 (January 27, 1983)
Little Dry Creek near Friant Dam	LDC	NA	57.9	1975–2012	26	2,457 (March 11, 1995)

Source: DWR 2013a; USGS 2013; SJRRP 2013

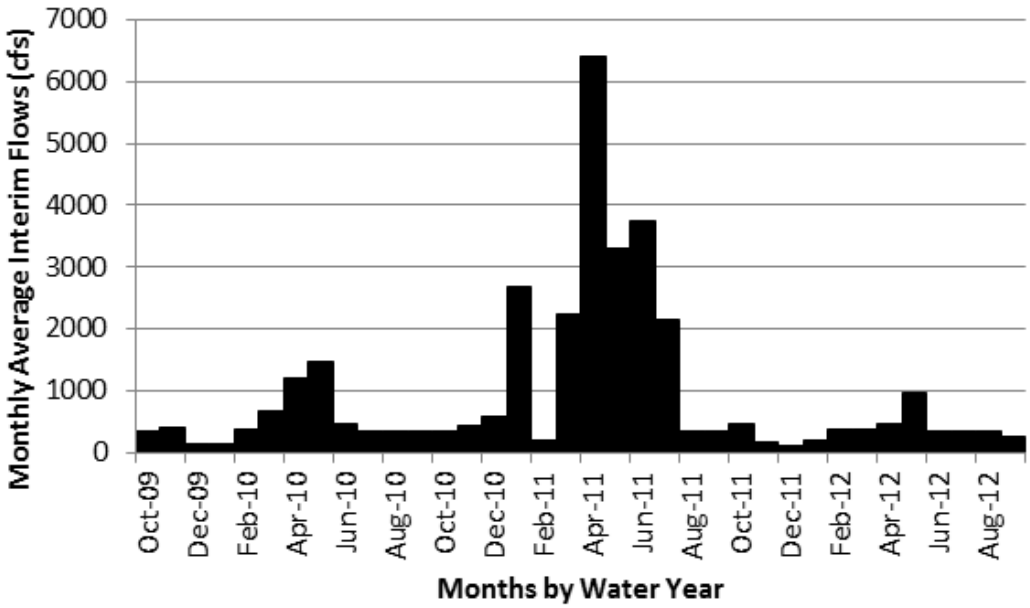
Notes:

[1] Period of record is expressed by Water Year.

[2] Average streamflow data is reported for the referenced period of record, including Interim Flows, which began in Water Year 2009.

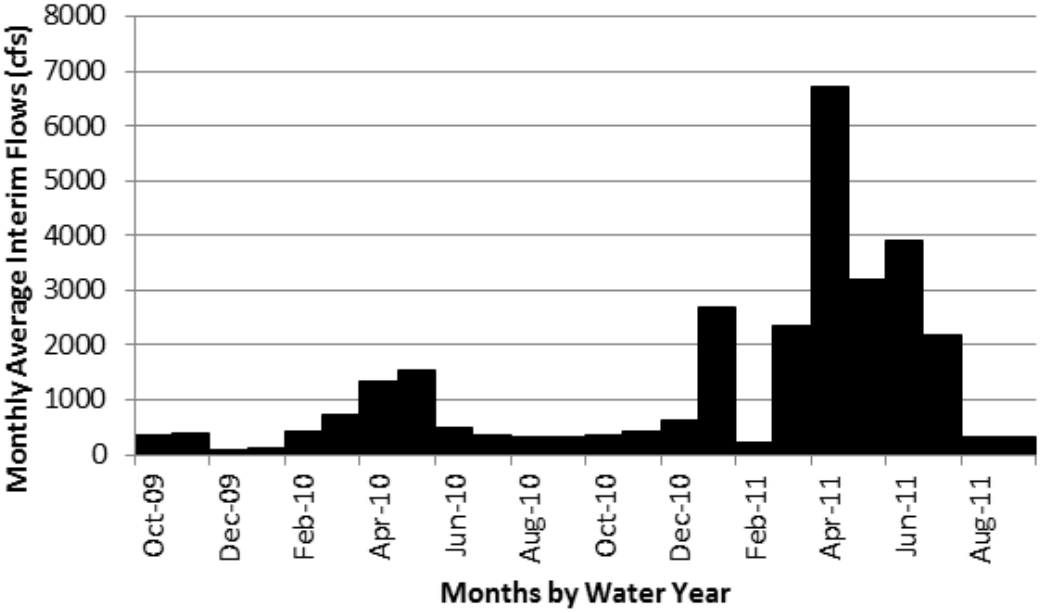
[3] Difference between Friant Dam releases and gage flow below dam caused by minor inflows and depletions between the two locations, and by difference in extent of period of record through Water Year 2011 or Water Year 2012.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
NA = not applicable
No. = number
USGS = U.S. Geological Survey



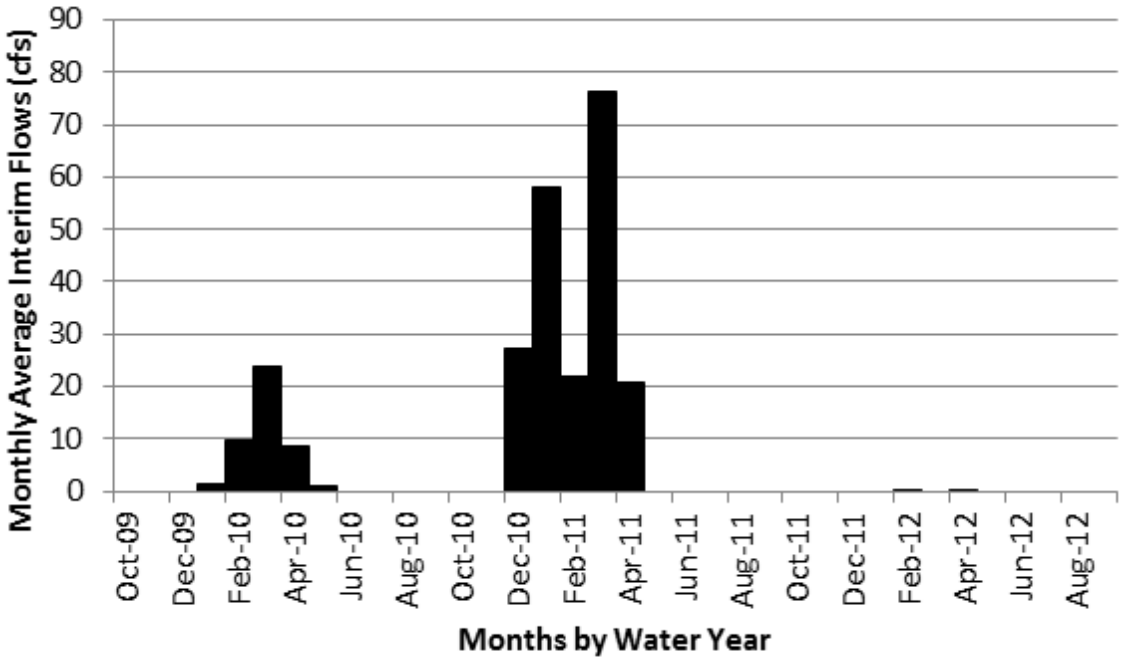
Source: SJRRP 2013, Gage ID SJF
Key: cfs = cubic feet per second

Figure 14-4. Monthly Average Friant Dam Releases (Post-Interim Flows)



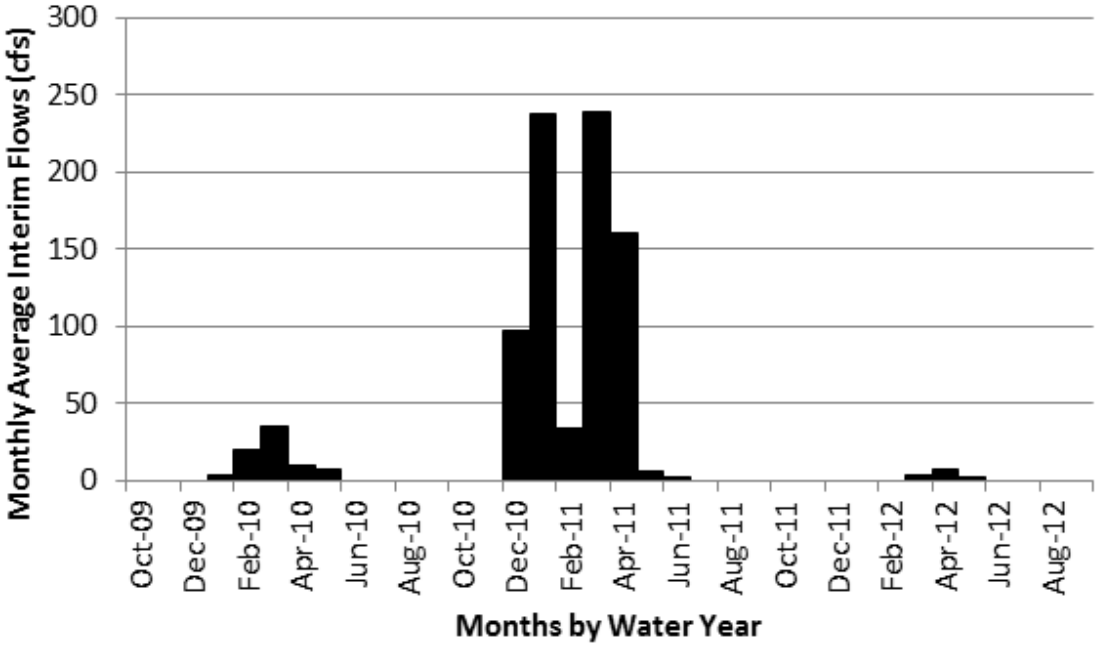
Source: USGS 2013, Gage Station No. 11251000
Key: cfs = cubic feet per second

Figure 14-5. Monthly Average Flows for San Joaquin River Below Friant Dam (Post-Interim Flows)



Source: SJRRP 2013, Gage ID CTK
Key: cfs = cubic feet per second

Figure 14-6. Monthly Average Flows for Cottonwood Creek Near Friant Dam (Post-Interim Flows)



Source: SJRRP 2013, Gage ID LDC
Key: cfs = cubic feet per second

Figure 14-7. Monthly Average Flows for Little Dry Creek Near Friant Dam (Post-Interim Flows)

Reach 1B Flows within Reach 1B are predominantly influenced by inflow from Reach 1A, diversions, and seepage losses. Fifteen water diversions are located along this reach, some of which are regularly active. Table 14-4 lists the gages located in or near this reach segment, their periods of record, and average and maximum daily average streamflows. Figure 14-8 and Figure 14-9 show monthly average flows at the gages. Note that the Donny Bridge gage has several missing monthly of flow data that can be seen in the Skaggs Bridge gage figure.

Table 14-4. Streamflow Gages in San Joaquin River Reach 1B

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)[2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River at Donny Bridge	DNB	240.7	NA	1989–2012	336	7,900 (December 30, 1996)[3]
San Joaquin River at Skaggs Bridge	Skaggs[4]	232.1	NA	1975–2012	855	7,900 (December 30, 1996)[3]

Source: SJRRP 2013

Notes:

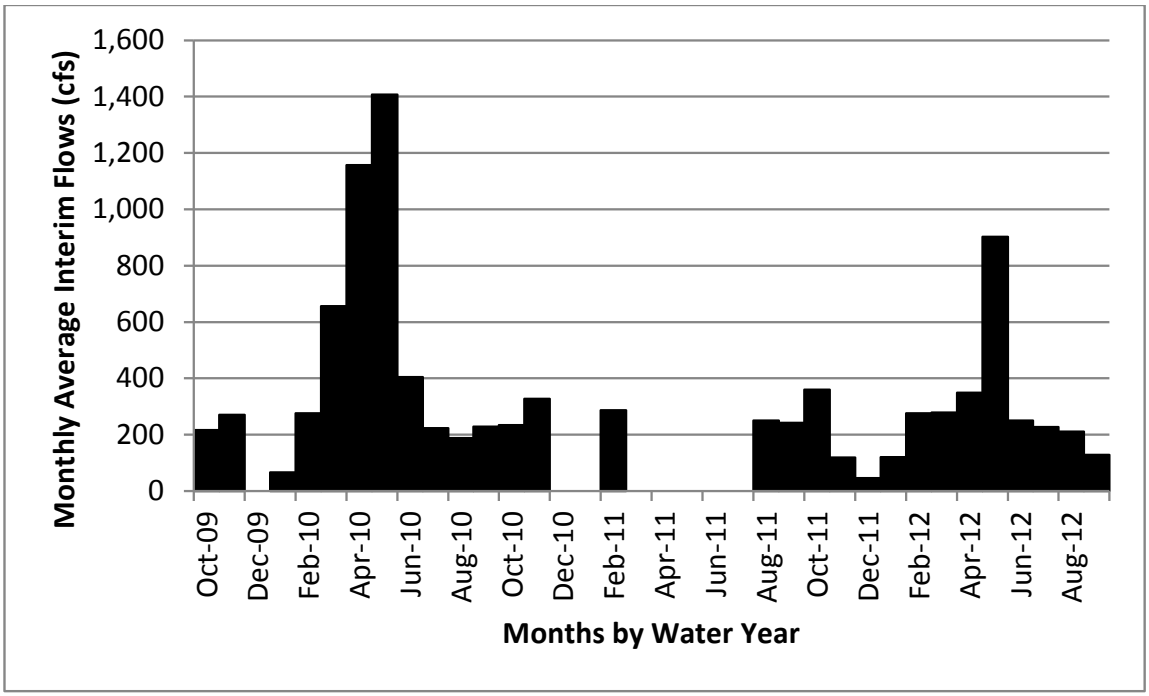
[1] Period of record is expressed by Water Year.

[2] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.

[3] This maximum daily average streamflow was exceeded in the January 1997 flood event.

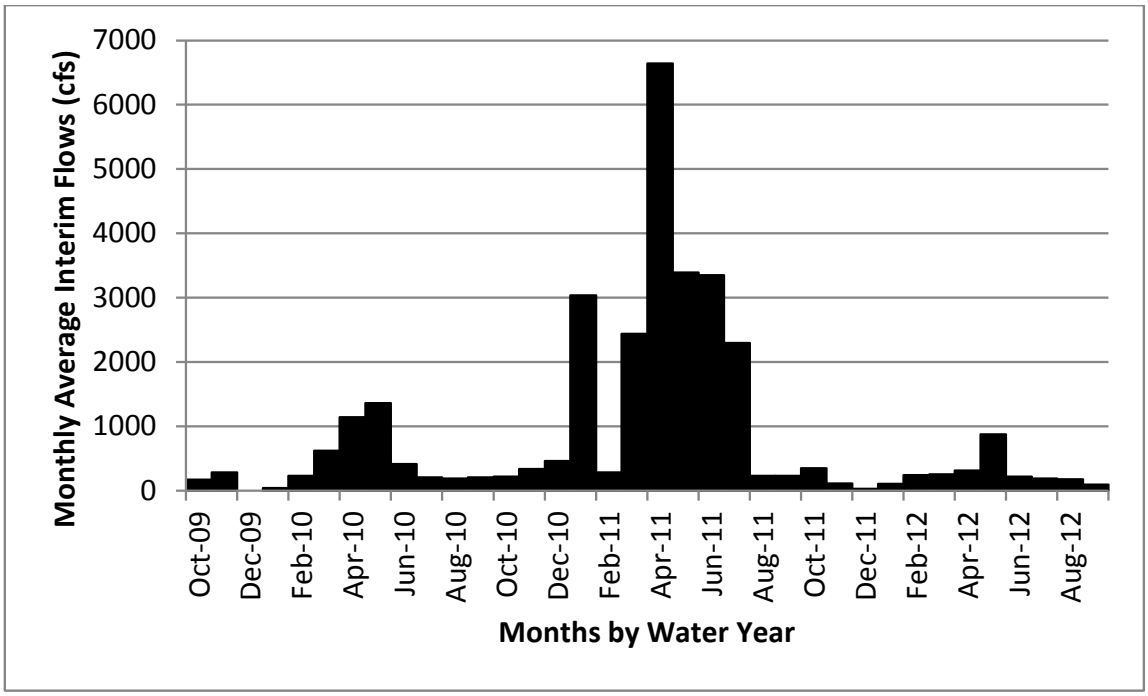
[4] San Joaquin River Restoration Program gage ID.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: SJRRP 2013, Gage ID DNB
Key: cfs = cubic feet per second

Figure 14-8. Monthly Average Flows for San Joaquin River at Donny Bridge (Post-Interim Flows)



Source: SJRRP 2013, Gage ID Skaggs
Key: cfs = cubic feet per second

Figure 14-9. Monthly Average Flows for San Joaquin River at Skaggs Bridge (Post-Interim Flows)

Reach 2 Reach 2 of the San Joaquin River marks the end of the incised channel, and is characterized by a meandering channel of low gradient. Reach 2 ends at Mendota Dam, and the Mendota Pool backwater extends upstream along a portion of this reach.

Before the release of Interim and Restoration flows began, Reach 2 was typically dry and flows only reached Mendota Pool from Reach 2B or from the Fresno Slough during periods of flood management releases. Flood flows most recently reached Mendota Pool from the San Joaquin and/or Kings rivers in 1997, 2001, 2005, 2006, and 2011. Restoration Flows will continue to flow through this reach and be recaptured at Mendota Pool while channel capacity constraints exist downstream.

In addition to Restoration Flows, Mendota Pool regularly receives water from the DMC, delivering water to the Exchange Contractors, other CVP contractors, and wildlife refuges and management areas. Mendota Pool provides no long-term storage for water supply operations or flood management.

The Mendota Pool averages about 400 feet wide, is generally less than 10 feet deep, and has a total capacity of about 8,500 acre-feet (Reclamation 2004). Mendota Dam, built in 1917, is owned and operated by the Central California ID. Mendota Dam is a flashboard-and-buttress dam, 23 feet high and 485 feet long; the crest elevation is 168.5 feet. Mendota Pool distributes water from the DMC and San Joaquin River to local diversion points. Manual gates and flashboards on the dam are opened or removed during periods of high flow to reduce seepage impacts on land surrounding Mendota Pool.

The reach is subdivided into two subreaches, 2A and 2B, at the Chowchilla Bypass Bifurcation Structure. These subreaches are described below.

Reach 2A Reach 2A is typified by the accumulation of sand, caused in part by backwater effects of the Chowchilla Bypass Bifurcation Structure and by a lower gradient relative to Reach 1. Reach 2A has high percolation losses; under steady-state conditions (i.e., losses are calculated under extended periods of steady flow), flow does not reach the Chowchilla Bypass Bifurcation Structure when flow at Gravelly Ford is less than 75 cfs (McBain and Trush 2002). Reach 2A has a design channel capacity of 8,000 cfs to accommodate controlled

releases from Friant Dam. Agricultural return flows within this reach are minor. Ten water diversions are located along this reach. Table 14-5 lists the gage located in this reach segment, the period of record, and average and maximum daily average streamflow. Figure 14-10 shows monthly average flows at the gage.

Table 14-5. Streamflow Gage in San Joaquin River Reach 2A

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs) [2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River at Gravelly Ford	GRF	236.9	NA	1975–2012	798	37,843 (January 4, 1997)

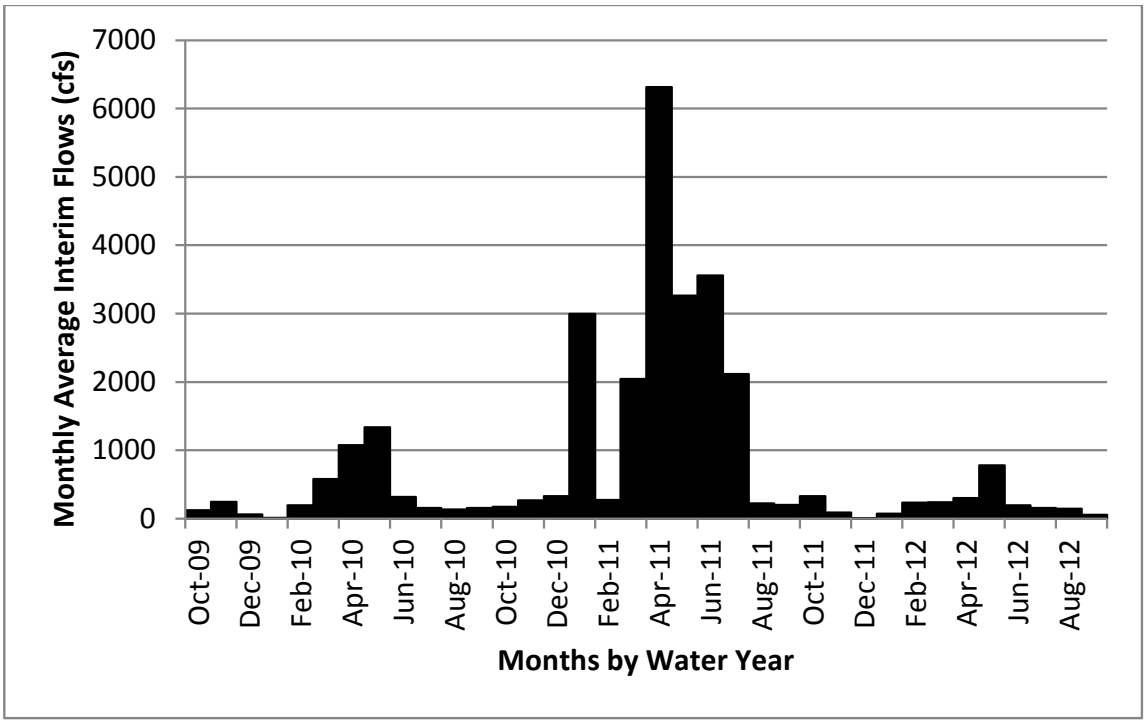
Source: SJRRP 2013

Notes:

[1] Period of record is expressed by Water Year.

[2] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
NA = not available
No. = number
USGS = U.S. Geological Survey



Source: SJRRP 2013, Gage ID GRF
Key: cfs = cubic feet per second

Figure 14-10. Monthly Average Flows for San Joaquin River at Gravelly Ford (Post-Interim Flows)

Reach 2B Reach 2B is a sandy channel extending into Mendota Pool, bordered by levees. The design conveyance capacity of this subreach is 2,500 cfs, but significant levee seepage has been observed at flows above 1,300 cfs (RMC 2007). Agricultural return flows within this reach are minor. A set of gates and flashboards at Mendota Dam may be manually opened or removed in advance of high-flow conditions. This process lowers the water level in the pool and reduces seepage impacts to adjacent lands, but hinders distribution of flows into canals diverting from Mendota Pool. Twenty-nine water diversions are located along this reach. One major road crossing in this reach can affect flow stage. The DMC typically conveys 2,500 to 3,000 cfs to Mendota Pool, and is the major source of pool inflow during the irrigation season. Table 14-6 shows the gage located in this reach segment, its period of record, and average and maximum daily average streamflow. Figure 14-11 shows monthly average flows at the gage and demonstrates the dry conditions within Reach 2B.

Channel capacity limitations below Mendota Pool have required recapture of most of the Interim and Restoration flows

at Mendota Pool. As the capacity of the San Joaquin River downstream from Mendota Pool is gradually increased, Restoration Flows will increase downstream from Mendota Pool, and recapture at Mendota Pool would only occur as needed (e.g., during scheduled construction activities downstream from Mendota Dam, such as in Reach 4B).

Table 14-6. Streamflow Gage in San Joaquin River Reach 2B

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)[2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River below Chowchilla Bypass Bifurcation Structure	SJB	217.8	NA	1975–1986, 1989–1997, 2006–2012	277	2,660 (May 23, 1978)

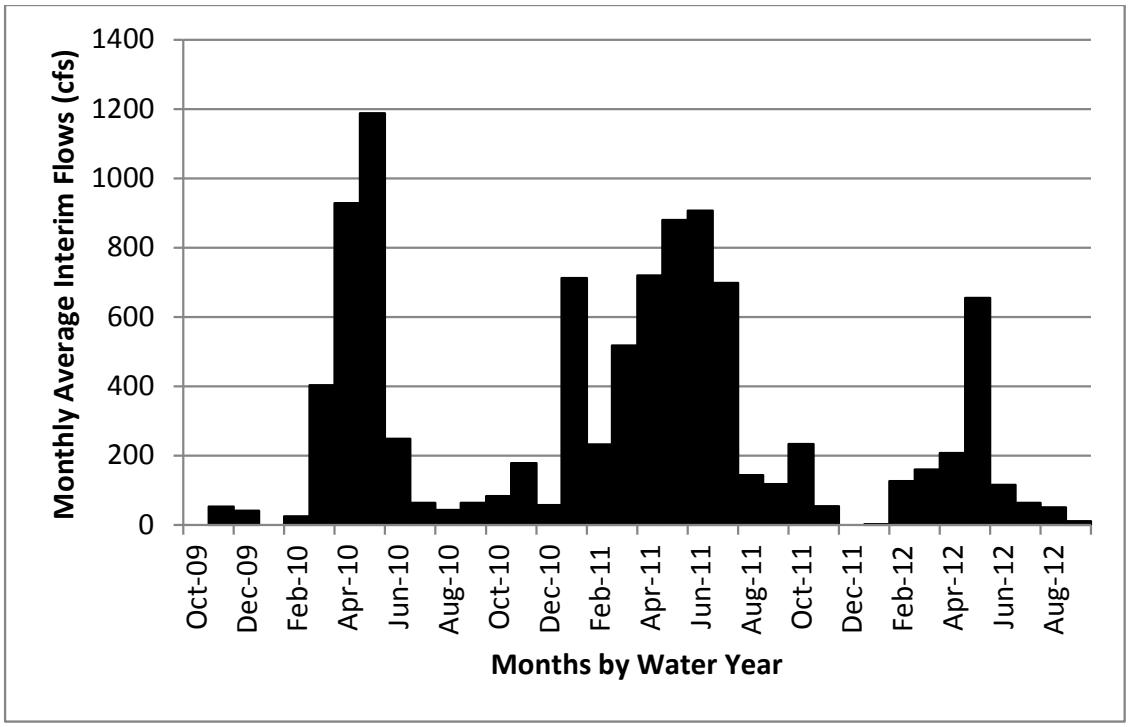
Source: SJRRP 2013

Notes:

[1] Period of record is expressed by Water Years.

[2] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
NA = not available
No. = number
USGS = U.S. Geological Survey



Source: SJRRP 2013, Gage ID SJB
Key: cfs = cubic feet per second

Figure 14-11. Monthly Average Flows for San Joaquin River Below Chowchilla Bypass Bifurcation Structure (Post-Interim Flows)

Reach 3 Reach 3 of the San Joaquin River flows 23 miles along a sandy channel from Mendota Dam to Sack Dam. The design capacity of Reach 3 is 4,500 cfs; however, observations suggests that seepage and associated flooding may begin in this reach at sustained flows above 800 cfs (RMC 2007). The estimated existing capacity of Reach 3 is 2,760 cfs without any flows on the levees (SJRRP 2014). Flows within this reach predominantly consist of water conveyed from the Delta by the DMC and released into the Mendota Pool for subsequent diversion at Arroyo Canal.

Sack Dam is a 5-foot-high concrete and wood diversion structure delivering water to the Arroyo Canal on the west side of the river (RMC 2003). During the last decade changes in groundwater use within this reach are thought to be causing subsidence between the Eastside Bypass and Reach 3. SLCC reports recent subsidence of Sack Dam at rates exceeding 0.5 feet per year (SLCC 2013). Both CCID and SLCC are working with growers in the western portion of Madera County to develop potential solutions to subsidence in those areas that

directly impact Sack Dam and other physical infrastructure (Exchange Contractors 2013, CCID 2012).

Flows of 500 to 600 cfs are typically released from the Mendota Pool for downstream diversions at Sack Dam. Flows greater than required for diversions (such as during flood events) spill over Sack Dam and into the San Joaquin River downstream into Reach 4A. The existing fish passage facility at Sack Dam is inoperable. Seven water diversions are located in this reach. One major road crossing in this reach can affect flow stage.

Table 14-7 lists the gage located in this reach segment, its period of record, and average and maximum daily average streamflow. Figure 14-12 shows monthly average flows at the gage.

Table 14-7. Streamflow Gage in San Joaquin River Reach 3

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)[3]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Mendota	11254000	217.8	3,940	1951–1954, 1975–2011[2]	617	8,770 (May 29, 1952)

Source: USGS 2013

Notes:

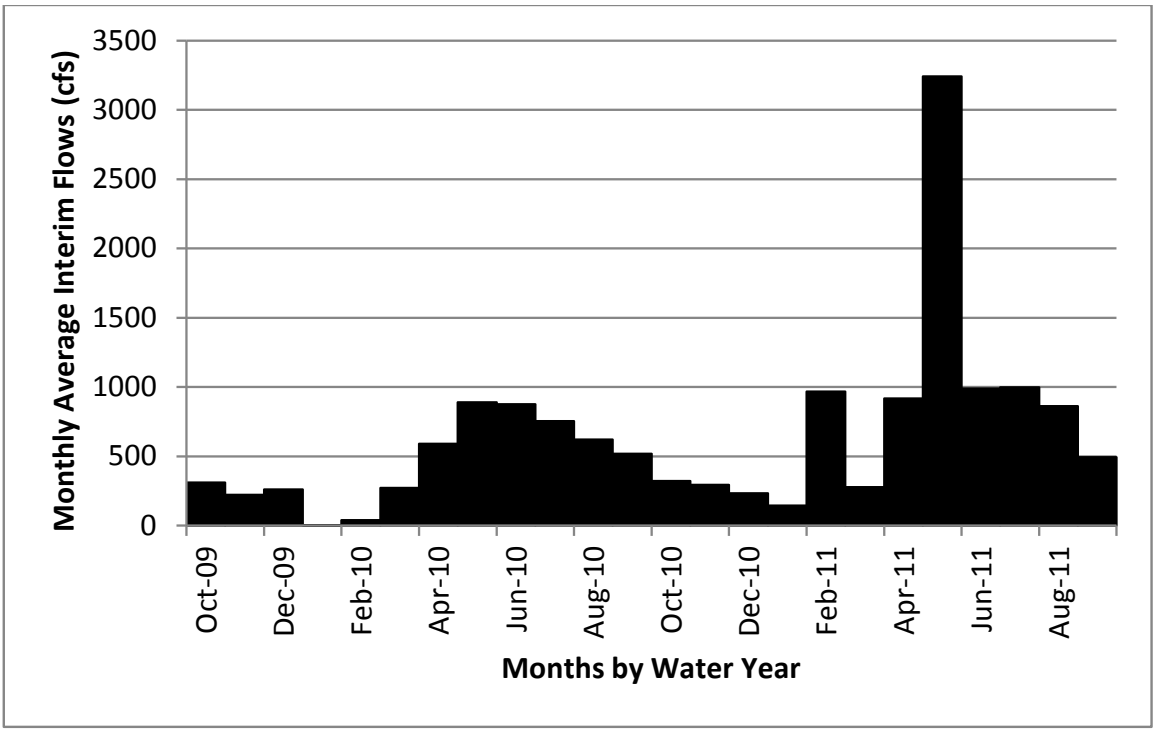
[1] Period of record is expressed in Water Years.

[2] Period of record coincides with the start of diversions from Friant Dam (1950).

[3] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.

Key:

CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
No. = number
USGS = U.S. Geological Survey



Source: USGS 2013, Gage Station No. 11254000
Key: cfs = cubic feet per second

Figure 14-12. Monthly Average Flows for San Joaquin River near Mendota (Post-Interim Flows)

Reach 4 Reach 4 of the San Joaquin River runs approximately 46 miles from Sack Dam to the confluence of the Eastside Bypass. Flows within much of this reach are predominantly agricultural return flows, although large sections of this reach are dry. Reach 4 is subdivided into three subreaches: Reach 4A, Reach 4B1, and Reach 4B2 (see Chapter 5, "Biological Resources – Fisheries and Aquatic Resources" for a map of these reaches) Reach 4A begins at Sack Dam and extends to the Sand Slough Control Structure; Reach 4B1 extends from the Sand Slough Control Structure to the Mariposa Bypass confluence; and Reach 4B2 begins at the confluence of the Mariposa Bypass and extends to the confluence of the Eastside Bypass.

Reach 4 subreaches have different characteristics and design capacities, as discussed below. Several road crossings exist in Reach 4; however, the dry conditions in this reach minimize their effect on stage and flow under current flow regimes.

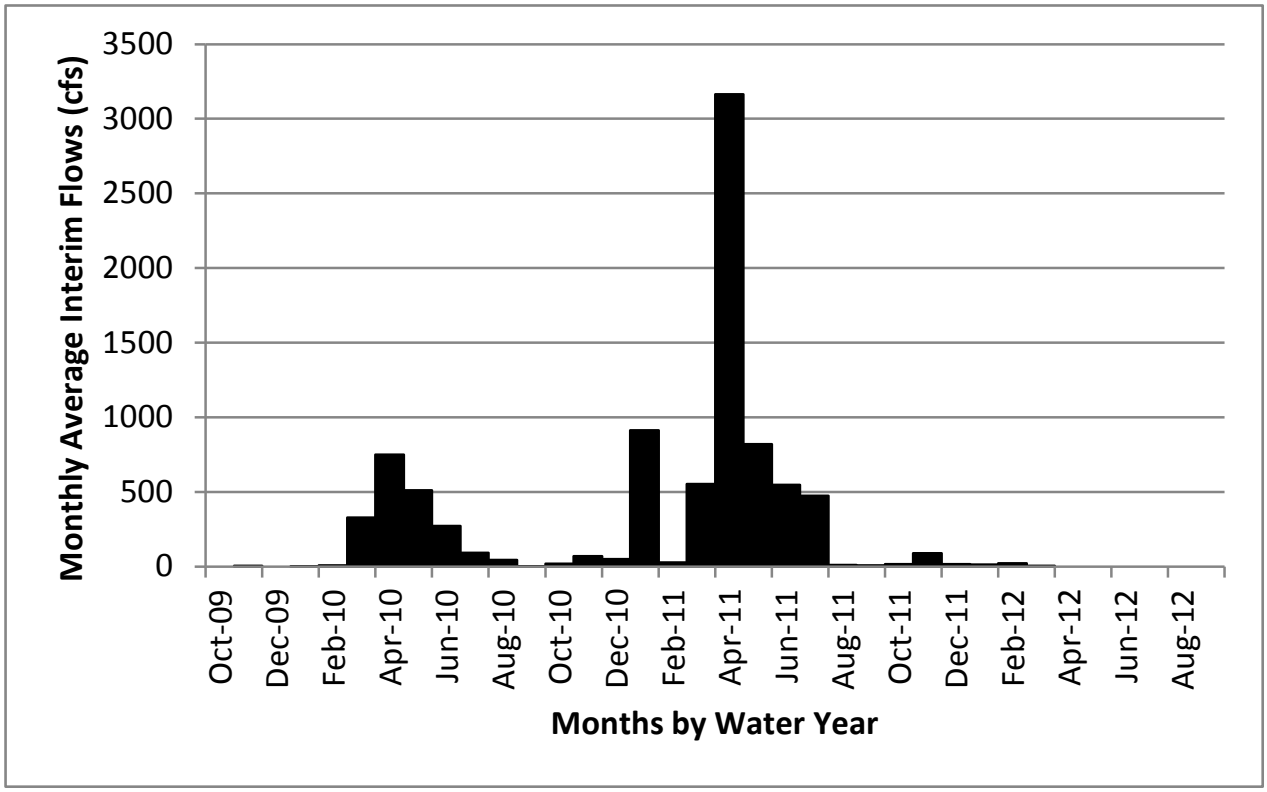
Reach 4A The design channel capacity in this subreach is approximately 4,500 cfs, beginning at Sack Dam and extending

to the Sand Slough Control Structure. The channel below Sack Dam has flow during the agricultural season (agricultural return flows) and during times of upstream flood releases. Four water diversions are located along this subreach. Table 14-8 lists the gage located in this reach segment, its period of record, and average and maximum daily average streamflow. Figure 14-13 shows monthly average flows at the gage.

Table 14-8. Streamflow Gage in San Joaquin River Reach 4A

Gage Name	USGS Gage Station No. or CDEC ID	Mile post	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs) [2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River at Sack Dam near Dos Palos	SDP	NA	NA	NA	294	2,660 (May 23, 1978)

Source: SJRRP 2013
Notes:
[1] Water year.
[2] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: SJRRP 2013; Gage SDP
Key: cfs = cubic feet per second

Figure 14-13. Monthly Average Flows for San Joaquin River at Sack Dam near Dos Palos (Post-Interim Flows)

Reach 4B1 This subreach has a design capacity of 1,500 cfs, and the Sand Slough Control Structure, which controls the flow split between the main stem of the San Joaquin River and Eastside Bypass, is designed to maintain this design discharge. Current practice, however, keeps the San Joaquin River headgates closed at the Sand Slough Control Structure, diverting all flow from Reach 4B1 to the Eastside Bypass (McBain and Trush 2002). Reach 4B1, therefore, is dry until downstream agricultural return flows contribute a baseflow, although this flow is often pumped and reused for irrigation. No streamflow gages are located in this subreach.

Reach 4B2 The design channel capacity of Reach 4B2 is 10,000 cfs. The channel carries tributary and flood flows from the Mariposa Bypass. No operational storage for water supply exists within this reach. Two water diversions are located along this reach. No streamflow gages are located in this subreach.

Reach 5 Reach 5 of the San Joaquin River extends from the confluence of the Eastside Bypass downstream to the Merced River confluence. The design capacity of Reach 5 is 26,000 cfs; no significant capacity constraints have been identified in this reach. Reach 5 receives flow from Reach 4B2 and the Eastside Bypass. Agricultural and wildlife management area return flows also enter Reach 5 via Mud and Salt sloughs, which drain the west side of the San Joaquin Valley. Three major road crossings within this reach can affect flow stage.

Table 14-9 lists the gages located in or near this reach segment, their periods of record, and average and maximum daily average streamflows. Figure 14-14, Figure 14-15, Figure 14-16, and Figure 14-17 show monthly average flows since Interim Flows began in 2009.

Table 14-9. Streamflow Gages in San Joaquin River Reach 5

Gage Name	USGS Gage Station No. or CDEC ID	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)[2]	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Stevinson	SJS	118.2	NA	1982–2011	740	23,900 (January 28, 1997)
Salt Slough at HW 165 near Stevinson	11261100	NA	NA	1986–2012	181	810 (February 20, 1986)
San Joaquin River at Fremont Ford Bridge	11261500	118.2	7,615	1951–1971, 1986–1989, 2002–2011[3]	1025	22,500 (April 8, 2006)
Mud Slough near Gustine	11262900	NA	NA	1986–2012	101	1,060 (February 9, 1998)

Source: DWR 2013a; USGS 2013

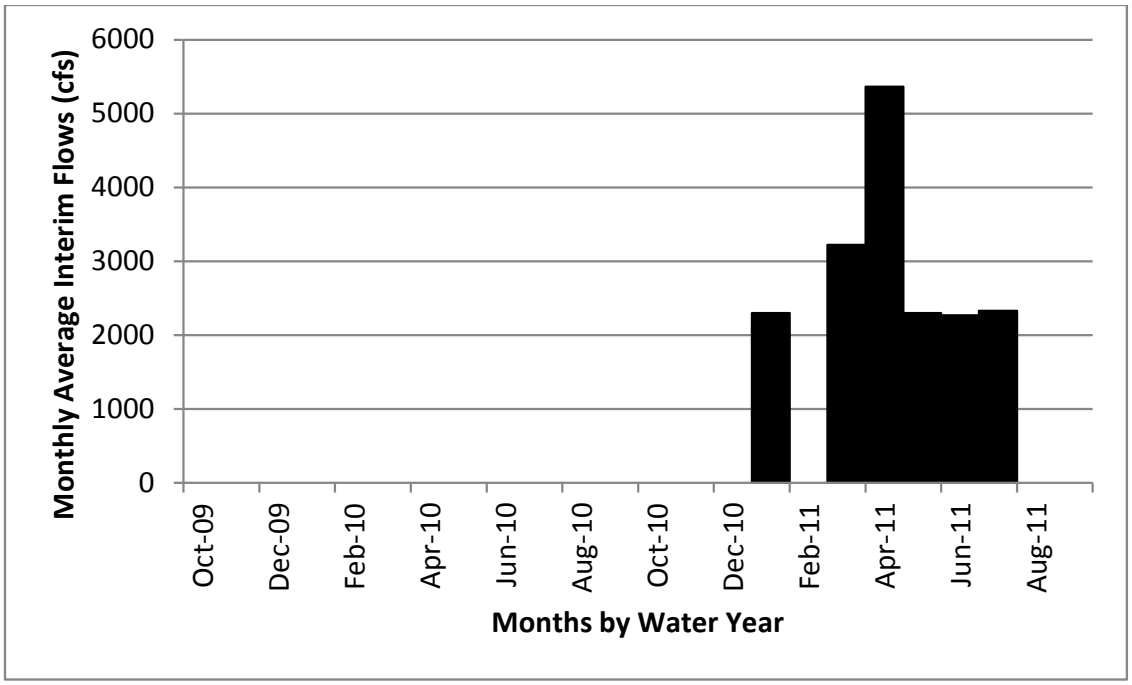
Notes:

[1] Water year.

[2] Average streamflow data is reported for the referenced period of record including Interim Flows, which began in Water Year 2009.

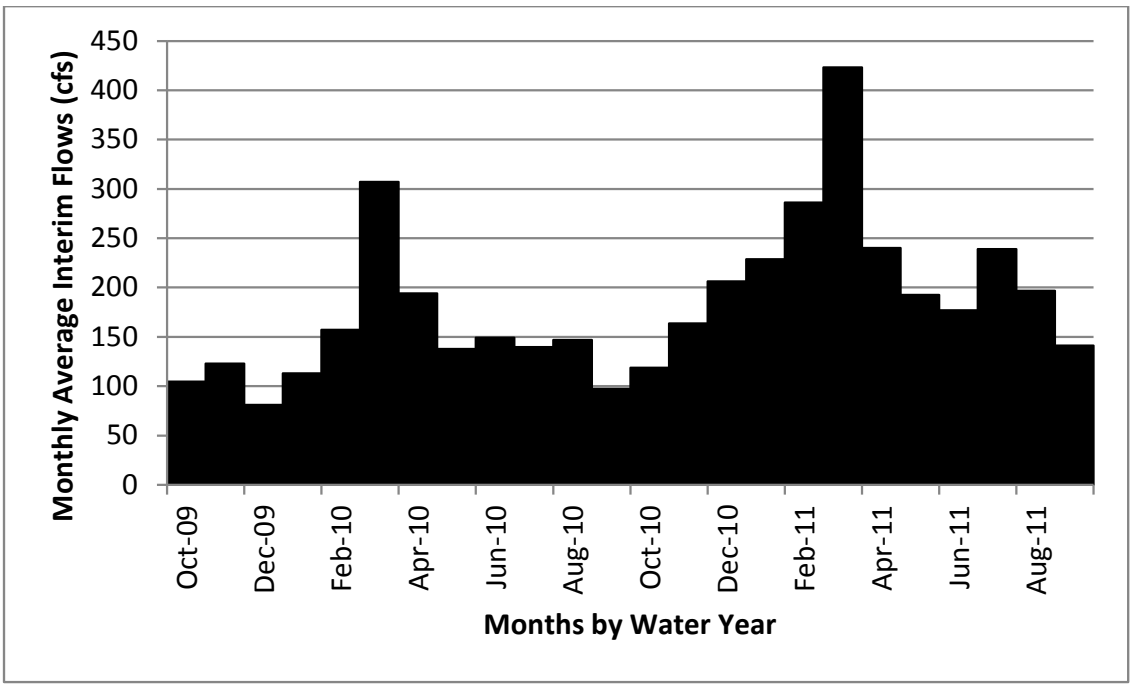
[3] Period of record coincides with start of diversions from Friant Dam (1950).

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
HW = highway
ID = identification
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



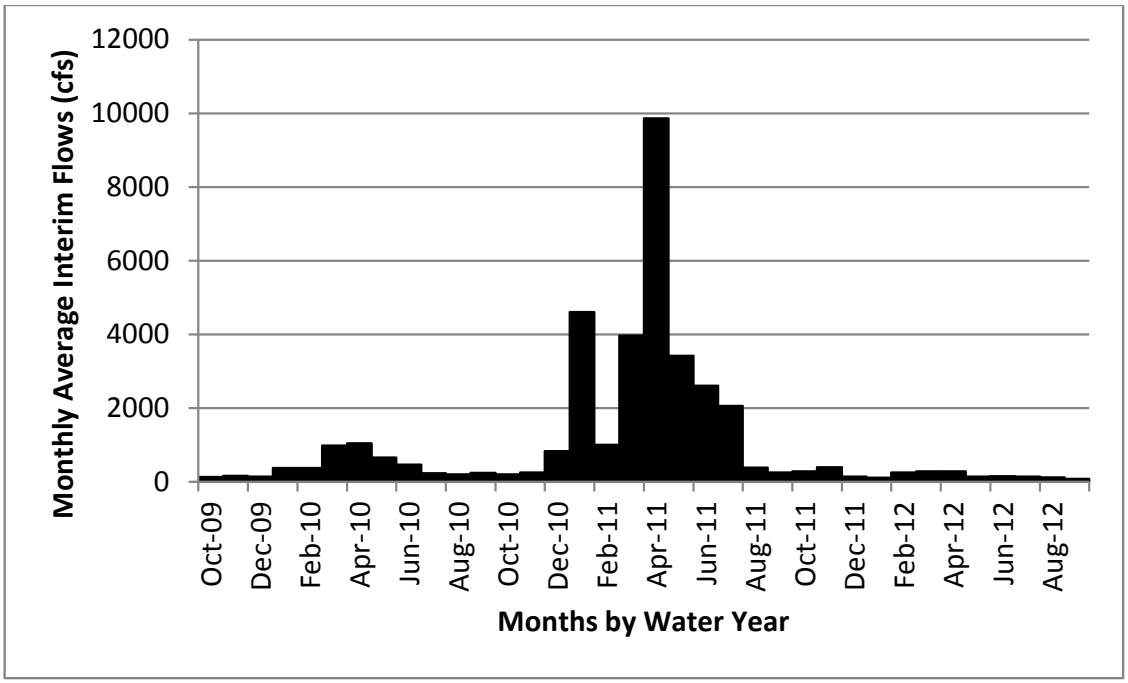
Source: DWR 2013a, Gage ID SJS
Key: cfs = cubic feet per second

Figure 14-14. Monthly Average Flows for San Joaquin River near Stevinson (Post-Interim Flows)



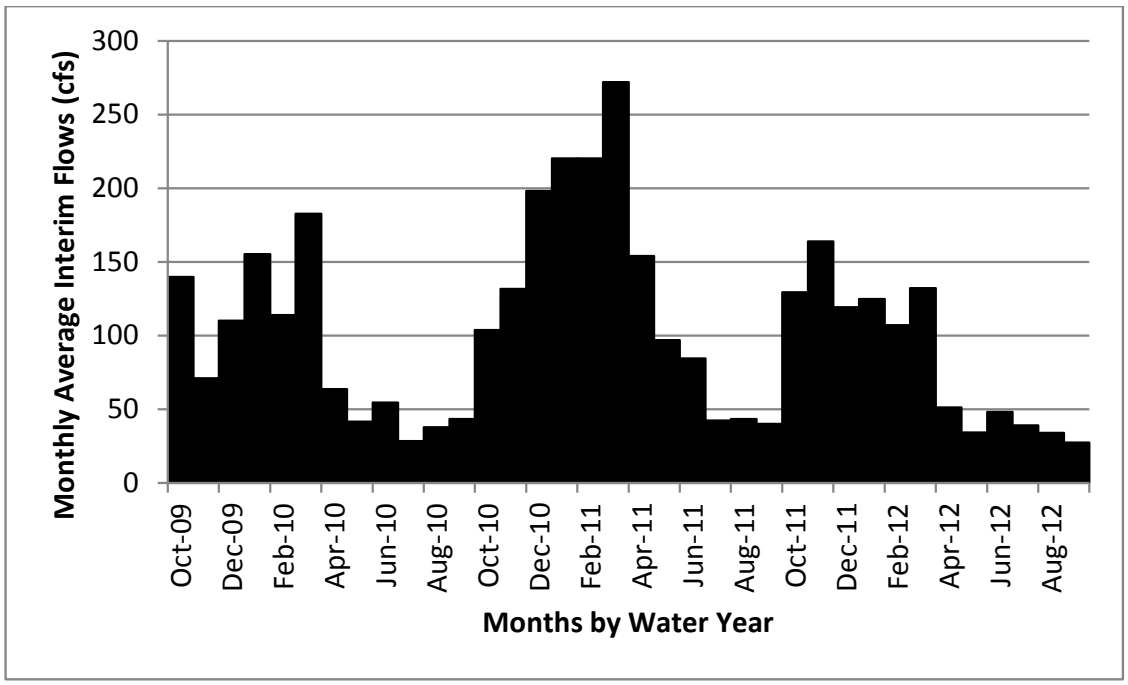
Source: USGS 2013, Gage Station No. 11261100
Key: cfs = cubic feet per second

Figure 14-15. Monthly Average Flows for Salt Slough at Highway 165 near Stevinson (Post-Interim Flows)



Source: USGS 2013, Gage Station No. 11261500
Key: cfs = cubic feet per second

Figure 14-16. Monthly Average Flows for San Joaquin River at Fremont Ford Bridge (Post-Interim Flows)



Source: USGS 2013, Gage Station No. 11262900
Key: cfs = cubic feet per second

Figure 14-17. Monthly Average Flows for Mud Slough near Gustine (Post-Interim Flows)

Fresno Slough/James Bypass The Fresno Slough/James Bypass conveys Kings River flood flows into the San Joaquin River from the south, via the Mendota Pool. Flows from the Kings River are regulated by Pine Flat Dam and the Crescent Weir, which are operated by the Kings River Conservation District. More details regarding Fresno Slough/James Bypass effects on San Joaquin River flood operations can be found in Chapter 12, "Hydrology – Flood Management." Reclamation supplements natural flow from the Fresno Slough/James Bypass and San Joaquin River into the Mendota Pool with deliveries from the DMC to satisfy water supply contracts. The CVP and SWP Water Service Areas section below describes the effects of Fresno Slough/James Bypass flows on water deliveries at the Mendota Pool.

Chowchilla Bypass and Tributaries The Chowchilla Bypass extends from the Chowchilla Bypass Bifurcation Structure to the Eastside Bypass at the confluence of the Fresno River. More details regarding flood control operations of the Chowchilla Bypass are discussed in Chapter 12, "Hydrology – Flood Management." The design channel capacity of the bypass is 5,500 cfs. The bypass was constructed in highly permeable soils, and much of the initial flood flows infiltrate and recharge groundwater.

Eastside Bypass, Mariposa Bypass, and Tributaries The Eastside Bypass is divided into three reaches with design channel capacities of 17,000 cfs, 16,500 cfs, and 13,500 cfs, respectively. The channel capacity in Eastside Bypass Reach 3 increases to 18,500 cfs at the confluence of Bear Creek. Flow within Eastside Bypass Reach 3 is controlled by the Eastside Bypass Control Structure. The Mariposa Bypass has a design channel capacity of 8,500 cfs. Flow within the Mariposa Bypass is controlled by the Mariposa Bypass Control Structure, which diverts water from the Eastside Bypass back to Reach 4 of the San Joaquin River. Channel capacities in both bypasses may be less than design capacities because of subsidence of the Eastside Bypass levees, including a cumulative subsidence of approximately 4.5 feet along the Eastside Bypass over the last 5 years due to changes in groundwater use (SLCC 2013). Flood control operations of the Eastside Bypass and Mariposa Bypass are discussed in Chapter 12, "Hydrology – Flood Management."

Storage on Eastside Bypass tributaries (e.g., Buchanan Dam, Hidden Dam) can be coordinated with CVP Friant Division operations to meet contract deliveries on the Madera Canal

(Reclamation 1997). Hidden Dam forms Hensley Lake on the Fresno River upstream from the Eastside Bypass. USACE operates Hidden Dam for flood control; the total storage of Hensley Lake is 90,600 acre-feet. Buchanan Dam forms Eastman Lake on the Chowchilla River upstream from the Eastside Bypass. USACE operates Buchanan Dam for flood control; the total storage of Eastman Lake is 150,600 acre-feet.

San Joaquin River from Merced River to the Delta

Flows in the San Joaquin River below the Merced River confluence to the Delta are controlled in large part by releases from reservoirs located on tributary systems, including the Merced, Tuolumne, and Stanislaus rivers, to satisfy contract deliveries and instream flow requirements, as well as operational agreements, such as the Vernalis Adaptive Management Program (VAMP) up through 2011.

VAMP was a 12-year experimental management program initiated in 2000, which the State Water Board accepted as the implementation of the San Joaquin River flow standard pursuant to D-1641. It was initiated to protect juvenile Chinook salmon emigrating through the San Joaquin River and Delta, and to evaluate how Chinook salmon survival rates change in response to alterations in San Joaquin River flows and exports at CVP and SWP facilities in the south Delta when the Head of Old River Barrier is installed (see Chapter 27, “Cumulative Effects,” for more details on VAMP).

The expiration of VAMP in 2011 introduced uncertainty regarding responsibility for meeting San Joaquin River flow standards set forth in the 1995 Bay Delta Plan in the interim until new San Joaquin River flow standards are identified. Merced Irrigation District has and will continue to meet its pulse flow requirements and commitments. Reclamation entered into a two-year agreement with Merced Irrigation District to continue to provide VAMP-like spring pulse flows in the San Joaquin River at Vernalis. However, that agreement expired on December 31, 2013. It is unclear whether Reclamation will be able to continue to acquire water from willing sellers to meet VAMP-like spring pulse flow targets in the San Joaquin River. Concurrently, Reclamation is participating in the San Joaquin Tributary Settlement Process (SJTSP). The goal of the SJTSP is to collaboratively develop an implementation plan for San Joaquin River flow objectives that satisfies all requirements set by regulatory agencies and their ongoing regulatory processes, including the State Water Board’s Bay-Delta Plan update and ongoing FERC processes

on the Merced and Tuolumne rivers while minimizing impacts to water supply and other beneficial uses. Although VAMP expired in 2011, a VAMP-like operating condition is included in both the Existing Condition and Future No Action Condition of the Reclamation March 2012 Benchmark CalSim II model, as described in the Modeling Appendix.

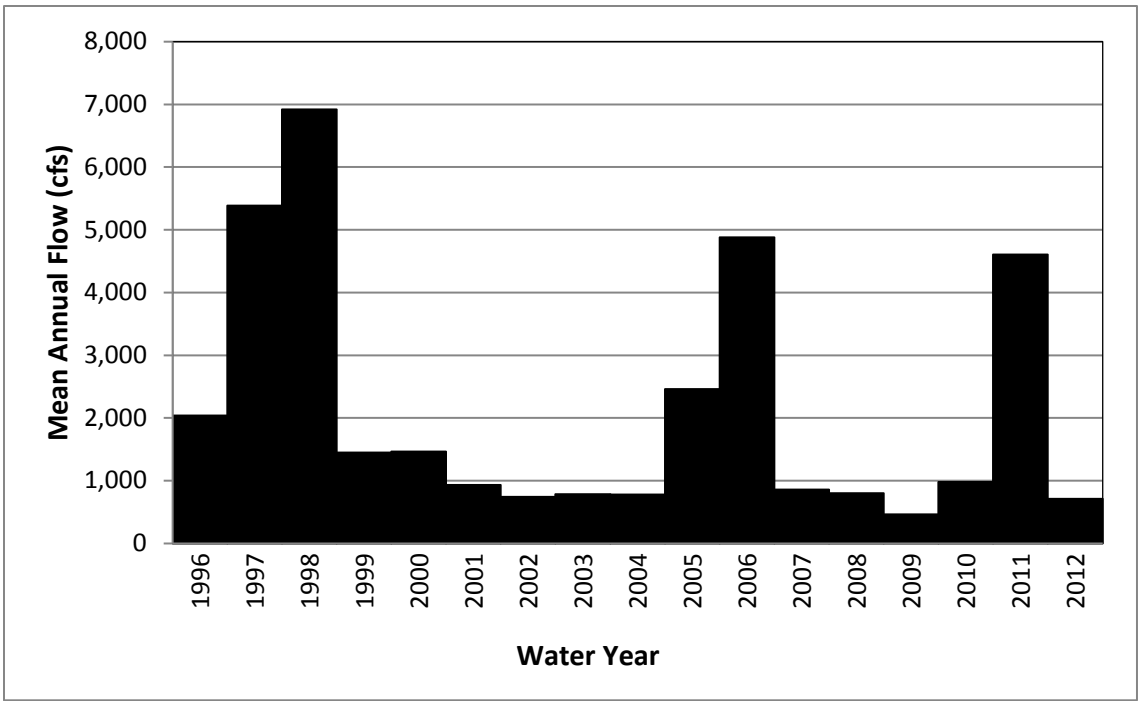
The hydrology and hydraulics of the San Joaquin River downstream from the Merced River return to a more natural state because there is no extensive flood bypass system, and there is continuous tributary flow from the Merced, Tuolumne, and Stanislaus rivers. Table 14-10 lists gages in or near the San Joaquin River downstream from the Merced River, their periods of record, and average and maximum daily average streamflows. Figure 14-18, Figure 14-19, and Figure 14-20 show historical annual average flows at the gages. Table 14-11, Table 14-12, and Table 14-13 show historical average monthly flows at the gages.

Table 14-10. San Joaquin River Streamflow Gages Downstream from the Merced River

Gage Name	USGS Gage Station Number	Milepost	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Crows Landing	11274550	118.2	9,694	1996–2012	2,132	37,600 (January 28, 1997)
San Joaquin River near Vernalis	11303500	NA	13,536	1951–2012[2]	4,401	70,000 (December 9-10, 1950)
Stanislaus River at Ripon	11303000	NA	1,075	1941–2012	956	47,000 (December 24, 1955)

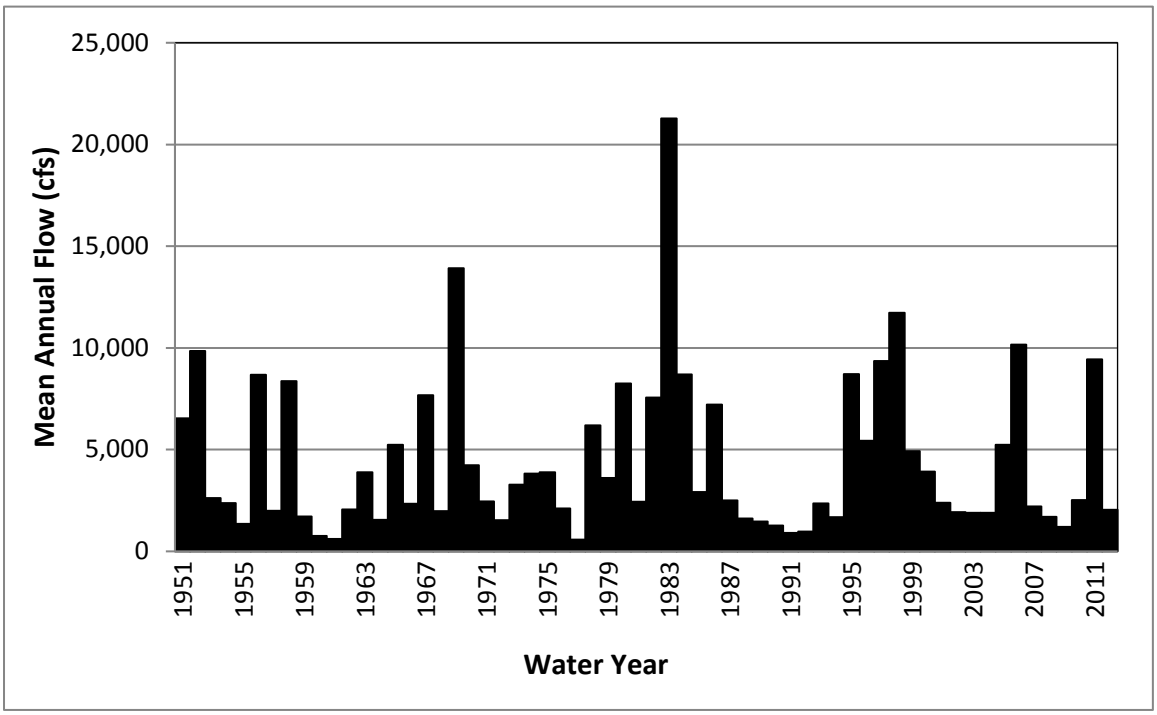
Source: USGS 2013

Notes:
[1] Water year.
[2] Period of record coincides with start of diversions from Friant Dam (1950).
Key:
cfs = cubic feet per second
NA = not available
USGS = U.S. Geological Survey



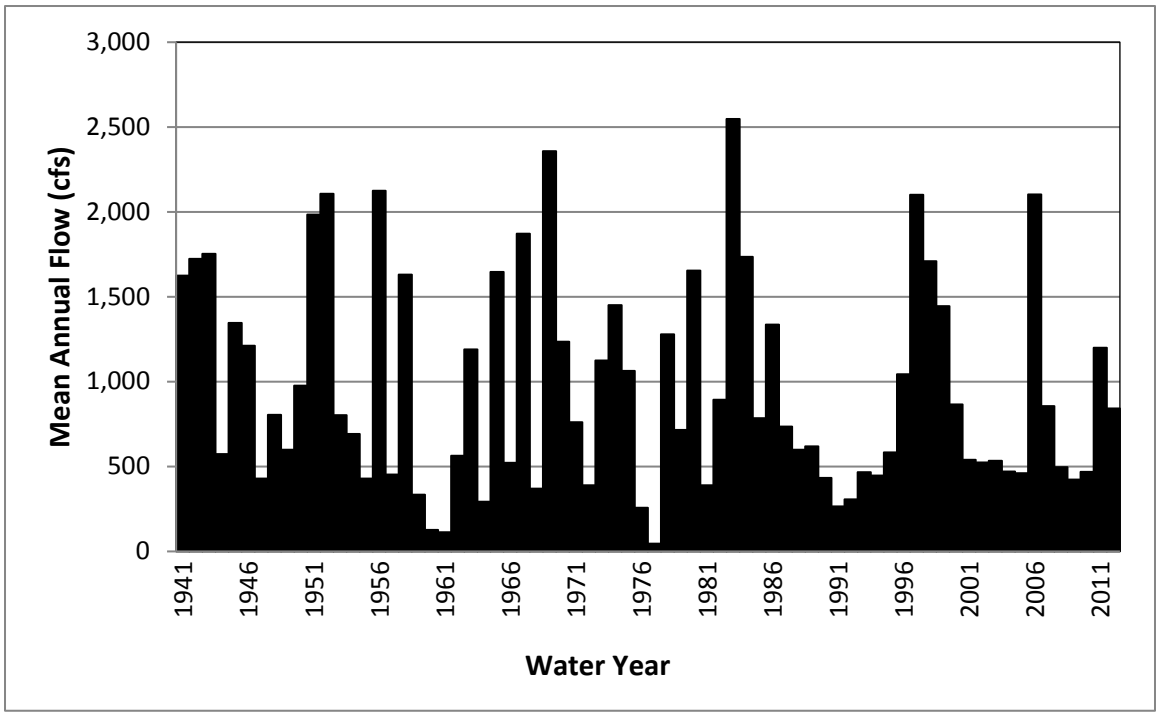
Source: USGS 2013, Gage Station No. 11274550
Key: cfs = cubic feet per second

Figure 14-18. Historical Annual Average Flow for San Joaquin River near Crows Landing



Source: USGS 2013, Gage Station No. 11303500
Key: cfs = cubic feet per second

Figure 14-19. Historical Annual Average Flow for San Joaquin River near Vernalis



Source: USGS 2013, Gage Station No. 11303000
Key: cfs = cubic feet per second

Figure 14-20. Historical Annual Average Flow for Stanislaus River at Ripon

Table 14-11. Historical Average Monthly Flows for San Joaquin River near Crows Landing

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	1,042	913	1,168	3,187	4,170	3,138	3,859	3,164	2,321	1,370	717	691
Wet	1,102	891	1,752	7,184	9,272	6,082	8,931	6,951	5,455	3,034	1,191	1,133
Above-Normal	1,219	908	940	1,213	2,564	2,724	1,816	1,438	874	619	610	729
Below-Normal	543	677	804	755	833	973	728	769	447	357	334	289
Dry	1,040	1,004	795	914	917	1,163	885	1,031	513	440	436	361
Critical	1,097	1,043	869	1,136	1,224	1,035	789	1,058	574	379	404	368

Source: USGS 2013, Gage Station No. 11274550
Notes:
[1] Period of record Water Years 1996–2012; some years may be missing data.
[2] San Joaquin Valley Water Year Types as defined in Modeling Appendix.
Key:
cfs = cubic feet per second

Table 14-12. Historical Average Monthly Flows for San Joaquin River near Vernalis

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	2,509	2,383	3,709	5,515	6,778	6,975	7,096	6,788	5,134	2,513	1,627	1,967
Wet	2,349	2,128	4,364	9,479	12,878	14,126	16,278	15,080	11,591	5,384	2,869	3,517
Above-Normal	4,045	4,178	7,039	7,433	8,431	7,187	4,518	4,710	3,291	1,585	1,447	1,812
Below-Normal	1,657	1,850	2,879	2,977	3,170	2,841	2,140	2,803	2,435	914	753	1,008
Dry	2,843	2,571	2,698	2,751	2,506	2,312	1,893	1,844	1,187	968	982	1,139
Critical	1,945	1,719	1,709	1,684	1,666	1,765	1,503	1,469	981	811	827	863

Source: USGS 2013, Gage Station No. 11303500

Notes:

[1] Period of record Water Years 1951–2012; some years may be missing data.

[2] San Joaquin Valley Water Year Types as defined in Modeling Appendix.

Key:

cfs = cubic feet per second

Table 14-13. Historical Average Monthly Flows for Stanislaus River at Ripon

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	454	462	830	1,152	1,189	1,324	1,487	1,926	1,344	542	402	378
Wet	369	357	972	1,836	1,988	2,317	2,690	3,285	2,358	954	651	625
Above-Normal	649	995	1,702	1,845	1,960	1,694	1,471	2,150	1,172	332	288	316
Below-Normal	272	338	521	623	613	672	937	1,723	1,327	275	194	210
Dry	608	413	579	585	432	438	649	690	474	371	316	227
Critical	472	363	345	314	303	595	559	553	437	365	308	266

Source: USGS 2013, Gage Station No. 11303000

Notes:

[1] Period of record Water Years 1941–2012; some years may be missing data; New Melones Dam constructed by 1978.

[2] San Joaquin Valley Water Year Types as defined in Modeling Appendix.

Key:

cfs = cubic feet per second

Merced River The Merced River flows west out of the Sierra Nevada to its confluence with the San Joaquin River at the end of Reach 5. Merced River streamflows are regulated primarily by New Exchequer and McSwain dams, which form Lake

McClure and Lake McSwain, respectively. The Crocker-Hoffman Diversion Dam is located downstream from New Exchequer and McSwain dams. Lake McClure is a water supply, hydropower, and flood control reservoir. Lake McSwain is a regulating reservoir approximately 6 miles downstream from Lake McClure. Both reservoirs are owned and operated by the Merced ID. Minimum flow standards were established in 1964 (Project No. 2179) by a FERC license and the Davis-Grunsky Contract No. D-GGR17 between Merced ID and DWR. During high-flow events, a portion of Merced River flows are conveyed to the San Joaquin River through Merced Slough.

Tuolumne River The Tuolumne River enters the San Joaquin River downstream from the Merced River. The largest reservoir on the Tuolumne River is New Don Pedro Lake, owned and operated by the Turlock ID and Modesto ID for water supply, hydropower, and flood control purposes. La Grange Reservoir below New Don Pedro Lake is also jointly owned by the two irrigation districts and is operated as a diversion dam. The *1995 New Don Pedro Settlement Agreement* contains instream flow requirements on the Tuolumne River for the anadromous fishery downstream from the project (CDFW et al. 1995).

Stanislaus River The Stanislaus River flows into the San Joaquin River just upstream from Vernalis. New Melones Reservoir is the largest reservoir on the Stanislaus River, operated as part of the CVP for water supply, hydropower, flood control, water quality, and environmental purposes. Downstream from New Melones Reservoir is Tulloch Reservoir, operated as part of the Tri-Dam Project, and Goodwin Reservoir. Both dams are operated by Oakdale Irrigation District and the South San Joaquin Irrigation District.

A 1987 study agreement between CDFW and Reclamation contains Stanislaus River instream flow standards (CDFW and Reclamation 1987). The agreement specifies interim annual water allocations of 98,300 – 302,000 acre-feet, depending on New Melones Reservoir carryover storage and inflow. Annual flow schedules are determined by CDFW. State Water Board Decision 1422 (D-1422) required New Melones storage to be used for meeting a TDS objective of 500 ppm at Vernalis on the San Joaquin River. D-1422 also states water quality goals for DO in the Stanislaus River. A subsequent State Water Board decision, D-1641, revised water quality standards at Vernalis (via the *1995 Bay-Delta Plan*) to an average monthly

conductivity of 0.7 µS/cm from April through August, and 1 µS/cm from September through March (State Water Board 2000).

Sacramento-San Joaquin Delta

The hydraulics of the Delta are complicated by tidal influences, a multitude of agricultural and M&I diversions for use within the Delta itself, and by CVP and SWP operations and exports. Principal factors affecting Delta hydrodynamics are (1) river inflow from the Sacramento, San Joaquin River, Mokelumne, and Cosumnes rivers and other smaller eastside tributaries; (2) daily tidal inflow and outflow through San Francisco Bay; and (3) export pumping from the south Delta, primarily through the Banks and Jones pumping plants. Historical average monthly total Delta inflow is shown in Table 14-14 by year type.

Table 14-14. Historical Average Monthly Sacramento-San Joaquin Delta Inflow

Year Type[2]	Average Monthly Inflow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	15,974	18,986	35,174	55,667	63,789	57,610	42,701	32,288	24,846	19,903	17,986	18,141
Wet	18,972	25,159	61,626	97,084	106,684	92,290	77,677	53,943	39,662	25,702	21,850	23,621
Above-Normal	12,717	15,297	21,482	65,912	74,084	74,818	37,090	33,465	23,817	19,602	18,647	18,497
Below-Normal	16,291	16,045	20,588	30,082	44,193	37,739	24,312	21,703	18,119	17,263	16,515	16,043
Dry	13,652	16,370	20,294	20,787	26,815	27,825	17,701	15,526	13,650	16,884	15,695	14,005
Critical	13,750	13,283	16,409	17,924	18,340	17,306	13,158	10,694	10,654	12,395	12,249	11,756

Source: calculated value, DWR 2013b

Notes:

[1] Period of record Water Years 1956–2012.

[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.

Key:

cfs = cubic feet per second

Average winter outflow from the Delta is about 32,000 cfs, while the average summer outflow is 6,000 cfs. Because of tidal factors and changing channel geometry, Delta outflow is typically calculated rather than a directly measured. Table 14-15 shows the calculated average monthly Delta outflow by year type.

Table 14-15. Historical Average Monthly Sacramento-San Joaquin Delta Outflow

Year Type[2]	Average Monthly Outflow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	9,416	14,265	30,524	51,788	60,313	53,174	37,726	26,598	16,136	8,464	6,575	9,146
Wet	12,587	21,391	58,629	94,595	103,949	89,633	73,810	48,198	30,735	14,277	10,408	15,036
Above-Normal	6,764	10,939	17,088	61,808	69,422	70,412	32,302	27,895	13,479	7,188	6,008	7,877
Below-Normal	10,394	11,745	16,201	26,774	42,353	32,811	19,423	15,722	8,450	5,472	4,970	6,932
Dry	6,894	10,770	14,135	16,013	22,610	22,532	11,215	9,814	5,711	4,378	3,557	4,853
Critical	5,660	6,426	8,947	11,110	12,925	9,971	7,087	5,435	4,079	3,675	3,167	3,463

Source: calculated value, DWR 2013b
Notes:
[1] Period of record Water Years 1956–2012.
[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.
Key:
cfs = cubic feet per second

The San Joaquin River enters the Delta downstream from Vernalis and splits into several channels including the main river channel, Middle River, and Old River. In the south Delta, CVP and SWP export pumping in Middle and Old rivers can further reduce the minimum water levels such that sufficient pump draft cannot be maintained, and irrigation diversions for local agriculture can be interrupted. Historically, the Middle River, which contains a temporary barrier to facilitate adequate water levels and water quality for agricultural diversions, has its highest monthly minimum stage in February and is about 0.1 foot below msl. The lowest monthly minimum stage typically occurs in August and is about 0.8 feet below msl. During dry and critical years, under existing conditions, the highest minimum stage in the Middle River typically occurs in April and is about 0.6 feet below msl.

The CVP pumping facility is the Jones Pumping Plant, formerly called the Tracy Pumping Plant. The Jones Pumping Plant is at the end of an earth-lined intake channel about 2.5 miles long. The Jones Pumping Plant consists of six pumps, with a nominal and permitted pumping capacity of 4,600 cfs during the irrigation season, and 4,200 cfs during the winter nonirrigation season. Limitations at the Jones Pumping Plant are the result of a DMC freeboard constriction near the O'Neill Forebay at San Luis Reservoir, and current water demand in the upper sections of the DMC. The SWP pumping facility is the Banks Pumping Plant. The Banks Pumping Plant supplies water for the South Bay Aqueduct and the California

Aqueduct, and consists of 11 pumps that have a total combined installed capacity of 10,300 cfs. Under current operational constraints, exports from the Banks Pumping Plant generally are limited to a daily average of 6,680 cfs, except between December 15 and March 15, when exports can be increased by 33 percent of San Joaquin River flow. The Banks Pumping Plant exports water from the Clifton Court Forebay, a 31 TAF reservoir that provides storage for off-peak pumping, and moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels.

Recent historical average monthly pumping, by year type, at the Jones and Banks pumping plants are shown in Table 14-16 and Table 14-17, respectively.

Table 14-16. Historical Average Monthly Exports from the Jones Pumping Plant

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	2,943	2,394	2,120	2,384	2,769	2,876	2,544	2,333	3,040	3,952	3,952	3,363
Wet	2,857	2,110	1,767	2,135	2,672	2,713	2,303	2,491	3,222	4,005	4,134	3,182
Above-Normal	2,532	1,697	1,332	2,407	2,985	3,062	2,618	2,262	3,458	4,287	4,186	3,695
Below-Normal	2,825	2,301	1,991	1,753	2,150	2,719	2,467	2,464	3,450	4,289	4,121	3,495
Dry	3,212	2,858	2,664	2,765	2,907	2,880	2,971	2,193	2,993	4,342	4,185	3,558
Critical	3,305	3,227	3,148	3,286	3,416	3,334	2,624	2,010	1,747	2,564	2,737	3,118

Source: calculated value, DWR 2013b

Notes:

[1] Period of record Water Years 1956–2012.

[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.

Key:

cfs = cubic feet per second

Table 14-17. Historical Average Monthly Exports from the Banks Pumping Plant

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	2,313	2,284	2,826	3,029	2,582	2,369	1,753	1,233	1,732	2,953	3,521	3,093
Wet	2,331	2,215	2,643	2,472	2,102	1,543	1,522	1,297	1,938	2,925	3,357	2,870
Above-Normal	2,040	2,636	3,359	4,781	4,162	2,443	1,605	1,287	3,078	3,635	4,496	4,183
Below-Normal	1,738	1,564	2,036	2,463	1,834	2,170	1,484	1,199	1,758	3,022	3,555	3,296
Dry	2,077	2,531	2,926	2,747	2,513	2,918	2,177	1,129	1,052	3,540	3,992	3,108
Critical	3,549	2,720	3,690	4,053	3,481	3,966	2,239	1,203	912	1,539	2,405	2,449

Source: calculated value, DWR 2013b
Notes:
[1] Period of record Water Years 1968–2012.
[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.
Key:
cfs = cubic feet per second

A number of agreements exist between Reclamation and DWR regarding how the CVP and SWP will jointly operate to meet the goals and needs of the projects, and to meet shared responsibilities for in-basin flow and water quality requirements in the Delta. Both projects export water from the Delta for use in areas to the south. This has led to issues involving how the requirements would be met by the two projects, and which project could export any naturally occurring water in excess of the requirements. For example, the *Coordinated Operation Agreement* (COA), signed in November 1986, contains joint operations rules that the CVP and SWP have agreed to follow to allow operations while meeting in-basin flow and/or water quality standards in the Delta (Reclamation and DWR 1986).

CVP and SWP operations are also constrained by a number of flow and quality regulations throughout the Sacramento River Basin that have occurred since the COA was signed. These other operational agreements have been developed to define how the CVP and SWP will share these responsibilities. Many of these agreements restrict maximum allowable export from the Delta at any time and can be impacted by changes in Delta inflow. Typically, the CVP and SWP attempt to maximize their export pumping from the Delta within these operational constraints (see Modeling Appendix for a description of operational constraints considered in this study).

Contra Costa Water District (CCWD) supplies CVP water to its users via several Delta intakes. At the Rock Slough pumping plant, the water is lifted 127 feet into the Contra Costa Canal by a series of four pumping plants. The 47.5-mile-long canal terminates in Martinez Reservoir. The canal capacity gradually decreases from the Rock Slough diversion capacity of 350 cfs to 22 cfs at the terminus. Table 14-18 shows historical average monthly exports from the CCWD Rock Slough Pumping Plant by year type.

CCWD also constructed and operates the 160,000-acre-foot Los Vaqueros Reservoir, which has an intake and pumping plant on the Old River for diverting surplus Delta flows to reservoir storage, or CVP contract water to CCWD users. CCWD constructed an alternate intake on Victoria Canal for this diversion in 2010. CCWD also has a fourth diversion facility in the Delta, at the southern end of a 3,000-foot-long channel running due south of Suisun Bay, near Mallard Slough. This facility has a capacity of 39.3 cfs.

Los Vaqueros Reservoir is refilled by diversions only when source water chloride concentration is relatively low. Los Vaqueros water is used for water quality blending and delivery during low Delta outflow periods, when the chloride concentration at Rock Slough and the Old River is greater than 65 mg/L. The Old River and Victoria Canal facilities allow CCWD to divert up to 250 cfs to a blending facility with the Contra Costa Canal, and to divert up to 200 cfs of CVP and Los Vaqueros water rights water for storage in Los Vaqueros Reservoir. The Mallard Slough facility is only used during periods of very high Delta outflow.

Table 14-18. Historical Average Monthly Exports from the Contra Costa Water District Rock Slough Pumping Plant by Year Type

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	125	104	81	86	95	99	113	151	212	218	199	159
Wet	130	98	73	72	72	79	89	128	173	186	202	160
Above-Normal	113	88	72	95	96	97	129	137	191	207	196	165
Below-Normal	103	109	91	86	104	83	111	157	233	238	221	156
Dry	126	98	72	86	91	124	131	179	270	257	175	145
Critical	147	131	113	117	152	140	136	176	222	232	199	172

Source: calculated value, DWR 2013b

Notes:

[1] Period of record Water Years 1956–2012.

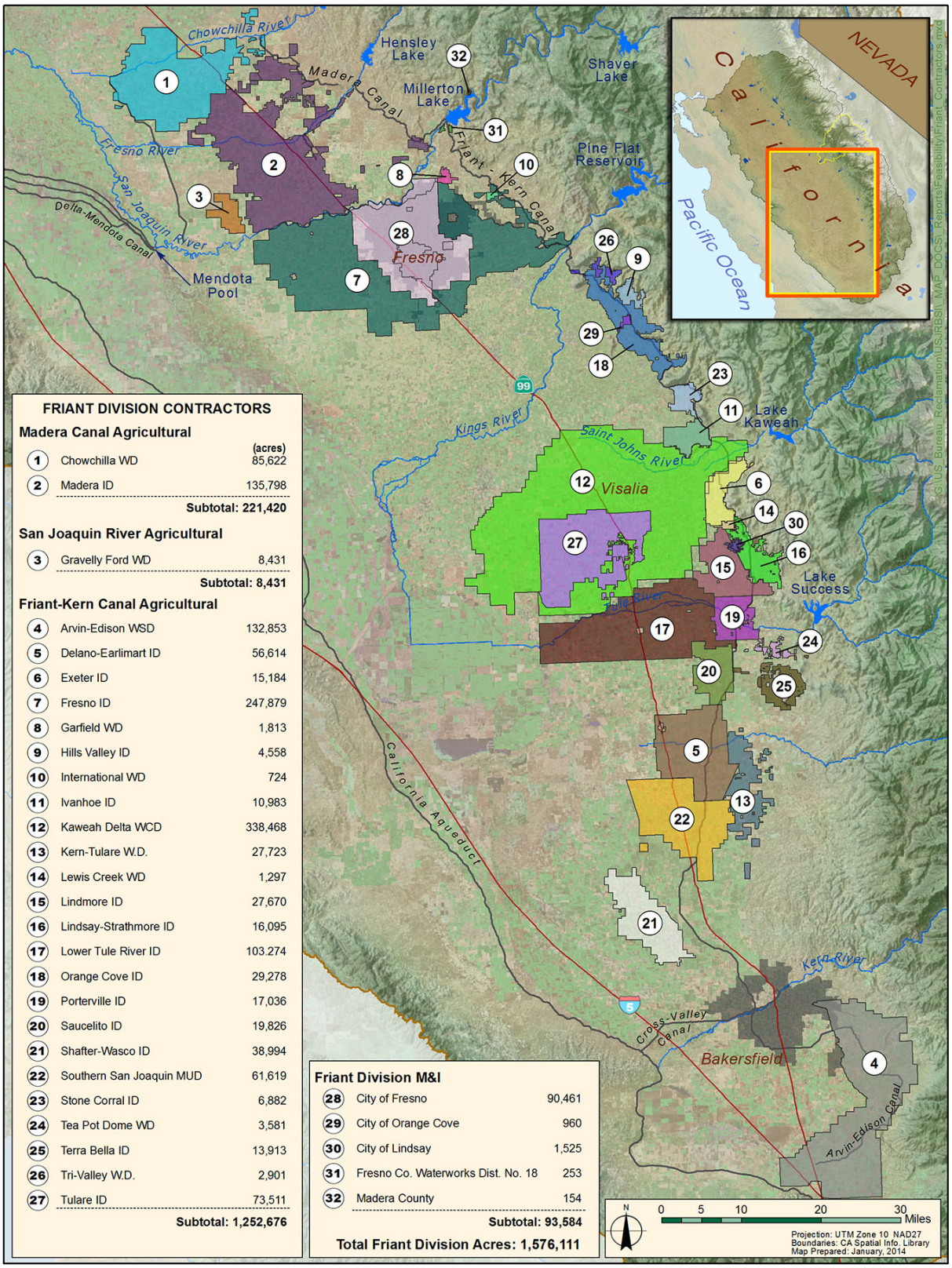
[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.

Key:

cfs = cubic feet per second

Central Valley Project Friant Division Water Service Area and Facilities

Friant Division facilities include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south, respectively, to agricultural and urban water contractors. These facilities are described in the San Joaquin River System Upstream from Friant Dam section, above. Historically, the Friant Division has delivered an average of about 1,300 TAF of water annually. Figure 14-21 shows the locations and acreage of the 28 Friant Division long-term contractors.



FRIAND DIVISION CONTRACTORS

		(acres)
Madera Canal Agricultural		
1	Chowchilla WD	85,622
2	Madera ID	135,798
	Subtotal: 221,420	
San Joaquin River Agricultural		
3	Gravelly Ford WD	8,431
	Subtotal: 8,431	
Friant-Kern Canal Agricultural		
4	Arvin-Edison WSD	132,853
5	Delano-Earlimart ID	56,614
6	Exeter ID	15,184
7	Fresno ID	247,879
8	Garfield WD	1,813
9	Hills Valley ID	4,558
10	International WD	724
11	Ivanhoe ID	10,983
12	Kaweah Delta WCD	338,468
13	Kern-Tulare W.D.	27,723
14	Lewis Creek WD	1,297
15	Lindmore ID	27,670
16	Lindsay-Strathmore ID	16,095
17	Lower Tule River ID	103.274
18	Orange Cove ID	29,278
19	Porterville ID	17,036
20	Saucelito ID	19,826
21	Shafter-Wasco ID	38,994
22	Southern San Joaquin MUD	61,619
23	Stone Corral ID	6,882
24	Tea Pot Dome WD	3,581
25	Terra Bella ID	13,913
26	Tri-Valley W.D.	2,901
27	Tulare ID	73,511
	Subtotal: 1,252,676	

Friant Division M&I

28	City of Fresno	90,461
29	City of Orange Cove	960
30	City of Lindsay	1,525
31	Fresno Co. Waterworks Dist. No. 18	253
32	Madera County	154
	Subtotal: 93,584	

Total Friant Division Acres: 1,576,111

Note: Includes Friant Division Long-Term Contractors as of 2013.

Figure 14-21. Central Valley Project Friant Division Long-Term Contractors

The Friant Division was designed and is operated to support conjunctive water management in an area that was subject to groundwater overdraft. Chapter 13, "Hydrology – Groundwater," discusses the current state of groundwater use and overdraft in the region. Reclamation employs a two-class system of water allocation to support conjunctive water management and take advantage of water during wetter years:

- Class 1 supplies, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to quality groundwater, although most Friant Division long-term contractors have contracted for a combination of Class 1 and Class 2 supplies. During project operations, the first 800 TAF of annual water supply are delivered as Class 1 water.

- Class 2 water is a supplemental supply and is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft. Larger Class 2 contractors typically have access to good quality groundwater supplies and can use groundwater during periods of surface water deficiency. Many Class 2 contractors are in areas with high groundwater recharge capability and operate dedicated groundwater recharge facilities. Total Class 2 contracts equal 1.4 MAF.

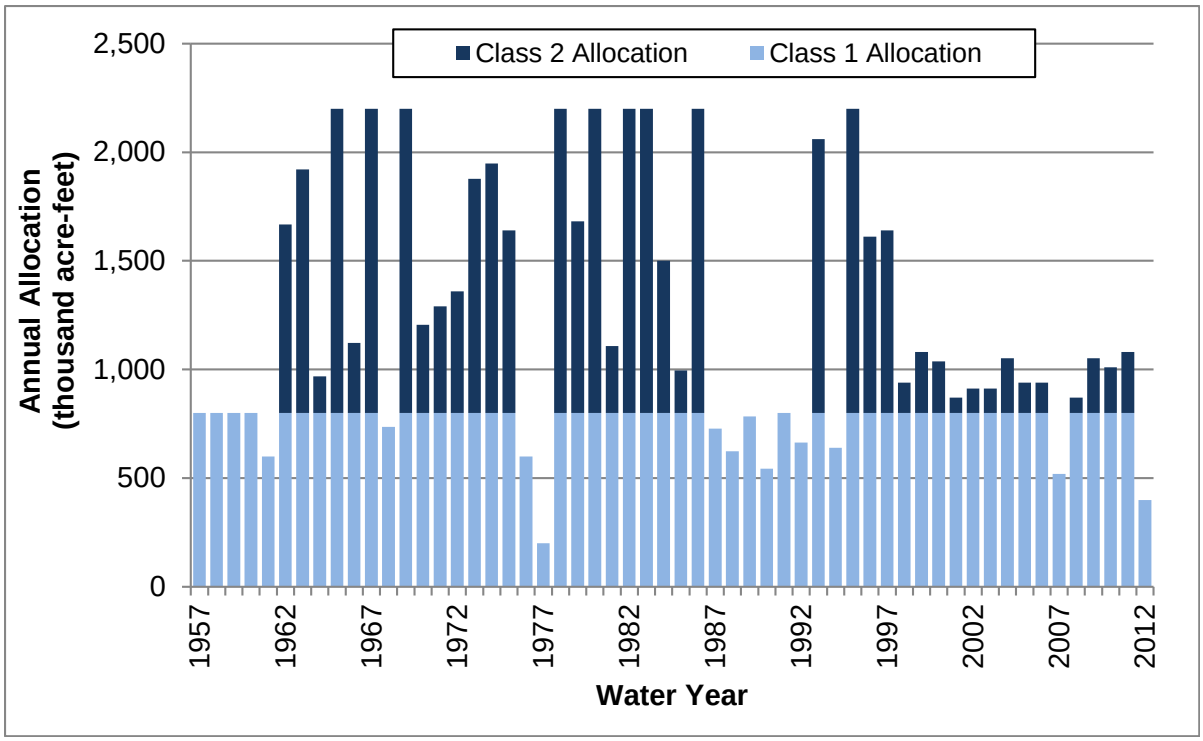
- In addition to Class 1 and Class 2 water deliveries, water can be provided in accordance with Section 215 of the Reclamation Reform Act of 1982, which authorizes delivery of unstorable water that would otherwise be released in accordance with flood management criteria or unmanaged flood flows. Delivery of such water has enabled San Joaquin Valley groundwater to be replenished at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

- The RWA program also makes water available, in wet hydrologic conditions, to all Friant Division long-term contractors who provide water to meet Restoration Flows, at a total cost of $10 per acre-foot. The reduction in water deliveries caused by Restoration Flows is monitored and recorded in the RWA.

Figure 14-22 shows the historical declared allocation of water to Friant Division contractors. Actual historical delivery of Class 2 water supplies may be less than but do not exceed declared allocations. As shown, annual allocation of Class 1 and Class 2 water varies widely in response to hydrologic conditions.

From 1957 through 2012, annual allocations of Class 1 water were typically at or above 75 percent of contract amounts, except in 4 extremely dry years. In this same period, full allocation of Class 2 water supplies occurred in about 20 percent of years. During the extended drought of 1987 through 1992, no Class 2 water was available and Class 1 allocations were below full contract amounts, except in 1 year (1991). During this and other historical drought periods, water contractors relied heavily on groundwater to meet water demands.

In addition to the Class 1, Class 2, and conjunctive management aspects of Friant Division operations, a program of transfers between districts takes place annually. This program provides opportunities to improve water management within the Friant Division Water Service Area. In wet years, water surplus to one district's need can be transferred to other districts with the ability to recharge groundwater. Conversely, in dry years, water is returned to districts with little or no groundwater supply, thereby providing an ongoing informal groundwater banking program within the Friant Division.



Note: Actual historical delivery of Class 2 water supplies may be less than but does not exceed declared allocations shown in figure.

Figure 14-22. Historical Water Allocation to Friant Division Contractors

The Cross Valley Canal is a privately owned canal that was constructed in the mid-1970s through a collaborative effort of several water agencies. The Cross Valley Canal is operated by the Kern County Water Agency (KCWA), which completed the Cross Valley Canal Expansion Project in 2012, increasing capacity to 1,422 cfs. The Cross Valley Canal allows water to be conveyed between the California Aqueduct and the Friant Kern Canal, for delivery to seven CVP contractors located in the east side of the southern San Joaquin Valley. CVP water supply from the Delta was designed to be delivered to Arvin-Edison Water Storage District (WSD) in exchange for a portion of their Friant Division CVP water supply available through Millerton Lake. Recently, Pixley ID and Lower Tule River ID have discontinued the exchange with Arvin-Edison WSD and have transferred their CVP water to other CVP WDs and purchased local supplies.

Other Central Valley Project Water Service Areas and Facilities

The CVP provides water to about 273 contractors, including Settlement Contractors in the Sacramento Valley, the Exchange Contractors in the San Joaquin Valley, agricultural and M&I

water service contractors in both the Sacramento and San Joaquin valleys, and wildlife refuges both north and south of the Delta. Several of the Federal contractors have water service areas located south of the Delta; most of their CVP supplies must be conveyed through the Delta before delivery.

Through an Exchange Contract, Reclamation provides a substitute water supply to the Exchange Contractors (CCID, Columbia Canal Company, SLCC, and the Firebaugh Canal WD), in exchange for the use of San Joaquin River water within the Friant Division. Each of the four Exchange Contractor entities has separate conveyance and delivery systems operated independently, although their combined water supply is managed as one unit for performance under the Exchange Contract. The Exchange Contractors, along with eight additional water right contractors, have conveyance and delivery systems that generally divert water from the DMC or Mendota Pool, convey water to customer delivery turnouts, and at times discharge to tributaries of the San Joaquin River.

Each February, and monthly thereafter, Reclamation evaluates hydrologic conditions throughout California to forecast CVP operations and to estimate the amount of water to be made available to Federal water service contractors for the contract year. Allocations vary from year to year, and are based on unimpaired inflow to Shasta Lake. In general, allocations to CVP water service contractors south of the Delta are lower than allocations to service contractors in the Sacramento Valley.

The CVP water service contracts have varying water shortage provisions. In 2001, Reclamation developed a draft CVP M&I Water Shortage Policy in consultation with the CVP M&I water service contractors (Reclamation 2001). This policy provides M&I water supplies with a 75 percent water supply reliability based on a contractor's historical use, as defined by the last 3 years of water deliveries unconstrained by the availability of CVP water. Before M&I supplies are reduced, irrigation water supplies would be reduced below 75 percent of contract entitlement. The policy also provides that when the allocation of irrigation water is reduced below 25 percent of contract entitlement, Reclamation will reassess the availability of CVP water and CVP water demand and, because of limited water supplies, M&I water supplies may be reduced below 75 percent of adjusted historical use. Table 14-19 shows historical CVP annual allocations since 1997.

Table 14-19. Historical Central Valley Project Annual Allocations

Year	Year Type[1]	CVP Contract Allocation (%)						
		Agricultural		Urban		Wildlife Refuges		Settlement/ Exchange
		North of Delta	South of Delta	North of Delta	South of Delta	North of Delta	South of Delta	
1997	Wet	90	90	90–100	90–100	As scheduled	As scheduled	100
1998	Wet	100	100	100	100	100	100	100
1999	Wet	100	70	95	95	100	100	100
2000	Above-Normal	100	65	100	90	100	100	100
2001	Dry	60	49	85	77	100	100	100
2002	Dry	100	70	100	95	100	100	100
2003	Above-Normal	100	75	100	100	100	100	100
2004	Below-Normal	100	70	100	95	100	100	100
2005	Above-Normal	100	85	100	100	100	100	100
2006	Wet	100	100	100	100	100	100	100
2007	Dry	100	50	100	75	100	100	100
2008	Critical	40	40	75	75	100	100	100
2009	Dry	40	10	75–100	60	100	100	100
2010	Below-Normal	100	45	100	75	100	100	100
2011	Wet	100	80	100	100	100	100	100
2012	Below-Normal	100	40	100	75	100	100	100

Source: Reclamation 2013
Note:
[1] Sacramento Valley Water Year Types as defined in Modeling Appendix.
Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta

The following subsections describe major SOD CVP facilities outside the Friant Division.

New Melones Reservoir New Melones Dam, completed in 1979, is the newest major facility of the CVP. The reservoir is located on the Stanislaus River and has a storage capacity of 2.4 MAF. New Melones Reservoir is operated for flood control on the lower Stanislaus River and in the Delta, irrigation and municipal supplies, hydropower, recreation, and fish and wildlife enhancement. Downstream from New Melones Reservoir are the Tulloch and Goodwin reservoirs, operated by the Oakdale and South San Joaquin irrigation districts. Table 14-20 shows recent historical average monthly storage operations at New Melones Reservoir.

Table 14-20. Historical Average End-of-Month New Melones Reservoir Storage

Year Type[2]	Average End-of-Month Storage (TAF)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	1,117	1,133	1,164	1,208	1,256	1,301	1,305	1,326	1,342	1,282	1,205	1,164
Wet	1,041	1,065	1,123	1,233	1,333	1,433	1,485	1,595	1,721	1,691	1,594	1,541
Above-Normal	1,395	1,411	1,425	1,418	1,440	1,465	1,475	1,523	1,550	1,482	1,414	1,373
Below-Normal	1,196	1,214	1,252	1,287	1,317	1,357	1,349	1,396	1,373	1,297	1,231	1,194
Dry	1,432	1,453	1,481	1,500	1,522	1,557	1,534	1,477	1,393	1,291	1,207	1,169
Critical	896	898	904	908	924	919	882	824	765	699	644	617

Source: DWR 2013a, Gage ID NML
Notes:
[1] Period of record Water Years 1976–2012; some years may be missing data.
[2] San Joaquin River Water Year Types as defined in Modeling Appendix.
Key:
TAF = thousand acre-feet

San Luis Reservoir/O'Neill Forebay Downstream from the Jones Pumping Plant, CVP water flows in the DMC and can be either diverted by the O'Neill Pumping-Generating Plant into the O'Neill Forebay, or can continue down the DMC for delivery to CVP contractors. The O'Neill Pumping-Generating Plant generates power from releases from the O'Neill Forebay back to the DMC. The O'Neill Pumping-Generating Plant consists of six pump-generating units, each with a capacity of 700 cfs.

The O'Neill Forebay is a joint CVP and SWP facility, with a storage capacity of about 56,000 acre-feet. In addition to its interactions with the DMC via the O'Neill Pumping-Generating Plant, it is part of the SWP California Aqueduct. Several WDs receive diversions directly from the O'Neill Forebay.

The William R. Gianelli Pumping-Generating Plant (Gianelli Pumping-Generating Plant), also a joint CVP and SWP facility, can pump water from the O'Neill Forebay into San Luis Reservoir, and generate power from releases from San Luis Reservoir to the O'Neill Forebay. The Gianelli Pumping-Generating Plant consists of eight units, each with a capacity of 1,375 cfs.

San Luis Reservoir lies at the base of foothills on the west side of the San Joaquin Valley. The reservoir provides offstream

storage for excess winter and spring flows diverted from the Delta. It was sized to reregulate and match Delta pumping to demands, with a total capacity of 2.0 MAF.

The CVP share of the storage at San Luis Reservoir is 965,660 acre-feet; the remaining 1,062,180 acre-feet is the SWP share. During late spring, summer, and early fall, water demands and schedules are greater than the capability of Reclamation and DWR to pump water from the Jones and Banks pumping plants; water stored in San Luis Reservoir is used to make up the difference. Since San Luis Reservoir receives very little natural inflow, water must be stored during late fall through early spring when the two Delta pumping plants can pump more water from the Delta than is needed to meet immediate water demands. The CVP share of San Luis Reservoir is typically at its lowest in August and September, and at its maximum in April.

Reclamation and DWR have the ability to use or exchange the diversion capacity capabilities of the CVP and SWP (i.e., Delta pumping into San Luis Reservoir) to enhance the beneficial uses of both projects. The Joint Point of Diversion (JPOD) capabilities are based on a staged implementation and conditional requirements for each stage of implementation. The stages of the JPOD are:

- **Stage 1** – For water service to Cross Valley Canal contractors, Tracy Veterans Cemetery, and Musco Olive, and to recover export reductions taken to benefit fish

- **Stage 2** – For any purpose authorized under the current project water right permits

- **Stage 3** – For any purpose authorized up to the physical capacity of the diversion facilities

Each stage has regulatory terms and conditions that must be satisfied to implement the JPOD.

The San Felipe Division of the CVP supplies water to customers in Santa Clara and San Benito counties from San Luis Reservoir. Operation of San Luis Reservoir has the potential to affect the water quality and reliability of these supplies if reservoir storage drops below 300 TAF. Low CVP and SWP water levels can affect water quality and reliability

by creating conditions for algae growth, or by exposing intake structures.

Table 14-21 shows historical average monthly storage in the CVP share of San Luis Reservoir by year type.

Table 14-21. Historical Average End-of-Month Central Valley Project San Luis Reservoir Storage

Year Type[2]	Average End-of-Month Storage (TAF)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	441	553	648	749	805	868	862	752	577	399	312	364
Wet	352	455	545	675	782	873	907	858	767	586	465	500
Above-Normal	677	742	767	811	884	948	925	791	612	454	380	432
Below-Normal	437	518	590	688	714	766	736	633	518	402	347	413
Dry	533	675	796	890	893	907	861	673	405	245	207	274
Critical	365	505	644	744	758	813	790	656	405	189	102	168

Source: DWR 2013a, Gage SLF
Notes:
[1] Period of record Water Years 1969–2012.
[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.
Key:
TAF = thousand acre-feet

Delta-Mendota Canal The DMC, completed in 1951, carries water from the Jones Pumping Plant to the San Luis–O'Neil reservoir complex and then along the west side of the San Joaquin Valley to Mendota Pool. Water is delivered along the DMC and at Mendota Pool to the Delta, West San Joaquin, and San Felipe divisions of the CVP (via San Luis Reservoir); to wildlife refuges; and to replace San Joaquin River water stored at Friant Dam and diverted into the Friant-Kern and Madera canals consistent with the San Joaquin River Exchange Contracts. The canal is about 117 miles long and has an initial diversion capacity of 4,600 cfs, which decreases to 3,211 cfs at the terminus.

Central Valley Project Contractor Facilities Exchange Contractors (Figure 14-23) provide water deliveries to over 240,000 acres of irrigable land on the west side of the San Joaquin Valley, from roughly the town of Mendota in the south, to the town of Crows Landing in the north. Deliveries are also made to the San Luis Wildlife Refuge Complex and the State WMAs.

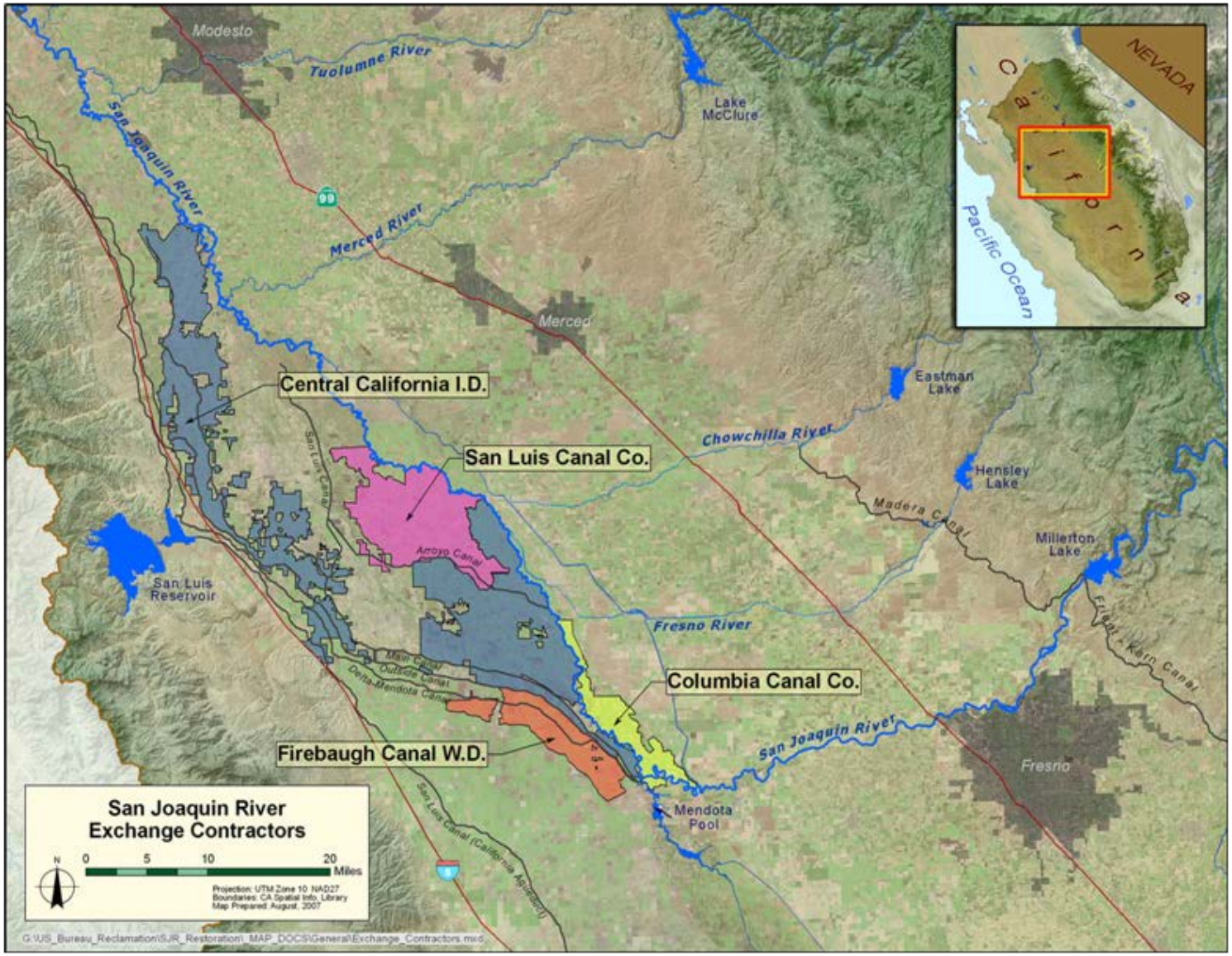


Figure 14-23. San Joaquin River Exchange Contractors

Although unique for each entity, operations generally consist of diverting sufficient flow from the DMC and Mendota Pool to the Exchange Contractors' main distribution systems. Depending on the particular Exchange Contractor entity, water is either directly delivered to community ditch systems of the customers from the main canal systems, or water is further conveyed through entity-owned and -maintained community ditch systems to ultimate points of delivery. Once delivered, the entities lose control of the water until the farmers' drainage, if any, is intercepted by district facilities.

State Water Project Water Service Areas and Facilities

The SWP operates under long-term contracts with 29 public water agencies throughout California. To provide water for the SWP, DWR negotiated settlement agreements to obtain water rights in the Feather River, and to divert that water from the Delta. DWR administers these settlement agreements with Feather River and Delta interests, and delivers about 900 TAF of water each year to Feather River agencies that hold senior water rights.

The SWP contracts between DWR and individual State water contractors define several classifications of water available for delivery under specific circumstances. All classifications are considered "project water." Table A is an exhibit to the SWP long-term water supply contracts. Table A amounts are used to define each contractor's proportion of the available water supply that DWR will allocate and deliver to that contractor. Each year, contractors may request an amount not to exceed their Table A amount. Table A amounts are used as a basis for allocations to contractors, but the actual annual supply to contractors varies, and depends on the amount of water available.

Although Table A is given first priority, water delivery capabilities of the SWP are frequently lower than Table A amounts. Each SWP contactor receives a percentage of its Table A contract amount, depending on hydrologic conditions and available SWP water in the system. Table A amounts were designed to increase gradually until the total combined maximum annual Table A amount for all water contracting agencies was achieved.

Currently, regardless of location in the SWP system, each contractor is entitled to the same percentage of Table A water. In September 2013, DWR released a Negative Declaration of a settlement with four North-of-Delta (NOD) contractors that

would modify the four NOD contractors' SWP contracts to improve water supply and reliability that has been reduced due to SOD export limitations. Implementation of the Settlement would allow the NOD plaintiffs to receive higher allocations of SWP water when SOD allocations are reduced due to environmental restrictions on pumping. Annual Table A allocations were initially for 4.23 MAF, assuming full SWP development (DWR 2013c), but have been reduced to 4.17 MAF as the result of amendments to water supply contracts in the 1990s (DWR 2013d).

The Monterey Agreement (State Water Contractors and DWR 1994), signed by 27 of the 29 SWP water contractors in 1994, restructured the SWP contracts to allocate water based on contractual Table A amounts instead of the amount of water requested for a given year. In times of shortages, the water supply to SWP agricultural and M&I contractors are reduced equally.

Many contractors also make frequent use of additional contract water types for deliveries over the approved and scheduled amount allocated to the contractors under Table A. Other contract types of water include Article 21 Water (surplus water available after operational requirements of SWP water deliveries, water quality, and Delta requirements are met), turn-back pool water (accounting of SWP supplies is used early in the year for later purchase by other SWP contractors at a set price), and carryover water (unused SWP allocation from the previous year).

The SWP allocation (proportion of Table A to be delivered) for any specific year is made based on a number of factors, including existing storage, current regulatory constraints, projected hydrologic conditions, and desired carryover storage. Since 1997, annual delivery of Table A water has varied between 1.233 MAF (in 2009) to 3.201 MAF (in 2000). Article 21 deliveries have varied between about 3 TAF (in 2008) to 731 TAF (in 2005) (DWR 2013c). Table 14-22 shows historical SWP deliveries since 1997 by year.

Table 14-22. Historical Annual State Water Project Deliveries

Year	Year Type[1]	Table A Amounts (TAF)	Article 21 (TAF)	Water Rights and Other Contractors[2] (TAF)	Fish and Wildlife (TAF)
1997	Wet	2,326	21	1,315	4
1998	Wet	1,726	20	1,007	2
1999	Wet	2,739	158	1,194	4
2000	Above-Normal	3,201	309	1,419	4
2001	Dry	1,691	43	1,556	3
2002	Dry	2,573	37	1,440	4
2003	Above-Normal	2,901	60	322	3
2004	Below-Normal	2,600	218	1,560	3
2005	Above-Normal	2,828	731	1,172	2
2006	Wet	2,973	621	1,232	2
2007	Dry	2,081	310	1,668	3
2008	Critical	1,234	3	1,598	3
2009	Dry	1,233	6	1,675	2

Source: DWR 2013c

Note:

[1] Sacramento Valley Water Year Types as defined in Modeling Appendix.

[2] Includes other State Water Project and non-State Water Project water contractors, and Feather River Water Service Area diversions.

Key:

TAF = thousand acre-feet

The following subsections describe major SOD SWP facilities.

San Luis Reservoir/O'Neill Forebay Downstream from the Banks Pumping Plant, SWP water flows in the California Aqueduct and into the O'Neill Forebay. The O'Neill Forebay and San Luis Reservoir are described in the Other Central Valley Project Water Service Areas and Facilities section of this chapter. Table 14-23 shows historical average monthly storage in the SWP share of San Luis Reservoir by year type.

Table 14-23. Historical Average End-of-Month State Water Project San Luis Reservoir Storage

Year Type[2]	Average End-of-Month Storage (TAF)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	639	674	753	860	936	980	963	872	741	631	581	620
Wet	586	642	743	904	995	1,011	1,005	954	890	819	785	850
Above-Normal	832	862	901	973	1,008	1,025	1,005	919	791	688	645	679
Below-Normal	436	470	527	665	785	872	850	739	647	642	634	619
Dry	734	760	831	908	965	1,029	989	842	655	516	464	489
Critical	588	602	680	752	826	902	889	778	573	391	304	330

Source: DWR 2013a, Gage LUS

Notes:

[1] Period of record Water Years 1969–2012.

[2] Sacramento Valley Water Year Types as defined in Modeling Appendix.

Key:

TAF = thousand acre-feet

California Aqueduct The California Aqueduct carries water 443 miles from the Banks Pumping Plant to areas in Southern California. The concrete-lined canal includes several pumping plants and branches to enable delivery to various agricultural and urban contractors, including the South Bay Aqueduct and coastal branch. South of the O'Neill Forebay, parallel to the DMC, the San Luis Canal (the central portion of the California Aqueduct) is a joint-use facility for the CVP and SWP. It begins on the southeast edge of the O'Neill Forebay and extends about 101.5 miles southeasterly to a point near Kettleman City. The California Aqueduct has a capacity ranging from 8,350 cfs to 13,100 cfs.

State Water Project Contractor Facilities The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers, or deliver it directly to agricultural and M&I water users. These deliveries are made via a variety of entity-owned and -maintained facilities.

Environmental Consequences and Mitigation Measures

This section discusses environmental consequences on surface water supplies and facilities operations associated with implementation of the alternatives. It also describes potential mitigation measures associated with impacts on surface water

that are significant or potentially significant. The potential direct and indirect effects to surface water supplies and facilities operations and associated mitigation measures are summarized in Table 14-24.

Table 14-24. Summary of Impacts and Mitigation Measures for Surface Water Supplies and Facilities Operations

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
SWS-1: Changes in Ability to Divert Water from Friant Dam	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SWS-2: Changes in Ability to Divert Water from San Joaquin River	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SWS-3: Change in Water Levels in the Old River near the Tracy Road Bridge	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 14-24. Summary of Impacts and Mitigation Measures for Surface Water Supplies and Facilities Operations (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
SWS-4: Change in Water Levels in the Grant Line Canal Above the Grant Line Canal Barrier	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
SWS-5: Change in Water Levels in the Middle River near the Howard Road Bridge	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Key:
LTS = less than significant
NI = no impact

Methods and Assumptions

This section describes the modeling and assumptions used to assess potential impacts to surface water supply and facilities operations.

A suite of modeling tools was used to evaluate the potential effects of Temperance Flat RM 274 Dam and Reservoir on surface water supplies and facilities operations, and to quantify potential benefits. CalSim II was used to simulate CVP and SWP operations, estimating the surface water flows, storages, and deliveries that could be expected with each alternative. The San Joaquin River Temperature Model (SJR5Q) provides a method to evaluate the flows and temperatures in the San Joaquin River downstream from Millerton Lake to the Merced River confluence. The Delta Simulation Model 2 (DSM2) was used to simulate Delta hydrodynamics, providing the data used to evaluate the water-level-related impacts in the Delta of each alternative. Analysis and modeling results are summarized below; more detailed explanations, assumptions, and results of these models are found in the Modeling Appendix.

All action alternatives are evaluated under existing and future conditions and compared to the No Action Alternative under existing and future conditions. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. Each of the alternatives is simulated using the same levels of development so that any changes from the basis of comparison in surface water supply and facilities operations can be attributed to the alternative.

Each of the modeling tools used for the analysis in this chapter (CalSim II, SJR5Q, and DSM2) is briefly described below, followed by a summary of the magnitude and timing of changes San Joaquin River flows and CVP and SWP operations under each action alternative compared to the existing conditions and No Action Alternative.

CalSim II

CalSim II is the application of the Water Resources Integrated Modeling System software to the CVP and SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP and SWP operations. The primary purpose of CalSim II is to evaluate the water supply reliability of the CVP and SWP at current and/or future levels of development (e.g., 2005, 2030), with and without various

assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP and SWP exports to the San Francisco Bay Area, San Joaquin Valley, Central Coast, and Southern California.

CalSim II typically simulates system operations for an 82-year period using a monthly time step. The alternatives assessed by CalSim, including No Action, have similar model structure and assumptions. All action alternatives include operation of Temperance Flat RM 274 Dam and Reservoir, as defined in Chapter 2, "Alternatives Description."

This analysis started with the future condition in the Shasta Lake Water Resources Investigation (SLWRI) 2012 Benchmark Version of the CalSim II model. This model version was selected both for consistency with the SLWRI and because it included the most recent set of updates to the CalSim II model.

As described in Chapter 3, "Considerations for Describing Affected Environment and Environmental Consequences," if ongoing CVP and SWP long-term operations re-consultation results in operational conditions that deviate substantially from the 2008 Long-Term Operations BA (Reclamation 2008) and the 2008/2009 BOs (USFWS 2008, NMFS 2009), these changes may be considered in future Investigation documents.

SJR5Q

SJR5Q covers the San Joaquin River downstream from Millerton Lake to the confluence with the Merced River. The model was developed using the USACE HEC-5Q modeling tool, which can be used for simulating water flow and quality of both reservoirs and streams. SJR5Q uses the river modeling capabilities of HEC-5Q to model both flow and temperature in the San Joaquin River from Millerton Lake to the Merced River confluence. The HEC-5Q user manual (USACE 1998) describes more completely the water quality relationships included in the model.

DSM2

DSM2 is a branched one-dimensional model used to simulate hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels. The hydrodynamic module can simulate channel stage, flow, and water velocity. Impact analysis for planning studies of the Delta is typically performed for an 82-year period (1922 to 2003).

Changes to Study Area Flows and CVP and SWP Operations

Each action alternative would affect San Joaquin River flows and CVP and SWP operations compared to either the existing conditions or the No Action Alternative. The magnitude and timing of changes vary according to each action alternative. Results are summarized below and represent changes to flows, storages, and diversions. These results are presented in more detail (e.g., year type tables) in the Modeling Appendix. While these results do not directly affect the analysis of impacts in this chapter, these results may be post-processed to meet the needs for analysis of significant impacts of alternatives in additional resource areas (e.g., impacts to Friant Division water supply in Chapter 23, "Socioeconomics, Population, and Housing"). These processes are described in corresponding sections of this Draft EIS.

San Joaquin River Upstream from Friant Dam Under the No Action Alternative, releases and diversions are made from Millerton Lake to satisfy downstream Holding Contract requirements, Friant Division demands, flood management requirements, and Restoration Flows. The action alternatives would affect average end-of-month storages in Millerton Lake, as seen in Table 14-25 and Table 14-26, by changing how water is stored between Millerton Lake and Temperance Flat RM 274 Reservoir. Wet winter and spring months would have less water stored in Millerton Lake compared to the existing conditions or No Action Alternative because water above the Millerton Lake minimum carryover storage targets would instead be stored in Temperance Flat RM 247 Reservoir. Dry months would have more water stored in Millerton Lake because Temperance Flat RM 274 Reservoir water storage would be delivered instead. Changes in reservoir levels would remain within historical operational levels.

Table 14-25. Average Simulated End-of-Month Millerton Lake Storage

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (TAF)[2]					No Action	Change from No Action (TAF)[3]				
	(TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	223	117 (52%)	117 (52%)	117 (52%)	117 (52%)	-88 (-39%)	219	121 (55%)	121 (55%)	121 (55%)	121 (55%)	-86 (-39%)
November	245	95 (39%)	96 (39%)	95 (39%)	96 (39%)	-109 (-44%)	240	100 (42%)	100 (42%)	100 (42%)	100 (42%)	-107 (-45%)
December	295	45 (15%)	45 (15%)	45 (15%)	45 (15%)	-159 (-54%)	279	61 (22%)	61 (22%)	61 (22%)	61 (22%)	-145 (-52%)
January	347	-7 (-2%)	-7 (-2%)	-6 (-2%)	-7 (-2%)	-206 (-59%)	325	15 (5%)	15 (5%)	15 (5%)	15 (5%)	-185 (-57%)
February	377	-36 (-10%)	-36 (-10%)	-36 (-10%)	-36 (-10%)	-234 (-62%)	360	-20 (-5%)	-20 (-5%)	-20 (-5%)	-20 (-5%)	-219 (-61%)
March	384	-42 (-11%)	-42 (-11%)	-42 (-11%)	-42 (-11%)	-239 (-62%)	375	-33 (-9%)	-33 (-9%)	-33 (-9%)	-32 (-9%)	-231 (-61%)
April	394	-52 (-13%)	-52 (-13%)	-53 (-13%)	-52 (-13%)	-252 (-64%)	345	-5 (-1%)	-5 (-1%)	-5 (-1%)	-5 (-1%)	-208 (-60%)
May	419	-74 (-18%)	-74 (-18%)	-75 (-18%)	-74 (-18%)	-272 (-65%)	390	-47 (-12%)	-48 (-12%)	-48 (-12%)	-47 (-12%)	-250 (-64%)
June	422	-73 (-17%)	-73 (-17%)	-76 (-18%)	-70 (-17%)	-258 (-61%)	403	-58 (-14%)	-58 (-14%)	-58 (-14%)	-56 (-14%)	-253 (-63%)
July	332	19 (6%)	19 (6%)	16 (5%)	20 (6%)	-173 (-52%)	319	28 (9%)	28 (9%)	28 (9%)	30 (10%)	-167 (-52%)
August	236	106 (45%)	106 (45%)	105 (45%)	106 (45%)	-88 (-37%)	229	113 (49%)	113 (49%)	112 (49%)	113 (49%)	-85 (-37%)
September	221	119 (54%)	119 (54%)	119 (54%)	119 (54%)	-83 (-38%)	217	123 (57%)	123 (57%)	123 (57%)	124 (57%)	-80 (-37%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node S18)

Notes:

1 Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

2 (%) indicates percent change from existing conditions. Negative value represents a decrease in storage, and positive value represents an increase in storage.

3 (%) indicates percent change from No Action Alternative. Negative value represents a decrease in storage, and positive value represents an increase in storage.

Key:
Alt = Alternative
TAF = thousand acre-feet

Table 14-26. Average Simulated End-of-Month Millerton Lake Storage in Dry and Critical Years

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (TAF)[3]					No Action	Change from No Action (TAF)[4]				
	(TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	210	130 (62%)	130 (62%)	130 (62%)	130 (62%)	-80 (-38%)	205	135 (66%)	135 (66%)	135 (66%)	135 (66%)	-75 (-37%)
November	224	116 (52%)	116 (52%)	116 (52%)	116 (52%)	-94 (-42%)	218	122 (56%)	122 (56%)	122 (56%)	122 (56%)	-88 (-40%)
December	259	81 (31%)	81 (31%)	81 (31%)	81 (31%)	-129 (-50%)	241	99 (41%)	99 (41%)	99 (41%)	99 (41%)	-111 (-46%)
January	297	43 (14%)	43 (14%)	43 (14%)	43 (14%)	-167 (-56%)	266	74 (28%)	74 (28%)	74 (28%)	74 (28%)	-136 (-51%)
February	313	27 (9%)	27 (9%)	27 (9%)	27 (9%)	-183 (-58%)	283	57 (20%)	57 (20%)	57 (20%)	57 (20%)	-153 (-54%)
March	315	25 (8%)	25 (8%)	25 (8%)	25 (8%)	-185 (-59%)	287	53 (19%)	53 (19%)	53 (19%)	53 (19%)	-157 (-55%)
April	359	-18 (-5%)	-18 (-5%)	-18 (-5%)	-18 (-5%)	-228 (-64%)	319	21 (7%)	21 (7%)	21 (7%)	21 (7%)	-189 (-59%)
May	383	-43 (-11%)	-43 (-11%)	-43 (-11%)	-43 (-11%)	-253 (-66%)	349	-9 (-2%)	-9 (-2%)	-9 (-2%)	-9 (-2%)	-219 (-63%)
June	333	7 (2%)	7 (2%)	7 (2%)	7 (2%)	-203 (-61%)	310	30 (10%)	30 (10%)	30 (10%)	30 (10%)	-180 (-58%)
July	229	111 (48%)	111 (48%)	111 (48%)	111 (48%)	-99 (-43%)	215	125 (58%)	125 (58%)	125 (58%)	125 (58%)	-85 (-40%)
August	165	175 (107%)	175 (107%)	175 (107%)	175 (107%)	-35 (-21%)	159	181 (114%)	181 (114%)	181 (114%)	181 (114%)	-29 (-18%)
September	177	163 (92%)	163 (92%)	163 (92%)	163 (92%)	-47 (-26%)	174	166 (95%)	166 (95%)	166 (95%)	166 (95%)	-44 (-25%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node S18)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in storage, and positive value represents an increase in storage.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in storage, and positive value represents an increase in storage.

Key:

Alt = Alternative

TAF = thousand acre-feet

San Joaquin River from Friant Dam to the Merced River

All action alternatives would reduce Reach 1 average streamflow in wetter winter and spring months (Table 14-27 and Table 14-28). This reduced flow is primarily caused in wet years when Temperance Flat RM 274 Reservoir would store large runoff events that otherwise would be released from Millerton Lake as flood flows. This storage would then be released in drier months and years, increasing flows in those months compared to the existing conditions or No Action Alternative (Table 14-27 and Table 14-28). Different beneficiaries, as outlined in Chapter 2, “Alternatives”, would cause changes in water supply routing (Friant-Kern Canal versus the river) and timing (agricultural water supply would be delivered on an irrigation schedule that is different from an M&I delivery schedule).

Flow changes in Reach 2A would be caused by similar operations described for Reach 1 (Table 14-29 and Table 14-30). Decreases in Reach 2B flows would be less than upstream because most flood flows bypass this reach; consequently, Reach 2B flows would be less sensitive to flood release changes at Friant Dam (Table 14-31 and Table 14-32). Increases in Reach 2B flows would be caused by releases from Temperance Flat Rm 274 storage for deliveries or exchanges at Mendota Pool.

Table 14-27. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 1

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	349	115 (33%)	170 (49%)	8 (2%)	85 (24%)	22 (6%)	350	103 (30%)	131 (37%)	3 (1%)	68 (19%)	21 (6%)
November	464	110 (24%)	208 (45%)	-5 (-1%)	88 (19%)	25 (5%)	465	99 (21%)	156 (34%)	-7 (-1%)	60 (13%)	8 (2%)
December	288	15 (5%)	49 (17%)	-76 (-26%)	-1 (0%)	-53 (-18%)	484	-9 (-2%)	11 (2%)	-95 (-20%)	-6 (-1%)	-72 (-15%)
January	474	-160 (-34%)	-164 (-35%)	-239 (-50%)	-161 (-34%)	-198 (-42%)	639	-122 (-19%)	-132 (-21%)	-188 (-29%)	-129 (-20%)	-162 (-25%)
February	741	-331 (-45%)	-304 (-41%)	-284 (-38%)	-289 (-39%)	-274 (-37%)	692	-307 (-44%)	-288 (-42%)	-275 (-40%)	-254 (-37%)	-235 (-34%)
March	1,385	-297 (-21%)	-273 (-20%)	-246 (-18%)	-228 (-16%)	-219 (-16%)	1,326	-246 (-19%)	-229 (-17%)	-222 (-17%)	-220 (-17%)	-194 (-15%)
April	1,552	-253 (-16%)	-223 (-14%)	-212 (-14%)	-224 (-14%)	-205 (-13%)	2,385	-242 (-10%)	-225 (-9%)	-215 (-9%)	-181 (-8%)	-174 (-7%)
May	1,205	-452 (-38%)	-419 (-35%)	-394 (-33%)	-388 (-32%)	-357 (-30%)	1,085	-252 (-23%)	-227 (-21%)	-208 (-19%)	-204 (-19%)	-162 (-15%)
June	1,047	-160 (-15%)	-157 (-15%)	-195 (-19%)	-95 (-9%)	-110 (-10%)	1,053	-102 (-10%)	-107 (-10%)	-142 (-14%)	-75 (-7%)	-43 (-4%)
July	633	32 (5%)	57 (9%)	27 (4%)	136 (21%)	112 (18%)	624	-27 (-4%)	-19 (-3%)	-43 (-7%)	60 (10%)	52 (8%)
August	343	131 (38%)	117 (34%)	94 (27%)	163 (47%)	160 (47%)	343	118 (35%)	91 (27%)	69 (20%)	136 (40%)	155 (45%)
September	343	135 (39%)	127 (37%)	21 (6%)	103 (30%)	35 (10%)	344	122 (36%)	99 (29%)	15 (4%)	84 (24%)	34 (10%)
Average Annual	734	-92 (-12%)	-66 (-9%)	-124 (-17%)	-66 (-9%)	-87 (-12%)	814	-71 (-9%)	-60 (-7%)	-108 (-13%)	-54 (-7%)	-63 (-8%)

Source: CalSim II 2005 and 2030 simulations (Node C18)

Notes:

1 Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

2 (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

3 (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-28. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 1

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions	Change from Existing Condition (cfs)[3]					No Action Alt	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	330	39 (12%)	64 (20%)	7 (2%)	30 (9%)	27 (8%)	317	23 (7%)	33 (10%)	4 (1%)	19 (6%)	24 (8%)
November	427	37 (9%)	78 (18%)	2 (0%)	26 (6%)	21 (5%)	404	24 (6%)	41 (10%)	3 (1%)	18 (4%)	17 (4%)
December	192	-33 (-17%)	-14 (-7%)	-62 (-32%)	-40 (-21%)	-36 (-19%)	374	-41 (-11%)	-32 (-9%)	-58 (-16%)	-44 (-12%)	-32 (-8%)
January	338	-206 (-61%)	-202 (-60%)	-225 (-67%)	-206 (-61%)	-179 (-53%)	506	-180 (-36%)	-180 (-36%)	-190 (-37%)	-179 (-35%)	-145 (-29%)
February	727	-345 (-47%)	-335 (-46%)	-329 (-45%)	-328 (-45%)	-334 (-46%)	697	-389 (-56%)	-385 (-55%)	-380 (-55%)	-336 (-48%)	-336 (-48%)
March	984	0 (0%)	5 (1%)	8 (1%)	7 (1%)	44 (4%)	985	0 (0%)	5 (0%)	4 (0%)	4 (0%)	38 (4%)
April	584	0 (0%)	9 (2%)	15 (3%)	12 (2%)	56 (10%)	735	0 (0%)	5 (1%)	9 (1%)	8 (1%)	50 (7%)
May	325	0 (0%)	14 (4%)	24 (7%)	20 (6%)	90 (28%)	321	0 (0%)	7 (2%)	15 (5%)	13 (4%)	81 (25%)
June	325	40 (12%)	50 (15%)	42 (13%)	61 (19%)	158 (49%)	321	24 (7%)	26 (8%)	26 (8%)	39 (12%)	142 (44%)
July	332	39 (12%)	55 (17%)	51 (15%)	67 (20%)	189 (57%)	330	23 (7%)	28 (9%)	31 (9%)	43 (13%)	169 (51%)
August	332	39 (12%)	39 (12%)	34 (10%)	53 (16%)	126 (38%)	330	23 (7%)	21 (6%)	21 (6%)	34 (10%)	113 (34%)
September	332	40 (12%)	42 (13%)	7 (2%)	31 (9%)	28 (8%)	333	24 (7%)	22 (7%)	5 (1%)	19 (6%)	25 (8%)
Average Annual	434	-27 (-6%)	-14 (-3%)	-34 (-8%)	-20 (-5%)	18 (4%)	470	-37 (-8%)	-32 (-7%)	-40 (-9%)	-28 (-6%)	15 (3%)

Source: CalSim II 2005 and 2030 simulations (Node C18)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-29. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 2A

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	190	115 (61%)	170 (90%)	8 (4%)	85 (45%)	22 (12%)	191	103 (54%)	131 (69%)	3 (2%)	68 (35%)	21 (11%)
November	341	110 (32%)	208 (61%)	-5 (-2%)	88 (26%)	25 (7%)	342	99 (29%)	156 (46%)	-7 (-2%)	60 (18%)	8 (2%)
December	168	15 (9%)	49 (29%)	-76 (-45%)	-1 (-1%)	-53 (-32%)	363	-9 (-2%)	11 (3%)	-95 (-26%)	-6 (-2%)	-72 (-20%)
January	375	-160 (-43%)	-164 (-44%)	-239 (-64%)	-161 (-43%)	-198 (-53%)	540	-122 (-23%)	-132 (-25%)	-188 (-35%)	-129 (-24%)	-162 (-30%)
February	641	-331 (-52%)	-304 (-47%)	-284 (-44%)	-289 (-45%)	-274 (-43%)	592	-307 (-52%)	-288 (-49%)	-275 (-46%)	-254 (-43%)	-235 (-40%)
March	1,255	-297 (-24%)	-273 (-22%)	-246 (-20%)	-228 (-18%)	-219 (-17%)	1,196	-246 (-21%)	-229 (-19%)	-222 (-19%)	-220 (-18%)	-194 (-16%)
April	1,403	-253 (-18%)	-223 (-16%)	-212 (-15%)	-224 (-16%)	-205 (-15%)	2,235	-242 (-11%)	-225 (-10%)	-215 (-10%)	-181 (-8%)	-174 (-8%)
May	1,015	-452 (-45%)	-419 (-41%)	-394 (-39%)	-388 (-38%)	-357 (-35%)	895	-252 (-28%)	-227 (-25%)	-208 (-23%)	-204 (-23%)	-162 (-18%)
June	857	-160 (-19%)	-157 (-18%)	-195 (-23%)	-95 (-11%)	-110 (-13%)	863	-102 (-12%)	-107 (-12%)	-142 (-16%)	-75 (-9%)	-43 (-5%)
July	404	32 (8%)	57 (14%)	27 (7%)	136 (34%)	112 (28%)	395	-27 (-7%)	-19 (-5%)	-43 (-11%)	60 (15%)	52 (13%)
August	114	131 (115%)	117 (103%)	94 (83%)	163 (143%)	160 (140%)	113	118 (104%)	91 (80%)	69 (61%)	136 (120%)	155 (137%)
September	133	135 (102%)	127 (96%)	21 (16%)	103 (77%)	35 (27%)	134	122 (91%)	99 (74%)	15 (11%)	84 (63%)	34 (26%)
Average Annual	573	-92 (-16%)	-66 (-12%)	-124 (-22%)	-66 (-12%)	-87 (-15%)	653	-71 (-11%)	-60 (-9%)	-108 (-17%)	-54 (-8%)	-63 (-10%)

Source: CalSim II 2005 and 2030 simulations (Node C18)

Notes:

1 Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

2 (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

3 (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-30. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 2A

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions	Change from Existing Condition (cfs)[3]					No Action Alt	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	39 (23%)	64 (38%)	7 (4%)	30 (18%)	27 (16%)	158	23 (14%)	33 (21%)	4 (3%)	19 (12%)	24 (15%)	39 (23%)
November	37 (12%)	78 (26%)	2 (1%)	26 (8%)	21 (7%)	281	24 (8%)	41 (15%)	3 (1%)	18 (6%)	17 (6%)	37 (12%)
December	-33 (-46%)	-14 (-19%)	-62 (-87%)	-40 (-55%)	-36 (-50%)	254	-41 (-16%)	-32 (-13%)	-58 (-23%)	-44 (-17%)	-32 (-13%)	-33 (-46%)
January	-206 (-87%)	-202 (-85%)	-225 (-94%)	-206 (-86%)	-179 (-75%)	407	-180 (-44%)	-180 (-44%)	-190 (-47%)	-179 (-44%)	-145 (-36%)	-206 (-87%)
February	-345 (-55%)	-335 (-53%)	-329 (-52%)	-328 (-52%)	-334 (-53%)	597	-389 (-65%)	-385 (-64%)	-380 (-64%)	-336 (-56%)	-336 (-56%)	-345 (-55%)
March	0 (0%)	5 (1%)	8 (1%)	7 (1%)	44 (5%)	855	0 (0%)	5 (1%)	4 (1%)	4 (0%)	38 (4%)	0 (0%)
April	0 (0%)	9 (2%)	15 (3%)	12 (3%)	56 (13%)	585	0 (0%)	5 (1%)	9 (2%)	8 (1%)	50 (9%)	0 (0%)
May	0 (0%)	14 (10%)	24 (18%)	20 (15%)	90 (67%)	131	0 (0%)	7 (5%)	15 (11%)	13 (10%)	81 (62%)	0 (0%)
June	40 (30%)	50 (37%)	42 (31%)	61 (45%)	158 (117%)	131	24 (18%)	26 (20%)	26 (20%)	39 (30%)	142 (108%)	40 (30%)
July	39 (38%)	55 (54%)	51 (49%)	67 (65%)	189 (184%)	100	23 (23%)	28 (28%)	31 (31%)	43 (43%)	169 (169%)	39 (38%)
August	39 (38%)	39 (38%)	34 (33%)	53 (51%)	126 (123%)	100	23 (23%)	21 (20%)	21 (21%)	34 (34%)	113 (113%)	39 (38%)
September	40 (33%)	42 (35%)	7 (6%)	31 (26%)	28 (23%)	123	24 (19%)	22 (18%)	5 (4%)	19 (16%)	25 (20%)	40 (33%)
Average Annual	-27 (-10%)	-14 (-5%)	-34 (-12%)	-20 (-7%)	18 (7%)	308	-37 (-12%)	-32 (-10%)	-40 (-13%)	-28 (-9%)	15 (5%)	-27 (-10%)

Source: CalSim II 2005 and 2030 simulations (Node C603)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-31. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 2B

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	11	116 (1045%)	171 (1537%)	9 (80%)	85 (768%)	23 (203%)	11	104 (928%)	131 (1173%)	3 (31%)	68 (610%)	21 (192%)
November	0	127 (n/a)	223 (n/a)	14 (n/a)	91 (n/a)	23 (n/a)	16	101 (617%)	158 (970%)	-4 (-27%)	62 (381%)	10 (63%)
December	44	73 (166%)	101 (231%)	-18 (-41%)	51 (117%)	-1 (-1%)	84	38 (46%)	58 (69%)	-47 (-56%)	30 (35%)	-25 (-30%)
January	80	19 (24%)	19 (24%)	-43 (-54%)	14 (17%)	-14 (-17%)	121	7 (6%)	-5 (-4%)	-55 (-45%)	-5 (-4%)	-20 (-17%)
February	130	-130 (-100%)	-104 (-80%)	-84 (-65%)	-91 (-70%)	-55 (-42%)	215	-191 (-89%)	-173 (-80%)	-159 (-74%)	-142 (-66%)	-119 (-56%)
March	60	-53 (-88%)	-31 (-52%)	-11 (-18%)	-22 (-37%)	16 (26%)	189	-145 (-76%)	-127 (-67%)	-120 (-63%)	-119 (-63%)	-99 (-52%)
April	1	-1 (-73%)	23 (2315%)	37 (3776%)	32 (3246%)	66 (6735%)	147	-119 (-80%)	-102 (-69%)	-91 (-62%)	-78 (-53%)	-46 (-31%)
May	83	-79 (-96%)	-49 (-59%)	-22 (-27%)	-25 (-31%)	25 (31%)	168	-117 (-70%)	-93 (-55%)	-72 (-43%)	-72 (-43%)	-17 (-10%)
June	23	97 (420%)	113 (492%)	95 (413%)	154 (669%)	178 (773%)	179	-20 (-11%)	-26 (-15%)	-42 (-24%)	18 (10%)	68 (38%)
July	94	83 (88%)	116 (123%)	100 (106%)	179 (190%)	199 (211%)	108	65 (60%)	73 (68%)	54 (50%)	135 (124%)	175 (162%)
August	0	131 (n/a)	117 (n/a)	94 (n/a)	163 (n/a)	160 (n/a)	0	118 (n/a)	91 (n/a)	69 (n/a)	136 (n/a)	155 (n/a)
September	0	135 (n/a)	127 (n/a)	21 (n/a)	103 (n/a)	35 (n/a)	0	122 (n/a)	99 (n/a)	15 (n/a)	84 (n/a)	34 (n/a)
Average Annual	44	44 (101%)	70 (160%)	17 (38%)	62 (142%)	55 (127%)	103	-2 (-2%)	8 (8%)	-37 (-36%)	11 (11%)	13 (12%)

Source: CalSim II 2005 and 2030 simulations (Node C605a)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second
n/a = not applicable

Table 14-32. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 2B

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions (cfs)	Change from Existing Condition (cfs)[3]					No Action Alt (cfs)	Change from No Action (cfs)[4]				
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	0	39 (n/a)	64 (n/a)	7 (n/a)	30 (n/a)	27 (n/a)	0	23 (n/a)	33 (n/a)	4 (n/a)	19 (n/a)	24 (n/a)
November	0	40 (n/a)	81 (n/a)	5 (n/a)	29 (n/a)	19 (n/a)	0	24 (n/a)	41 (n/a)	3 (n/a)	18 (n/a)	17 (n/a)
December	45	-6 (-13%)	13 (30%)	-35 (-78%)	-12 (-28%)	-9 (-20%)	48	-25 (-53%)	-16 (-34%)	-42 (-88%)	-28 (-58%)	-16 (-33%)
January	89	-57 (-64%)	-53 (-59%)	-75 (-84%)	-57 (-64%)	-30 (-34%)	103	-85 (-83%)	-85 (-83%)	-94 (-92%)	-84 (-82%)	-50 (-49%)
February	132	-132 (-100%)	-124 (-94%)	-117 (-89%)	-120 (-90%)	-72 (-54%)	195	-195 (-100%)	-192 (-98%)	-187 (-96%)	-148 (-76%)	-142 (-73%)
March	0	0 (0%)	5 (n/a)	8 (n/a)	7 (n/a)	44 (n/a)	0	0 (0%)	5 (n/a)	4 (n/a)	4 (n/a)	38 (n/a)
April	1	-1 (-100%)	9 (774%)	14 (1252%)	11 (1033%)	55 (4934%)	0	0 (0%)	5 (n/a)	9 (n/a)	8 (n/a)	50 (n/a)
May	0	0 (0%)	14 (n/a)	24 (n/a)	20 (n/a)	90 (n/a)	0	0 (0%)	7 (n/a)	15 (n/a)	13 (n/a)	81 (n/a)
June	0	40 (n/a)	50 (n/a)	42 (n/a)	61 (n/a)	158 (n/a)	0	24 (n/a)	26 (n/a)	26 (n/a)	39 (n/a)	142 (n/a)
July	0	39 (n/a)	55 (n/a)	51 (n/a)	67 (n/a)	189 (n/a)	0	23 (n/a)	28 (n/a)	31 (n/a)	43 (n/a)	169 (n/a)
August	0	39 (n/a)	39 (n/a)	34 (n/a)	53 (n/a)	126 (n/a)	0	23 (n/a)	21 (n/a)	21 (n/a)	34 (n/a)	113 (n/a)
September	0	40 (n/a)	42 (n/a)	7 (n/a)	31 (n/a)	28 (n/a)	0	24 (n/a)	22 (n/a)	5 (n/a)	19 (n/a)	25 (n/a)
Average Annual	22	4 (19%)	17 (80%)	-2 (-10%)	11 (51%)	53 (245%)	28	-13 (-46%)	-8 (-28%)	-16 (-58%)	-4 (-16%)	39 (140%)

Source: CalSim II 2005 and 2030 simulations (Node C605a)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

n/a = not applicable

Flow changes in Reach 3 through Reach 4A would be less sensitive to changes in flood releases from Friant Dam because most flood flows bypass these reaches (Table 14-33 through Table 14-36). Decreases in flow during wetter winter and spring months, therefore, would be less than observed for upstream reaches. Similar to upper reaches, operational differences between the action alternatives would cause differences in timing of Temperance Flat RM 274 storage and releases, which would cause difference in flows between alternatives.

Reach 4B1 would not have differences in flow because all flow bypasses this reach (Table 4-37 and 4-38). Reach 4B2 and Reach 5 would be sensitive to flood release changes as flood flows can reenter the San Joaquin River from the bypass system at these points (Table 14-39 through Table 14-42). Flow changes would be caused by decreased flood releases from Friant Dam and by changes in water supply routing and timing, similar to that described for other reaches.

Table 14-33. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 3

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	311	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	326	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	188	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	215	-14 (-6%)	-13 (-6%)	-15 (-7%)	-13 (-6%)	-12 (-6%)
December	185	-39 (-21%)	-39 (-21%)	-39 (-21%)	-39 (-21%)	-39 (-21%)	229	-61 (-27%)	-61 (-27%)	-58 (-25%)	-44 (-19%)	-61 (-27%)
January	283	-67 (-24%)	-67 (-24%)	-67 (-24%)	-67 (-24%)	-67 (-24%)	328	-69 (-21%)	-69 (-21%)	-69 (-21%)	-69 (-21%)	-70 (-21%)
February	333	-71 (-21%)	-68 (-20%)	-69 (-21%)	-70 (-21%)	-71 (-21%)	428	-138 (-32%)	-138 (-32%)	-138 (-32%)	-120 (-28%)	-139 (-32%)
March	374	-8 (-2%)	-8 (-2%)	-8 (-2%)	-8 (-2%)	-8 (-2%)	492	-87 (-18%)	-86 (-18%)	-87 (-18%)	-86 (-17%)	-99 (-20%)
April	368	4 (1%)	4 (1%)	4 (1%)	4 (1%)	4 (1%)	566	-84 (-15%)	-84 (-15%)	-84 (-15%)	-71 (-13%)	-86 (-15%)
May	526	-14 (-3%)	-14 (-3%)	-14 (-3%)	-14 (-3%)	-14 (-3%)	683	-91 (-13%)	-91 (-13%)	-91 (-13%)	-91 (-13%)	-94 (-14%)
June	448	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	605	-46 (-8%)	-46 (-8%)	-47 (-8%)	-47 (-8%)	-46 (-8%)
July	434	-3 (-1%)	-2 (-1%)	-1 (0%)	-2 (0%)	-1 (0%)	458	-13 (-3%)	-13 (-3%)	-17 (-4%)	-3 (-1%)	-12 (-3%)
August	404	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	408	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	355	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	366	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	351	-16 (-5%)	-16 (-5%)	-16 (-5%)	-16 (-5%)	-16 (-5%)	425	-50 (-12%)	-49 (-12%)	-50 (-12%)	-45 (-11%)	-51 (-12%)

Source: CalSim II 2005 and 2030 simulations (Node C607)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-34. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 3

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions	Change from Existing Condition (cfs)[3]					No Action Alt	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	293	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	308	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	147	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	157	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	101	-36 (-36%)	-36 (-36%)	-36 (-36%)	-36 (-36%)	-36 (-36%)	109	-40 (-36%)	-40 (-36%)	-40 (-36%)	-40 (-36%)	-40 (-36%)
January	134	-71 (-53%)	-71 (-53%)	-71 (-53%)	-71 (-53%)	-71 (-53%)	154	-88 (-57%)	-88 (-57%)	-88 (-57%)	-88 (-57%)	-88 (-57%)
February	279	-59 (-21%)	-59 (-21%)	-59 (-21%)	-59 (-21%)	-59 (-21%)	355	-131 (-37%)	-131 (-37%)	-131 (-37%)	-92 (-26%)	-131 (-37%)
March	195	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	198	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	215	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	219	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	292	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	298	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	395	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	403	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	391	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	393	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	388	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	391	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	341	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	351	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	264	-14 (-5%)	-14 (-5%)	-14 (-5%)	-14 (-5%)	-14 (-5%)	277	-21 (-8%)	-21 (-8%)	-21 (-8%)	-18 (-6%)	-21 (-8%)

Source: CalSim II 2005 and 2030 simulations (Node C607)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-35. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 4A

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	86	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	86	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	246	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	1 (0%)	265	-14 (-5%)	-13 (-5%)	-15 (-5%)	-13 (-5%)	-12 (-5%)
December	117	-39 (-33%)	-39 (-33%)	-39 (-33%)	-39 (-33%)	-39 (-33%)	272	-61 (-22%)	-61 (-22%)	-58 (-21%)	-44 (-16%)	-61 (-22%)
January	228	-67 (-29%)	-67 (-29%)	-67 (-29%)	-67 (-29%)	-67 (-29%)	405	-69 (-17%)	-69 (-17%)	-69 (-17%)	-69 (-17%)	-70 (-17%)
February	365	-71 (-19%)	-68 (-19%)	-69 (-19%)	-70 (-19%)	-71 (-19%)	456	-138 (-30%)	-138 (-30%)	-138 (-30%)	-120 (-26%)	-139 (-30%)
March	867	-8 (-1%)	-8 (-1%)	-8 (-1%)	-8 (-1%)	-8 (-1%)	1,023	-87 (-8%)	-86 (-8%)	-87 (-9%)	-86 (-8%)	-99 (-10%)
April	927	-5 (-1%)	-4 (0%)	-4 (0%)	-5 (-1%)	-4 (0%)	2,056	-84 (-4%)	-84 (-4%)	-84 (-4%)	-71 (-3%)	-86 (-4%)
May	386	-14 (-4%)	-14 (-4%)	-14 (-4%)	-14 (-4%)	-14 (-4%)	759	-91 (-12%)	-91 (-12%)	-91 (-12%)	-91 (-12%)	-94 (-12%)
June	318	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	572	-46 (-8%)	-46 (-8%)	-47 (-8%)	-47 (-8%)	-46 (-8%)
July	45	-3 (-7%)	-2 (-5%)	-1 (-1%)	-2 (-5%)	-1 (-1%)	67	-13 (-20%)	-13 (-20%)	-17 (-25%)	-3 (-5%)	-12 (-18%)
August	18	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	35	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	36	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	302	-17 (-6%)	-17 (-6%)	-17 (-6%)	-17 (-6%)	-17 (-6%)	499	-50 (-10%)	-49 (-10%)	-50 (-10%)	-45 (-9%)	-51 (-10%)

Source: CalSim II 2005 and 2030 simulations (Node C608)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-36. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 4A

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions	Change from Existing Condition (cfs)[3]					No Action Alt	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	77	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	71	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	204	-3 (-1%)	-3 (-1%)	-3 (-1%)	-3 (-2%)	3 (1%)	182	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	36	-36 (-100%)	-36 (-100%)	-36 (-100%)	-36 (-100%)	-36 (-100%)	142	-40 (-28%)	-40 (-28%)	-40 (-28%)	-40 (-28%)	-40 (-28%)
January	82	-71 (-87%)	-71 (-87%)	-71 (-87%)	-71 (-87%)	-71 (-87%)	218	-88 (-40%)	-88 (-40%)	-88 (-40%)	-88 (-40%)	-88 (-40%)
February	306	-59 (-19%)	-59 (-19%)	-59 (-19%)	-59 (-19%)	-59 (-19%)	372	-131 (-35%)	-131 (-35%)	-131 (-35%)	-92 (-25%)	-131 (-35%)
March	719	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	721	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	316	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	471	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	46	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	43	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	47	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	44	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	16	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	15	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	16	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	15	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	31	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	31	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	157	-14 (-9%)	-14 (-9%)	-14 (-9%)	-14 (-9%)	-13 (-9%)	192	-21 (-11%)	-21 (-11%)	-21 (-11%)	-18 (-9%)	-21 (-11%)

Source: CalSim II 2005 and 2030 simulations (Node C608)

Notes:

[1] Values presented for Dry years as defined by the Restoration year type.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-37. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 4B1

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: CalSim II 2005 and 2030 simulations (Node C609b)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-38. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 4B1

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions (cfs)	Change from Existing Condition (cfs)[3]					No Action Alt (cfs)	Change from No Action (cfs)[4]				
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: CalSim II 2005 and 2030 simulations (Node C609b)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-39. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 4B2

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	74	3 (4%)	3 (4%)	3 (4%)	3 (4%)	3 (4%)	75	3 (4%)	3 (4%)	3 (4%)	3 (4%)	2 (3%)
November	313	-16 (-5%)	-15 (-5%)	-19 (-6%)	-4 (-1%)	1 (0%)	311	-14 (-4%)	-13 (-4%)	-15 (-5%)	-13 (-4%)	-12 (-4%)
December	270	-101 (-37%)	-97 (-36%)	-102 (-38%)	-97 (-36%)	-97 (-36%)	361	-118 (-33%)	-118 (-33%)	-113 (-31%)	-90 (-25%)	-118 (-33%)
January	506	-175 (-34%)	-175 (-34%)	-174 (-34%)	-175 (-35%)	-174 (-34%)	583	-133 (-23%)	-131 (-23%)	-131 (-22%)	-131 (-22%)	-149 (-26%)
February	833	-283 (-34%)	-277 (-33%)	-277 (-33%)	-270 (-32%)	-296 (-36%)	791	-256 (-32%)	-254 (-32%)	-254 (-32%)	-231 (-29%)	-253 (-32%)
March	1,320	-240 (-18%)	-236 (-18%)	-232 (-18%)	-202 (-15%)	-231 (-17%)	1,261	-166 (-13%)	-165 (-13%)	-166 (-13%)	-164 (-13%)	-176 (-14%)
April	1,405	-227 (-16%)	-222 (-16%)	-224 (-16%)	-230 (-16%)	-247 (-18%)	2,179	-160 (-7%)	-159 (-7%)	-160 (-7%)	-128 (-6%)	-163 (-7%)
May	952	-338 (-36%)	-336 (-35%)	-336 (-35%)	-329 (-35%)	-345 (-36%)	887	-175 (-20%)	-175 (-20%)	-176 (-20%)	-172 (-19%)	-190 (-21%)
June	698	-201 (-29%)	-214 (-31%)	-219 (-31%)	-194 (-28%)	-230 (-33%)	676	-97 (-14%)	-96 (-14%)	-102 (-15%)	-109 (-16%)	-111 (-16%)
July	198	-44 (-22%)	-49 (-25%)	-61 (-31%)	-36 (-18%)	-75 (-38%)	199	-92 (-46%)	-92 (-46%)	-98 (-49%)	-66 (-33%)	-118 (-59%)
August	6	0 (1%)	0 (1%)	0 (1%)	0 (1%)	0 (1%)	6	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)
September	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	547	-134 (-25%)	-134 (-24%)	-136 (-25%)	-127 (-23%)	-140 (-26%)	609	-100 (-16%)	-99 (-16%)	-100 (-16%)	-91 (-15%)	-107 (-17%)

Source: CalSim II 2005 and 2030 simulations (Node C610)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-40. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 4B2

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions	Change from Existing Condition (cfs)[3]					No Action Alt	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	66	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	61	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	193	-3 (-1%)	-3 (-1%)	-3 (-1%)	-3 (-2%)	3 (1%)	171	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	76	-57 (-76%)	-57 (-76%)	-57 (-76%)	-57 (-76%)	-57 (-76%)	163	-53 (-33%)	-53 (-33%)	-53 (-33%)	-53 (-33%)	-53 (-33%)
January	295	-202 (-69%)	-202 (-69%)	-202 (-69%)	-203 (-69%)	-202 (-69%)	382	-181 (-47%)	-181 (-47%)	-181 (-47%)	-182 (-48%)	-181 (-47%)
February	735	-260 (-35%)	-258 (-35%)	-258 (-35%)	-253 (-34%)	-305 (-42%)	721	-299 (-42%)	-299 (-42%)	-299 (-42%)	-261 (-36%)	-300 (-42%)
March	707	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	708	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	305	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	460	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	36	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	36	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	34	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	5	0 (2%)	0 (4%)	0 (4%)	0 (4%)	0 (2%)	6	0 (-7%)	0 (-7%)	0 (-7%)	0 (-7%)	0 (-7%)
August	5	0 (4%)	0 (4%)	0 (4%)	0 (4%)	0 (4%)	5	0 (-5%)	0 (-5%)	0 (-5%)	0 (-5%)	0 (-5%)
September	20	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	21	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	203	-42 (-21%)	-42 (-21%)	-42 (-21%)	-42 (-21%)	-45 (-22%)	227	-43 (-19%)	-43 (-19%)	-43 (-19%)	-40 (-18%)	-43 (-19%)

Source: CalSim II 2005 and 2030 simulations (Node C610)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-41. Average Simulated Monthly Flow, San Joaquin River at Head of Reach 5

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	85	3 (3%)	3 (3%)	3 (3%)	3 (3%)	3 (3%)	86	3 (4%)	3 (4%)	3 (4%)	3 (4%)	2 (3%)
November	379	-16 (-4%)	-15 (-4%)	-19 (-5%)	-4 (-1%)	1 (0%)	377	-14 (-4%)	-13 (-3%)	-15 (-4%)	-13 (-3%)	-12 (-3%)
December	510	-101 (-20%)	-97 (-19%)	-102 (-20%)	-97 (-19%)	-97 (-19%)	601	-118 (-20%)	-118 (-20%)	-113 (-19%)	-90 (-15%)	-118 (-20%)
January	1,071	-242 (-23%)	-246 (-23%)	-258 (-24%)	-231 (-22%)	-247 (-23%)	1,147	-212 (-18%)	-210 (-18%)	-215 (-19%)	-204 (-18%)	-223 (-19%)
February	1,604	-285 (-18%)	-280 (-17%)	-279 (-17%)	-273 (-17%)	-298 (-19%)	1,563	-256 (-16%)	-255 (-16%)	-254 (-16%)	-232 (-15%)	-254 (-16%)
March	2,073	-241 (-12%)	-238 (-11%)	-233 (-11%)	-204 (-10%)	-232 (-11%)	2,012	-175 (-9%)	-174 (-9%)	-175 (-9%)	-173 (-9%)	-177 (-9%)
April	1,985	-239 (-12%)	-234 (-12%)	-236 (-12%)	-242 (-12%)	-259 (-13%)	2,785	-184 (-7%)	-183 (-7%)	-184 (-7%)	-152 (-5%)	-190 (-7%)
May	1,247	-353 (-28%)	-350 (-28%)	-350 (-28%)	-343 (-27%)	-359 (-29%)	1,190	-193 (-16%)	-193 (-16%)	-194 (-16%)	-190 (-16%)	-207 (-17%)
June	861	-221 (-26%)	-234 (-27%)	-245 (-28%)	-214 (-25%)	-250 (-29%)	824	-101 (-12%)	-100 (-12%)	-113 (-14%)	-114 (-14%)	-129 (-16%)
July	236	-44 (-19%)	-49 (-21%)	-61 (-26%)	-36 (-15%)	-75 (-32%)	236	-92 (-39%)	-92 (-39%)	-98 (-41%)	-66 (-28%)	-118 (-50%)
August	14	0 (1%)	0 (1%)	0 (1%)	0 (1%)	0 (1%)	15	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)
September	28	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	29	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	835	-144 (-17%)	-144 (-17%)	-148 (-18%)	-136 (-16%)	-150 (-18%)	899	-111 (-12%)	-111 (-12%)	-113 (-13%)	-102 (-11%)	-118 (-13%)

Source: CalSim II 2005 and 2030 simulations (Node C611)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-42. Average Simulated Monthly Flow in Dry and Critical Years, San Joaquin River at Head of Reach 5

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Conditions (cfs)	Change from Existing Condition (cfs)[3]					No Action Alt (cfs)	Change from No Action (cfs)[4]				
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	68	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	64	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	227	-3 (-1%)	-3 (-1%)	-3 (-1%)	-3 (-1%)	3 (1%)	204	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	290	-57 (-20%)	-57 (-20%)	-57 (-20%)	-57 (-20%)	-57 (-20%)	377	-53 (-14%)	-53 (-14%)	-53 (-14%)	-53 (-14%)	-53 (-14%)
January	827	-202 (-24%)	-202 (-24%)	-202 (-24%)	-203 (-25%)	-202 (-24%)	914	-181 (-20%)	-181 (-20%)	-181 (-20%)	-182 (-20%)	-181 (-20%)
February	1,583	-260 (-16%)	-258 (-16%)	-258 (-16%)	-253 (-16%)	-305 (-19%)	1,569	-299 (-19%)	-299 (-19%)	-299 (-19%)	-261 (-17%)	-300 (-19%)
March	903	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	904	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	459	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	614	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	125	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	123	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	73	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	70	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	13	0 (1%)	0 (2%)	0 (2%)	0 (2%)	0 (1%)	14	0 (-3%)	0 (-3%)	0 (-3%)	0 (-3%)	0 (-3%)
August	7	0 (3%)	0 (3%)	0 (3%)	0 (3%)	0 (3%)	8	0 (-3%)	0 (-3%)	0 (-3%)	0 (-3%)	0 (-3%)
September	21	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	21	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	375	-42 (-11%)	-42 (-11%)	-42 (-11%)	-42 (-11%)	-45 (-12%)	399	-43 (-11%)	-43 (-11%)	-43 (-11%)	-40 (-10%)	-43 (-11%)

Source: CalSim II 2005 and 2030 simulations (Node C611)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

All alternatives would reduce the average streamflow in the flood bypass system in wetter winter and spring months (Table 14-43 through Table 14-46). Temperance Flat RM 274 Reservoir would store large runoff events in wetter months and years that otherwise would be released from Millerton Lake as flood flows and would then be diverted into the bypasses. Changes in flow leaving Reach 5 and the flood bypass system would continue to reflect this capture of flood flows in Temperance Flat RM 274 Reservoir, for later release in drier months and years for water supply deliveries in upper reaches.

Table 14-43. Average Simulated Monthly Flow in Chowchilla Bypass Below Bifurcation Structure

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	22	-15 (-67%)	-14 (-62%)	-17 (-77%)	-2 (-9%)	0 (2%)	3	-1 (-50%)	-1 (-50%)	-1 (-50%)	-1 (-50%)	-1 (-50%)
December	108	-47 (-43%)	-42 (-39%)	-48 (-44%)	-42 (-39%)	-42 (-39%)	56	-41 (-74%)	-41 (-73%)	-42 (-74%)	-32 (-56%)	-41 (-74%)
January	253	-147 (-58%)	-151 (-59%)	-162 (-64%)	-142 (-56%)	-152 (-60%)	168	-119 (-70%)	-117 (-69%)	-122 (-73%)	-114 (-68%)	-131 (-78%)
February	255	-185 (-72%)	-184 (-72%)	-183 (-72%)	-181 (-71%)	-202 (-79%)	122	-99 (-81%)	-99 (-81%)	-99 (-81%)	-97 (-79%)	-99 (-81%)
March	342	-229 (-67%)	-227 (-66%)	-222 (-65%)	-193 (-56%)	-221 (-65%)	116	-89 (-77%)	-89 (-77%)	-89 (-77%)	-89 (-77%)	-82 (-71%)
April	528	-235 (-45%)	-229 (-43%)	-232 (-44%)	-238 (-45%)	-253 (-48%)	166	-112 (-67%)	-111 (-67%)	-112 (-67%)	-93 (-56%)	-116 (-70%)
May	650	-351 (-54%)	-348 (-54%)	-349 (-54%)	-341 (-52%)	-359 (-55%)	205	-122 (-60%)	-122 (-59%)	-123 (-60%)	-119 (-58%)	-132 (-64%)
June	471	-243 (-52%)	-256 (-54%)	-274 (-58%)	-236 (-50%)	-272 (-58%)	164	-71 (-43%)	-70 (-43%)	-89 (-54%)	-82 (-50%)	-99 (-60%)
July	181	-47 (-26%)	-54 (-30%)	-67 (-37%)	-41 (-22%)	-81 (-45%)	159	-85 (-53%)	-85 (-53%)	-90 (-56%)	-69 (-43%)	-114 (-72%)
August	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	234	-124 (-53%)	-125 (-53%)	-129 (-55%)	-117 (-50%)	-131 (-56%)	97	-61 (-64%)	-61 (-63%)	-64 (-66%)	-58 (-60%)	-68 (-70%)

Source: CalSim II 2005 and 2030 simulations (Node C605b)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-44. Average Simulated Monthly Flow in Eastside Bypass Below Sand Slough

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	73	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	74	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	234	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	1 (0%)	253	-14 (-5%)	-13 (-5%)	-15 (-6%)	-13 (-5%)	-12 (-5%)
December	116	-38 (-33%)	-38 (-33%)	-38 (-33%)	-38 (-33%)	-38 (-33%)	260	-61 (-23%)	-61 (-23%)	-57 (-22%)	-44 (-17%)	-61 (-23%)
January	226	-66 (-29%)	-66 (-29%)	-66 (-29%)	-66 (-29%)	-66 (-29%)	393	-69 (-18%)	-69 (-18%)	-69 (-18%)	-69 (-18%)	-70 (-18%)
February	353	-71 (-20%)	-68 (-19%)	-69 (-19%)	-70 (-20%)	-71 (-20%)	444	-138 (-31%)	-138 (-31%)	-138 (-31%)	-120 (-27%)	-138 (-31%)
March	854	-8 (-1%)	-8 (-1%)	-8 (-1%)	-8 (-1%)	-8 (-1%)	1,010	-87 (-9%)	-86 (-9%)	-87 (-9%)	-86 (-9%)	-99 (-10%)
April	914	-5 (-1%)	-4 (0%)	-4 (0%)	-5 (-1%)	-4 (0%)	2,044	-84 (-4%)	-84 (-4%)	-84 (-4%)	-71 (-3%)	-86 (-4%)
May	374	-14 (-4%)	-14 (-4%)	-14 (-4%)	-14 (-4%)	-14 (-4%)	747	-91 (-12%)	-91 (-12%)	-91 (-12%)	-91 (-12%)	-94 (-13%)
June	305	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	560	-46 (-8%)	-46 (-8%)	-47 (-8%)	-47 (-8%)	-46 (-8%)
July	33	-3 (-9%)	-2 (-7%)	-1 (-2%)	-2 (-6%)	-1 (-2%)	55	-13 (-24%)	-13 (-24%)	-17 (-30%)	-3 (-6%)	-12 (-22%)
August	6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	291	-17 (-6%)	-17 (-6%)	-17 (-6%)	-17 (-6%)	-17 (-6%)	487	-50 (-10%)	-49 (-10%)	-50 (-10%)	-45 (-9%)	-51 (-10%)

Source: CalSim II 2005 and 2030 simulations (Node C609a)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternatives

cfs = cubic feet per second

Table 14-45. Average Simulated Monthly Flow in Eastside Bypass Upstream from San Joaquin River Confluence

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	10	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	67	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	67	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	240	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	240	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	564	-67 (-12%)	-71 (-13%)	-84 (-15%)	-57 (-10%)	-72 (-13%)	564	-79 (-14%)	-78 (-14%)	-85 (-15%)	-73 (-13%)	-74 (-13%)
February	771	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	771	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)
March	753	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	752	-9 (-1%)	-9 (-1%)	-9 (-1%)	-9 (-1%)	-1 (0%)
April	580	-12 (-2%)	-12 (-2%)	-12 (-2%)	-12 (-2%)	-12 (-2%)	606	-24 (-4%)	-24 (-4%)	-24 (-4%)	-24 (-4%)	-27 (-4%)
May	295	-14 (-5%)	-14 (-5%)	-14 (-5%)	-14 (-5%)	-14 (-5%)	303	-18 (-6%)	-18 (-6%)	-18 (-6%)	-18 (-6%)	-17 (-6%)
June	163	-20 (-12%)	-20 (-12%)	-27 (-16%)	-20 (-12%)	-20 (-12%)	149	-4 (-3%)	-4 (-3%)	-11 (-8%)	-4 (-3%)	-18 (-12%)
July	38	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	38	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	288	-10 (-3%)	-10 (-4%)	-12 (-4%)	-9 (-3%)	-10 (-4%)	290	-11 (-4%)	-11 (-4%)	-12 (-4%)	-11 (-4%)	-12 (-4%)

Source: CalSim II 2005 and 2030 simulations (Node C589)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

Table 14-46. Average Simulated Monthly Flow in Mariposa Bypass

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Conditions	Change from Existing Condition (cfs)[2]					No Action Alt	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	74	3 (4%)	3 (4%)	3 (4%)	3 (4%)	3 (4%)	75	3 (4%)	3 (4%)	3 (4%)	3 (4%)	2 (3%)
November	313	-16 (-5%)	-15 (-5%)	-19 (-6%)	-4 (-1%)	1 (0%)	311	-14 (-4%)	-13 (-4%)	-15 (-5%)	-13 (-4%)	-12 (-4%)
December	270	-101 (-37%)	-97 (-36%)	-102 (-38%)	-97 (-36%)	-97 (-36%)	361	-118 (-33%)	-118 (-33%)	-113 (-31%)	-90 (-25%)	-118 (-33%)
January	506	-175 (-34%)	-175 (-34%)	-174 (-34%)	-175 (-35%)	-174 (-34%)	583	-133 (-23%)	-131 (-23%)	-131 (-22%)	-131 (-22%)	-149 (-26%)
February	833	-283 (-34%)	-277 (-33%)	-277 (-33%)	-270 (-32%)	-296 (-36%)	791	-256 (-32%)	-254 (-32%)	-254 (-32%)	-231 (-29%)	-253 (-32%)
March	1,320	-240 (-18%)	-236 (-18%)	-232 (-18%)	-202 (-15%)	-231 (-17%)	1,261	-166 (-13%)	-165 (-13%)	-166 (-13%)	-164 (-13%)	-176 (-14%)
April	1,405	-227 (-16%)	-222 (-16%)	-224 (-16%)	-230 (-16%)	-247 (-18%)	2,179	-160 (-7%)	-159 (-7%)	-160 (-7%)	-128 (-6%)	-163 (-7%)
May	952	-338 (-36%)	-336 (-35%)	-336 (-35%)	-329 (-35%)	-345 (-36%)	887	-175 (-20%)	-175 (-20%)	-176 (-20%)	-172 (-19%)	-190 (-21%)
June	698	-201 (-29%)	-214 (-31%)	-219 (-31%)	-194 (-28%)	-230 (-33%)	676	-97 (-14%)	-96 (-14%)	-102 (-15%)	-109 (-16%)	-111 (-16%)
July	198	-44 (-22%)	-49 (-25%)	-61 (-31%)	-36 (-18%)	-75 (-38%)	199	-92 (-46%)	-92 (-46%)	-98 (-49%)	-66 (-33%)	-118 (-59%)
August	6	0 (1%)	0 (1%)	0 (1%)	0 (1%)	0 (1%)	6	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)	0 (-1%)
September	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	547	-134 (-25%)	-134 (-24%)	-136 (-25%)	-127 (-23%)	-140 (-26%)	609	-100 (-16%)	-99 (-16%)	-100 (-16%)	-91 (-15%)	-107 (-17%)

Source: CalSim II 2005 and 2030 simulations (Node C587a)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternatives
cfs = cubic feet per second

San Joaquin River from the Merced River to the Delta
Flow changes in the San Joaquin River and in its associated tributaries below Reach 5 would be less than changes seen in upstream reaches (Table 14-47 through Table 14-56). None of the alternatives would change San Joaquin River tributary streamflows. Percent changes in San Joaquin River streamflow would be less than observed in upstream reaches because the basis-of-comparison or magnitude of flow in the San Joaquin River increases considerably as it nears the Delta. Similarly, effects caused by changes in flood releases from Friant Dam would diminish as the river nears the Delta. Most new water supply deliveries associated with the alternatives are made upstream from this reach and would, therefore, not increase flows below Reach 5 in drier months and years.

Table 14-47. Average Simulated Monthly Merced River Inflow to San Joaquin River

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	449	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	461	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	437	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	437	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	592	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	601	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	908	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	907	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	1,153	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,178	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	849	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	846	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	668	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	650	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	974	2 (0%)	3 (0%)	3 (0%)	2 (0%)	3 (0%)	956	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	919	0 (0%)	0 (0%)	4 (0%)	0 (0%)	0 (0%)	943	0 (0%)	0 (0%)	11 (1%)	0 (0%)	0 (0%)
July	705	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	739	0 (0%)	0 (0%)	4 (1%)	0 (0%)	0 (0%)
August	461	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	497	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	270	-1 (0%)	-1 (-1%)	-1 (-1%)	-1 (0%)	-1 (-1%)	283	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	696	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	706	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C566)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-48. Average Simulated Monthly Merced River Inflow in Dry and Critical Years to San Joaquin River

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	292	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	293	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	356	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	356	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	370	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	370	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	608	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	596	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	789	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	797	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	317	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	319	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	466	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	475	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	308	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	258	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	160	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	166	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	109	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	118	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	96	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	100	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	58	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	58	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	324	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	322	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Summarized from CALSIM II 2005 and 2030 simulations (Node C566)

Notes:

[1] Values presented for Dry and Critical years as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:
Alt = Alternative
cfs = cubic feet per second

Table 14-49. Average Simulated Monthly Flow at San Joaquin River Below Merced River

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	696	3 (0%)	3 (0%)	3 (0%)	3 (0%)	3 (0%)	685	3 (0%)	3 (0%)	3 (0%)	3 (0%)	2 (0%)
November	1,264	-16 (-1%)	-15 (-1%)	-19 (-1%)	-4 (0%)	1 (0%)	1,237	-14 (-1%)	-13 (-1%)	-15 (-1%)	-13 (-1%)	-12 (-1%)
December	1,490	-101 (-7%)	-97 (-6%)	-102 (-7%)	-97 (-6%)	-97 (-6%)	1,561	-118 (-8%)	-118 (-8%)	-113 (-7%)	-90 (-6%)	-118 (-8%)
January	2,285	-242 (-11%)	-246 (-11%)	-258 (-11%)	-231 (-10%)	-247 (-11%)	2,310	-212 (-9%)	-210 (-9%)	-215 (-9%)	-204 (-9%)	-223 (-10%)
February	3,292	-285 (-9%)	-280 (-8%)	-279 (-8%)	-273 (-8%)	-298 (-9%)	3,217	-256 (-8%)	-255 (-8%)	-254 (-8%)	-232 (-7%)	-254 (-8%)
March	3,203	-241 (-8%)	-238 (-7%)	-233 (-7%)	-204 (-6%)	-232 (-7%)	3,084	-175 (-6%)	-174 (-6%)	-175 (-6%)	-173 (-6%)	-177 (-6%)
April	2,660	-238 (-9%)	-233 (-9%)	-235 (-9%)	-241 (-9%)	-258 (-10%)	3,419	-184 (-5%)	-183 (-5%)	-184 (-5%)	-152 (-4%)	-190 (-6%)
May	2,289	-350 (-15%)	-347 (-15%)	-348 (-15%)	-341 (-15%)	-356 (-16%)	2,203	-193 (-9%)	-193 (-9%)	-194 (-9%)	-190 (-9%)	-207 (-9%)
June	1,803	-221 (-12%)	-234 (-13%)	-242 (-13%)	-214 (-12%)	-250 (-14%)	1,750	-101 (-6%)	-100 (-6%)	-102 (-6%)	-114 (-6%)	-129 (-7%)
July	933	-45 (-5%)	-51 (-5%)	-63 (-7%)	-38 (-4%)	-76 (-8%)	927	-92 (-10%)	-92 (-10%)	-94 (-10%)	-66 (-7%)	-118 (-13%)
August	513	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	510	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	745	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	734	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	1,754	-144 (-8%)	-144 (-8%)	-147 (-8%)	-136 (-8%)	-150 (-9%)	1,792	-111 (-6%)	-110 (-6%)	-111 (-6%)	-102 (-6%)	-118 (-7%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C620)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-50. Average Simulated Monthly Flow in Dry and Critical Years at San Joaquin River Below Merced River

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	508	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	483	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	1,013	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	3 (0%)	967	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	1,033	-57 (-6%)	-57 (-6%)	-57 (-6%)	-57 (-6%)	-57 (-6%)	1,094	-53 (-5%)	-53 (-5%)	-53 (-5%)	-53 (-5%)	-53 (-5%)
January	1,728	-202 (-12%)	-202 (-12%)	-202 (-12%)	-203 (-12%)	-202 (-12%)	1,763	-181 (-10%)	-181 (-10%)	-181 (-10%)	-182 (-10%)	-181 (-10%)
February	2,888	-260 (-9%)	-258 (-9%)	-258 (-9%)	-253 (-9%)	-305 (-11%)	2,827	-299 (-11%)	-299 (-11%)	-299 (-11%)	-261 (-9%)	-300 (-11%)
March	1,404	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,365	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	874	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,018	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	462	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	395	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	221	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	193	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	78	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	57	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	103	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	82	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	491	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	473	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	887	-42 (-5%)	-42 (-5%)	-42 (-5%)	-42 (-5%)	-45 (-5%)	880	-43 (-5%)	-43 (-5%)	-43 (-5%)	-40 (-5%)	-43 (-5%)

Source: Summarized from CALSIM II 2005 and 2030 simulations (Node C620)

Notes:

[1] Values presented for Dry and Critical years as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-51. Average Simulated Monthly Tuolumne River Inflow to San Joaquin River

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	597	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	594	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	574	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	569	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	839	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	809	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	1,286	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,246	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	1,704	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,651	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	2,136	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,064	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	1,941	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1,947	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	1,754	-1 (0%)	-1 (0%)	0 (0%)	-1 (0%)	0 (0%)	1,797	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	1,451	0 (0%)	0 (0%)	6 (0%)	0 (0%)	0 (0%)	1,422	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	1,103	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,104	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	477	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	476	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	482	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	479	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	1,192	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	1,177	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C545)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-52. Average Simulated Monthly Tuolumne River Inflow in Dry and Critical Years to San Joaquin River

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	347	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	347	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	345	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	345	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	350	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	350	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	794	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	723	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	1,135	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,101	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	570	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	552	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	662	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	686	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	649	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	683	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	298	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	299	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	284	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	284	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	298	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	298	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	299	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	299	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	498	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	493	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node 545)

Notes:

[1] Values presented for Dry And Critical years as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-53. Average Simulated Monthly Flow at San Joaquin River Below Tuolumne River

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	1,389	3 (0%)	3 (0%)	3 (0%)	3 (0%)	3 (0%)	1,377	3 (0%)	3 (0%)	3 (0%)	3 (0%)	2 (0%)
November	1,850	-16 (-1%)	-15 (-1%)	-19 (-1%)	-4 (0%)	1 (0%)	1,818	-14 (-1%)	-13 (-1%)	-15 (-1%)	-13 (-1%)	-12 (-1%)
December	2,329	-101 (-4%)	-97 (-4%)	-102 (-4%)	-97 (-4%)	-97 (-4%)	2,371	-118 (-5%)	-118 (-5%)	-113 (-5%)	-90 (-4%)	-118 (-5%)
January	3,572	-242 (-7%)	-246 (-7%)	-258 (-7%)	-231 (-6%)	-247 (-7%)	3,557	-212 (-6%)	-210 (-6%)	-215 (-6%)	-204 (-6%)	-223 (-6%)
February	5,005	-285 (-6%)	-280 (-6%)	-279 (-6%)	-273 (-5%)	-298 (-6%)	4,876	-256 (-5%)	-255 (-5%)	-254 (-5%)	-232 (-5%)	-254 (-5%)
March	5,356	-241 (-5%)	-238 (-4%)	-233 (-4%)	-204 (-4%)	-232 (-4%)	5,165	-175 (-3%)	-174 (-3%)	-175 (-3%)	-173 (-3%)	-177 (-3%)
April	4,672	-236 (-5%)	-231 (-5%)	-233 (-5%)	-239 (-5%)	-257 (-5%)	5,440	-184 (-3%)	-183 (-3%)	-184 (-3%)	-152 (-3%)	-190 (-3%)
May	4,117	-351 (-9%)	-348 (-8%)	-348 (-8%)	-341 (-8%)	-357 (-9%)	4,076	-193 (-5%)	-193 (-5%)	-194 (-5%)	-190 (-5%)	-207 (-5%)
June	3,288	-221 (-7%)	-234 (-7%)	-236 (-7%)	-214 (-7%)	-250 (-8%)	3,210	-101 (-3%)	-101 (-3%)	-103 (-3%)	-114 (-4%)	-129 (-4%)
July	2,069	-46 (-2%)	-52 (-2%)	-63 (-3%)	-38 (-2%)	-77 (-4%)	2,067	-92 (-4%)	-92 (-4%)	-94 (-5%)	-66 (-3%)	-118 (-6%)
August	1,055	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,054	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	1,314	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	1,299	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	2,987	-144 (-5%)	-144 (-5%)	-147 (-5%)	-136 (-5%)	-150 (-5%)	3,011	-111 (-4%)	-111 (-4%)	-111 (-4%)	-102 (-3%)	-118 (-4%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C630)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-54. Average Simulated Monthly Flow in Dry and Critical Years at San Joaquin River Below Tuolumne River

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	919	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	895	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	1,369	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	3 (0%)	1,322	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	1,384	-57 (-4%)	-57 (-4%)	-57 (-4%)	-57 (-4%)	-57 (-4%)	1,444	-53 (-4%)	-53 (-4%)	-53 (-4%)	-53 (-4%)	-53 (-4%)
January	2,523	-202 (-8%)	-202 (-8%)	-202 (-8%)	-203 (-8%)	-202 (-8%)	2,486	-181 (-7%)	-181 (-7%)	-181 (-7%)	-182 (-7%)	-181 (-7%)
February	4,032	-260 (-6%)	-258 (-6%)	-258 (-6%)	-253 (-6%)	-305 (-8%)	3,937	-299 (-8%)	-299 (-8%)	-299 (-8%)	-261 (-7%)	-300 (-8%)
March	1,985	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,930	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	1,567	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,739	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	1,140	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,111	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	516	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	491	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	358	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	338	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	432	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	413	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	844	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	827	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	1,405	-42 (-3%)	-42 (-3%)	-42 (-3%)	-42 (-3%)	-45 (-3%)	1,394	-43 (-3%)	-43 (-3%)	-43 (-3%)	-40 (-3%)	-43 (-3%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C630)

Notes:

[1] Values presented for Dry and Critical years as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-55. Average Simulated Monthly Stanislaus River Inflow to San Joaquin River

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	921	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	930	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	394	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	396	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	426	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	449	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	622	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	631	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	732	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	740	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
March	965	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,028	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	1,414	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,462	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)
May	1,225	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,300	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	878	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	892	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
July	564	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	574	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	522	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	536	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	565	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	587	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
Average Annual	769	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	794	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C528)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-56. Average Simulated Monthly Stanislaus River Inflow in Dry and Critical Years to San Joaquin River

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	785	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	786	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	294	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	294	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	273	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	275	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	342	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	340	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	495	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	474	2 (0%)	2 (0%)	2 (0%)	2 (0%)	2 (0%)
March	305	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	299	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	1,030	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,036	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	947	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	974	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	399	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	380	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	363	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	334	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	359	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	366	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	358	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	362	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	495	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	493	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C528)

Notes:

[1] Values presented for Dry and Critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

San Francisco Bay/Sacramento-San Joaquin Delta Under the action alternatives, Delta inflows from the San Joaquin River would decrease slightly in wetter months because of reduced flood flows in the San Joaquin River (Table 14-57 and Table 14-58). Percent changes would be small because the basis-of-comparison or magnitude of flow in the San Joaquin River increases considerably as it reaches the Delta.

Changes in Delta inflows, though small, would result in a reoperation of CVP and SWP pumping, although changes would be small (Table 14-59 and Table 14-60). Table 14-61 and Table 14-62 show that outflow changes from the Delta would typically be less than 1 percent.

Table 14-57. Average Simulated Monthly Flow at San Joaquin River Upstream from Vernalis

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	2,771	3 (0%)	3 (0%)	3 (0%)	3 (0%)	3 (0%)	2,768	3 (0%)	3 (0%)	3 (0%)	3 (0%)	2 (0%)
November	2,634	-16 (-1%)	-15 (-1%)	-19 (-1%)	-4 (0%)	1 (0%)	2,604	-14 (-1%)	-13 (0%)	-15 (-1%)	-13 (0%)	-12 (0%)
December	3,198	-101 (-3%)	-97 (-3%)	-102 (-3%)	-97 (-3%)	-97 (-3%)	3,263	-118 (-4%)	-118 (-4%)	-113 (-3%)	-90 (-3%)	-118 (-4%)
January	4,770	-242 (-5%)	-246 (-5%)	-258 (-5%)	-231 (-5%)	-247 (-5%)	4,763	-212 (-4%)	-210 (-4%)	-215 (-5%)	-204 (-4%)	-223 (-5%)
February	6,270	-285 (-5%)	-280 (-4%)	-279 (-4%)	-273 (-4%)	-298 (-5%)	6,149	-256 (-4%)	-255 (-4%)	-254 (-4%)	-232 (-4%)	-253 (-4%)
March	7,150	-241 (-3%)	-238 (-3%)	-233 (-3%)	-204 (-3%)	-232 (-3%)	7,023	-175 (-2%)	-174 (-2%)	-175 (-2%)	-173 (-2%)	-177 (-3%)
April	6,763	-236 (-3%)	-231 (-3%)	-232 (-3%)	-239 (-4%)	-256 (-4%)	7,580	-186 (-2%)	-186 (-2%)	-187 (-2%)	-155 (-2%)	-193 (-3%)
May	6,267	-351 (-6%)	-348 (-6%)	-348 (-6%)	-341 (-5%)	-357 (-6%)	6,301	-193 (-3%)	-193 (-3%)	-194 (-3%)	-190 (-3%)	-207 (-3%)
June	4,804	-221 (-5%)	-234 (-5%)	-235 (-5%)	-214 (-4%)	-250 (-5%)	4,739	-100 (-2%)	-99 (-2%)	-101 (-2%)	-112 (-2%)	-128 (-3%)
July	3,297	-46 (-1%)	-52 (-2%)	-63 (-2%)	-38 (-1%)	-77 (-2%)	3,303	-92 (-3%)	-92 (-3%)	-94 (-3%)	-66 (-2%)	-118 (-4%)
August	2,114	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,126	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	2,377	-1 (0%)	-2 (0%)	-2 (0%)	-1 (0%)	-2 (0%)	2,386	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
Average Annual	4,355	-144 (-3%)	-144 (-3%)	-147 (-3%)	-136 (-3%)	-150 (-3%)	4,404	-111 (-3%)	-111 (-3%)	-111 (-3%)	-102 (-2%)	-118 (-3%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C637)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-58. Average Simulated Monthly Flow in Dry Years and Critical Years at San Joaquin River Upstream from Vernalis

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	2,083	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,060	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	1,955	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	3 (0%)	1,909	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	2,004	-57 (-3%)	-57 (-3%)	-57 (-3%)	-57 (-3%)	-57 (-3%)	2,067	-53 (-3%)	-53 (-3%)	-53 (-3%)	-53 (-3%)	-53 (-3%)
January	3,269	-202 (-6%)	-202 (-6%)	-202 (-6%)	-203 (-6%)	-202 (-6%)	3,231	-181 (-6%)	-181 (-6%)	-181 (-6%)	-182 (-6%)	-181 (-6%)
February	4,986	-260 (-5%)	-258 (-5%)	-258 (-5%)	-253 (-5%)	-305 (-6%)	4,870	-298 (-6%)	-298 (-6%)	-298 (-6%)	-260 (-5%)	-298 (-6%)
March	2,595	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,534	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	2,962	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3,140	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	2,532	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,529	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	1,376	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,331	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	1,181	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,132	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	1,265	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,253	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	1,650	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,638	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Annual	2,303	-42 (-2%)	-42 (-2%)	-42 (-2%)	-42 (-2%)	-45 (-2%)	2,290	-43 (-2%)	-43 (-2%)	-43 (-2%)	-40 (-2%)	-43 (-2%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C637)

Notes:

[1] Values presented for dry and critical year types as defined by the San Joaquin River Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-59. Average Simulated Monthly Exports through Jones and Banks Pumping Plants

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (TAF)[2]					No Action	Change from No Action (TAF)[3]				
	(TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	426	0 (0%)	0 (0%)	2 (0%)	0 (0%)	-1 (0%)	414	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	0 (0%)
November	411	5 (1%)	4 (1%)	4 (1%)	2 (1%)	4 (1%)	409	9 (2%)	9 (2%)	8 (2%)	9 (2%)	9 (2%)
December	547	1 (0%)	1 (0%)	1 (0%)	1 (0%)	-1 (0%)	548	-1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
January	417	-4 (-1%)	-4 (-1%)	-4 (-1%)	-4 (-1%)	-4 (-1%)	417	-1 (0%)	-1 (0%)	0 (0%)	-1 (0%)	0 (0%)
February	402	0 (0%)	0 (0%)	1 (0%)	1 (0%)	0 (0%)	402	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)
March	423	2 (0%)	2 (0%)	2 (0%)	2 (0%)	2 (1%)	426	3 (1%)	3 (1%)	3 (1%)	3 (1%)	3 (1%)
April	128	-3 (-2%)	-3 (-2%)	-3 (-2%)	-3 (-2%)	-3 (-2%)	144	-2 (-2%)	-2 (-2%)	-2 (-2%)	-2 (-1%)	-2 (-2%)
May	136	-12 (-9%)	-12 (-9%)	-12 (-9%)	-11 (-8%)	-12 (-8%)	137	-9 (-7%)	-9 (-7%)	-10 (-7%)	-10 (-7%)	-9 (-7%)
June	296	-3 (-1%)	-4 (-1%)	-4 (-1%)	-3 (-1%)	-4 (-1%)	298	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)
July	644	-4 (-1%)	-4 (-1%)	-5 (-1%)	-4 (-1%)	0 (0%)	629	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	592	2 (0%)	2 (0%)	3 (0%)	2 (0%)	0 (0%)	583	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	551	6 (1%)	6 (1%)	6 (1%)	6 (1%)	5 (1%)	557	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
Average Annual	4,972	-9 (0%)	-10 (0%)	-7 (0%)	-11 (0%)	-11 (0%)	4,963	-3 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node D409)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

TAF = thousand acre-feet

Table 14-60. Average Simulated Monthly Exports in Dry and Critical Years through Jones and Banks Pumping Plants

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (TAF)[3]					No Action	Change from No Action (TAF)[4]				
	(TAF)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	329	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	308	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
November	371	-1 (0%)	-1 (0%)	0 (0%)	-1 (0%)	0 (0%)	374	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
December	441	-2 (0%)	-2 (0%)	-1 (0%)	-2 (0%)	-2 (0%)	442	-2 (0%)	3 (1%)	3 (1%)	3 (1%)	3 (1%)
January	371	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	371	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)
February	355	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	363	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)
March	254	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	-2 (-1%)	251	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	106	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	112	1 (1%)	1 (1%)	1 (1%)	1 (1%)	1 (1%)
May	106	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	104	0 (0%)	-1 (-1%)	-1 (-1%)	-1 (-1%)	-1 (-1%)
June	126	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	125	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	563	-10 (-2%)	-9 (-2%)	-13 (-2%)	-9 (-2%)	0 (0%)	530	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	406	1 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	382	-2 (-1%)	-3 (-1%)	-2 (-1%)	-3 (-1%)	-2 (-1%)
September	450	-1 (0%)	1 (0%)	-1 (0%)	-1 (0%)	0 (0%)	423	2 (0%)	2 (0%)	2 (0%)	1 (0%)	2 (0%)
Average Annual	3,878	-20 (-1%)	-17 (0%)	-20 (-1%)	-20 (-1%)	-9 (0%)	3,784	-6 (0%)	-1 (0%)	-1 (0%)	-1 (0%)	-1 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node D409)

Notes:

[1] Values presented for Dry and Critical year types as defined by the Sacramento Valley Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

TAF = thousand acre-feet

Table 14-61. Average Simulated Monthly Delta Outflow

Month	Existing Level (2005)[1]						Future Level (2030)[1]					
	Existing Condition	Change from Existing Condition (cfs)[2]					No Action	Change from No Action (cfs)[3]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	6,036	6 (0%)	6 (0%)	11 (0%)	6 (0%)	5 (0%)	5,993	-1 (0%)	-1 (0%)	-1 (0%)	-2 (0%)	-1 (0%)
November	11,672	-13 (0%)	-11 (0%)	-18 (0%)	8 (0%)	-1 (0%)	11,648	-55 (0%)	-56 (0%)	-53 (0%)	-56 (0%)	-56 (0%)
December	21,576	-124 (-1%)	-114 (-1%)	-118 (-1%)	-115 (-1%)	-112 (-1%)	21,677	-137 (-1%)	-166 (-1%)	-159 (-1%)	-137 (-1%)	-165 (-1%)
January	42,060	-219 (-1%)	-224 (-1%)	-228 (-1%)	-198 (0%)	-210 (0%)	42,162	-203 (0%)	-202 (0%)	-209 (0%)	-196 (0%)	-218 (-1%)
February	51,671	-355 (-1%)	-345 (-1%)	-401 (-1%)	-322 (-1%)	-361 (-1%)	51,439	-287 (-1%)	-280 (-1%)	-279 (-1%)	-256 (0%)	-289 (-1%)
March	42,733	-279 (-1%)	-275 (-1%)	-272 (-1%)	-243 (-1%)	-272 (-1%)	42,586	-229 (-1%)	-229 (-1%)	-228 (-1%)	-228 (-1%)	-223 (-1%)
April	30,224	-195 (-1%)	-191 (-1%)	-193 (-1%)	-197 (-1%)	-210 (-1%)	30,745	-140 (0%)	-140 (0%)	-140 (0%)	-116 (0%)	-146 (0%)
May	22,637	-176 (-1%)	-174 (-1%)	-174 (-1%)	-169 (-1%)	-181 (-1%)	22,286	-46 (0%)	-46 (0%)	-47 (0%)	-41 (0%)	-61 (0%)
June	12,853	-166 (-1%)	-177 (-1%)	-177 (-1%)	-159 (-1%)	-192 (-1%)	12,670	-77 (-1%)	-77 (-1%)	-77 (-1%)	-89 (-1%)	-104 (-1%)
July	7,873	-42 (-1%)	-49 (-1%)	-62 (-1%)	-36 (0%)	-76 (-1%)	7,867	-93 (-1%)	-94 (-1%)	-98 (-1%)	-69 (-1%)	-122 (-2%)
August	4,353	-7 (0%)	-6 (0%)	-8 (0%)	-6 (0%)	-4 (0%)	4,330	4 (0%)	4 (0%)	4 (0%)	4 (0%)	4 (0%)
September	9,893	3 (0%)	1 (0%)	1 (0%)	2 (0%)	3 (0%)	9,853	4 (0%)	4 (0%)	4 (0%)	4 (0%)	4 (0%)
Average Annual	21,785	-129 (-1%)	-128 (-1%)	-135 (-1%)	-118 (-1%)	-133 (-1%)	21,758	-104 (0%)	-106 (0%)	-106 (0%)	-97 (0%)	-114 (-1%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C406)

Notes:

[1] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[2] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[3] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 14-62. Average Simulated Monthly Delta Outflow in Dry and Critical Years

Month	Existing Level (2005)[1,2]						Future Level (2030)[1,2]					
	Existing Condition	Change from Existing Condition (cfs)[3]					No Action	Change from No Action (cfs)[4]				
	(cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt (cfs)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
October	5,047	1 (0%)	1 (0%)	6 (0%)	-1 (0%)	-5 (0%)	5,014	2 (0%)	2 (0%)	2 (0%)	2 (0%)	2 (0%)
November	7,551	13 (0%)	11 (0%)	11 (0%)	17 (0%)	4 (0%)	7,520	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)
December	7,323	-17 (0%)	-18 (0%)	-17 (0%)	-18 (0%)	-8 (0%)	7,567	1 (0%)	-79 (-1%)	-79 (-1%)	-80 (-1%)	-79 (-1%)
January	12,858	-7 (0%)	-8 (0%)	-8 (0%)	-7 (0%)	-5 (0%)	13,134	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
February	17,752	-28 (0%)	-29 (0%)	-29 (0%)	-29 (0%)	-27 (0%)	17,798	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)	-3 (0%)
March	16,598	30 (0%)	31 (0%)	30 (0%)	30 (0%)	32 (0%)	16,508	15 (0%)	15 (0%)	15 (0%)	15 (0%)	15 (0%)
April	12,245	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	12,294	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
May	8,771	-8 (0%)	-9 (0%)	-8 (0%)	-9 (0%)	0 (0%)	8,505	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
June	6,187	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6,197	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
July	4,622	-2 (0%)	-1 (0%)	-2 (0%)	-2 (0%)	-2 (0%)	4,663	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	3,815	-20 (-1%)	-17 (0%)	-22 (-1%)	-18 (0%)	-11 (0%)	3,951	9 (0%)	10 (0%)	10 (0%)	11 (0%)	10 (0%)
September	3,424	-6 (0%)	-6 (0%)	-6 (0%)	-6 (0%)	-7 (0%)	3,277	1 (0%)	1 (0%)	1 (0%)	1 (0%)	1 (0%)
Average Annual	8,793	-4 (0%)	-4 (0%)	-4 (0%)	-3 (0%)	-2 (0%)	8,812	2 (0%)	-5 (0%)	-5 (0%)	-5 (0%)	-5 (0%)

Source: Summarized from CalSim II 2005 and 2030 simulations (Node C406)

Notes:

[1] Values presented for Dry and Critical year types as defined by the Sacramento Valley Water Year Hydrologic Classification Indices.

[2] Alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing conditions evaluation, a 2005 level of development is used as the basis for comparison. Similarly, the future conditions evaluation uses a 2030 level of development as a basis of comparison. All evaluations use a simulation period of October 1921–September 2003.

[3] (%) indicates percent change from existing conditions. Negative value represents a decrease in flow, and positive value represents an increase in flow.

[4] (%) indicates percent change from No Action Alternative. Negative value represents a decrease in flow, and positive value represents an increase in flow.

Key:

Alt = Alternative

cfs = cubic feet per second

Central Valley Project/State Water Project Water Service Areas As the "central hub" of California's water supply delivery system, minor changes in Delta operations due to Temperance Flat RM 274 Dam operations could result in other minor changes to operations throughout the CVP and SWP system. Increased Friant Division water deliveries would be due to additional storage in Temperance Flat RM 274 Reservoir. Changes in water supply deliveries and Delta conditions could also result in changes in operations to other CVP and SWP facilities, including increased water deliveries due to additional storage in Temperance Flat RM 274 Reservoir. Recipients of exports through the Banks and Jones pumping plants include the Exchange Contractors, Federal wildlife refuges, and CVP and SWP water service contractors. Deliveries differ by action alternative, as described in Chapter 2, "Alternatives Description."

Changes in CVP and SWP deliveries, including changes in Friant Division deliveries from Millerton Lake, are shown in the Modeling Appendix. Detailed impact analyses of the economic effects of changes in water deliveries to CVP and SWP water service areas are found in Chapter 23, "Socioeconomics, Population, and Housing." A description of CVP and SWP operations can be found in the Affected Environment section of this chapter and in the Modeling Appendix.

Criteria for Determining Significance of Effects

The thresholds of significance for impacts to surface water supplies and facilities operations are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. An alternative was determined to result in a significant impact related to surface water supply if it would adversely affect surface water supply facilities operations, as measured by the criteria in Table 14-63. The impact indicators are discussed in the following sections. Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

Table 14-63. Impact Indicators and Significance Criteria for Surface Water Supply Facilities Operations

Impact Indicator	Significance Criterion
Friant Dam diversion capacities	Reduce Millerton Lake water-level elevations below the Friant-Kern Canal or Madera Canal intakes at Friant Dam.
San Joaquin River diversion capacities	Reduce the ability to satisfy downstream Holding Contract diversions in Reach 1, or reduce capacity of other existing operational diversion facilities in Reaches 2 through 5 in the San Joaquin River.
Water levels in the south Delta[1]	Reduce water surface elevation, relative to the basis of comparison, with sufficient frequency and magnitude to adversely affect south Delta water users' abilities to divert water during the irrigation season.

Note:
[1] Changes in south Delta water levels are estimated using the Delta Simulation Model 2.
Key:
Delta = Sacramento-San Joaquin Delta

Friant Dam Diversion Capacities

Diversions are made at Friant Dam to the Friant-Kern and Madera canals for CVP Friant Division water supplies. Changes in Millerton Lake water surface elevations could adversely affect the operation of existing diversion facilities at the Friant Dam (see Table 14-2).

San Joaquin River Diversion Capacities

Releases are made at Friant Dam to comply with Holding Contract requirements along Reach 1. Several other diversion facilities exist in Reach 1 through Reach 5. Changes in streamflow within these reaches could adversely affect the operation of existing diversion facilities, including pumps, pipelines, and weirs.

Water Levels in the South Delta

Water levels in the south Delta are influenced to varying degrees by natural tidal fluctuations, San Joaquin River flows, barrier operations, Jones and Banks export pumping, local agricultural diversions and drainage return flows, channel capacities, siltation, and dredging. When the Jones and Banks pumping plants are exporting water, water levels in local channels can be drawn down, particularly during water years with low flow. The South Delta Water Agency (SDWA) and local farmers in the south and central Delta are interested in maintaining adequate water levels for their siphons and pumps, which are installed at fixed locations in the Delta, to continue to be used for irrigation diversions. The alternatives could affect the ability of the SDWA to divert water if changes in Delta flows reduce Delta channel water levels during the irrigation season (April to October).

The South Delta Temporary Barriers Program was initiated by DWR in 1991 to improve water conditions in the south Delta and to provide design data for permanent gates. Since 1991, DWR has seasonally installed four barriers. Three barriers, located on the Middle River, Grant Line Canal, and Old River, facilitate adequate water levels and water quality for agricultural diversions. The barriers are constructed from rock fill and incorporate overflow weirs and gated culverts. These barriers are installed in spring and removed in fall. A fourth barrier is seasonally installed at the Head of the Old River for fish control, but not in all years due to fisheries concerns. The existing seasonal barriers significantly affect water levels in the south Delta (see Chapter 27, "Cumulative Effects," for additional details).

To evaluate the potential water-level effects of the alternatives, modeling results were examined for sites near three monitoring locations near the three temporary barriers. South Delta agricultural irrigation users are primarily concerned with the water level at low-low tide because this is the minimum water surface elevation they experience. The impact analysis considers the maximum change in water elevation at the low-low tide for each day of each month. Channel tidal levels at the following three south Delta locations were evaluated:

- **Old River at Tracy Boulevard Bridge (Road Bridge)** – This station is a tidal level and EC monitoring location, and is upstream from the temporary barrier and proposed permanent barrier just east (upstream) from the DMC intake and fish facility.

- **Grant Line Canal above the Grant Line Canal Barrier** – This station is upstream from the temporary barrier on Grant Line Canal and upstream from the proposed permanent tidal gate.

- **Middle River near the Howard Road Bridge** – This station is located just upstream from the temporary barrier near the Victoria Canal and the proposed permanent tidal gate.

Water levels in the south Delta are considered to adversely affect water users, as defined by DWR's *Water Level Response Plan*, if they are below 0.0 foot msl at the Old River near the Tracy Boulevard Bridge, and at locations above the Grant Line Canal Barrier, or 0.3 foot above msl at the Middle River near the Howard Road Bridge (Reclamation and DWR 2004;

Reclamation et al. 2004). A change in water level is considered to be significant if the water level is below the identified limit, and the water-level change between the alternative and baseline is greater than a 0.1-foot decrease during the irrigation season (April through October).

Topics Eliminated from Further Discussion

Operating Temperance Flat RM 274 Reservoir could impact groundwater or socioeconomic conditions, as described in Chapters 13, "Hydrology – Groundwater," and 23, "Socioeconomics, Population, and Housing," respectively. Potential impacts to those resource areas are therefore not described in this chapter. Changes in surface water supplies are not considered an impact independent of the associated changes to groundwater and socioeconomics.

Additional water supply deliveries from operating Temperance Flat RM 274 Reservoir would not physically impact CVP and SWP conveyance and storage facilities downstream from Friant Dam. Additional deliveries would be made within existing capacity limits and operational constraints.

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives.

Impact SWS-1: Changes in Ability to Divert Water from Friant Dam

Primary Study Area

No Action Alternative Changes in Millerton Lake volumes and surface water elevations would be within operating ranges of the existing condition and would not constrain operations of existing diversion facilities at Friant Dam to meet existing authorized purposes.

There would be **no impact** under the No Action Alternatives.

Action Alternatives Changes in Millerton Lake volumes and surface water elevations would be within operating ranges of the existing conditions and would not constrain operations of existing diversion facilities at Friant Dam.

There would be **no impact** under the action alternatives. Mitigation is not required and thus not proposed.

Impact SWS-2: Changes in Ability to Divert Water from the San Joaquin River

Extended Study Area

No Action Alternative Changes in San Joaquin River flow volumes and timing would be within typical historical ranges and would not impede existing diversion facilities. Reclamation would continue to release sufficient flow to the San Joaquin River to satisfy Holding Contract diversions in Reach 1 and to meet Restoration Flow requirements (SJRRP 2012).

There would be **no impact** under the No Action Alternative.

Action Alternatives Changes in San Joaquin River flow volumes and timing would be within typical historical ranges and would not impede existing diversion facilities. Flows in Wet years would be reduced (see Attachment E in the Modeling Appendix) when Temperance Flat RM 274 Reservoir captures flood flows, but would not impede existing diversion facilities. Flows in other year types would generally increase and would not impede existing diversion facilities. Reclamation would continue to release sufficient flow to the San Joaquin River to satisfy Holding Contract diversions in Reach 1 and to meet Restoration Flow requirements.

There would be **no impact** under the action alternatives. Mitigation for this impact is not required and thus not proposed.

Impact SWS-3: Change in Water Levels in the Old River near the Tracy Road Bridge

Extended Study Area

No Action Alternative Water levels in the Delta could be lower under the No Action Alternative than existing conditions, but water-level changes of this magnitude and frequency would not adversely affect agricultural users' ability to divert irrigation water. As shown in Table 14-64, water-level decreases greater than 0.1 foot would not occur when water levels would be below the identified threshold in the simulated irrigation months during the late spring. The greatest decrease was 0.04 foot, compared to existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Table 14-64. Change in Simulated Monthly Maximum 15-Minute Water Levels in Delta at Low-Low Tide Under the No Action Alternative Compared to Existing Conditions

Month[1]	Old River at Tracy Boulevard Bridge (feet)[2]	Grant Line Canal Above the Grant Line Canal Barrier (feet)[2]	Middle River near the Howard Road Bridge (feet)[2]
April	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)
May	-0.02 (0%)	-0.03 (0%)	-0.04 (0%)
June	0 (0%)	0 (0%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)
October	0 (0%)	0 (0%)	0 (0%)

Source: DSM2 simulations (Nodes 071_3116, 129_5691, and 206_5533)

Notes:

[1] Simulation period: October 1921–September 2003.

[2] (%) indicates percent of months with a maximum decrease in the water level exceeding 0.1 foot resulting in a water level below the identified limit.

Action Alternatives The action alternatives would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of reducing infrequent spring flood flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels.

As shown in Table 14-65, water-level decreases greater than 0.1 foot in the Old River near the Tracy Road Bridge that also result in water levels below the identified threshold would not occur in the simulated irrigation months during the late spring. The greatest decreases were 0.02 foot and 0.02 foot, compared to the existing conditions and No Action Alternative, respectively, yet these maximum decreases would not adversely affect agricultural users' ability to divert irrigation water.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not required and thus not proposed.

Table 14-65. Simulated Monthly Maximum 15-Minute Change in Water Levels at Old River near Tracy Road Bridge at Low-Low Tide

Month1	Existing Level (2005)[2]					Future Level (2030)[2]				
	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)
April	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.02 (0%)	0 (0%)	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.02 (0%)
May	0 (0%)	0 (0%)	0 (0%)	-0.02 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-0.01 (0%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
October	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: DSM2 simulations (Node 071_3116)

Notes:
[1] Simulation period: October 1921–September 2003.
[2] (%) indicates percent of months with a maximum decrease in the water level exceeding 0.1 foot resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Impact SWS-4: Change in Water Levels in the Grant Line Canal Above the Grant Line Canal Barrier

Extended Study Area

No Action Alternative Water levels in the Delta could be lower under the No Action Alternative than existing conditions, but changes in water level of this magnitude and frequency would not adversely affect agricultural users' ability to divert irrigation water. As shown in Table 14-64, water-level decreases greater than 0.1 foot would not occur and would not decrease water levels below the identified threshold in the simulated irrigation months during the late spring. The greatest decreases were 0.03 foot, compared to existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of reducing infrequent spring flood flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels.

As shown in Table 14-66, water-level decreases greater than 0.1 foot in the Grant Line Canal above the Grant Line Canal

Barrier that also result in water levels below the identified limit rarely occurred in the simulated irrigation months during the late spring. The greatest decreases were 0.03 foot and 0.02 foot compared to the existing conditions and No Action Alternative, respectively, yet these maximum decreases would not adversely affect agricultural users' ability to divert irrigation water.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not required and thus not proposed.

Table 14-66. Simulated Monthly Maximum 15-Minute Change in Water Levels at Grant Line Canal above Grant Line Canal Barrier at Low-Low Tide

Month[1]	Existing Level (2005)[2]					Future Level (2030)[2]				
	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)
April	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.02 (0%)	0 (0%)	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)
May	0 (0%)	0 (0%)	0 (0%)	-0.03 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-0.02 (0%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
October	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: DSM2 simulations (Node 129_5691)

Notes:
[1] Simulation period: October 1921–September 2003.
[2] (%) indicates percent of months with a maximum decrease in the water level exceeding 0.1 foot resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Impact SWS-5: Change in Water Levels in the Middle River near the Howard Road Bridge

Extended Study Area

No Action Alternative Water levels in the Delta could be lower under the No Action Alternative than existing conditions, but changes in water level of this magnitude and frequency would not adversely affect agricultural users' ability to divert irrigation water.

As shown in Table 14-64, water-level decreases greater than 0.1 foot would not occur and would not decrease water levels

below the identified threshold in the simulated irrigation months during the late spring. The greatest decrease was 0.04 foot, compared to existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of reducing infrequent spring flood flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels.

As shown in Table 14-67, water level decreases greater than 0.1 foot in the Middle River near the Howard Road Bridge that also result in water levels below the identified limit would not occur in the simulated irrigation months during the late spring. The greatest decreases were 0.04 foot and 0.02 foot, compared to the existing conditions and No Action Alternative, respectively, yet these maximum decreases would not adversely affect agricultural users' ability to divert irrigation water.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not required and thus not proposed.

Table 14-67. Simulated Monthly Maximum 15-Minute Change in Water Levels at Middle River near Howard Road Bridge at Low-Low Tide

Month[1]	Existing Level (2005)[2]					Future Level (2030)[2]				
	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)	Alt 1 (ft msl)	Alt 2 (ft msl)	Alt 3 (ft msl)	Alt 4 (ft msl)	Alt 5 (ft msl)
April	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.02 (0%)	0 (0%)	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-0.02 (0%)
May	-0.03 (0%)	-0.03 (0%)	-0.03 (0%)	-0.04 (0%)	-0.04 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-0.01 (0%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
October	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: DSM2 simulations (Node 206_5533)

Notes:

[1] Simulation period: October 1921–September 2003.

[2] (%) indicates percent of months with a maximum decrease in the water level exceeding 0.1 foot resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 14-24.

No mitigation is required for Impact SWS-1 within the primary study area, or for Impacts SWS-2, SWS-3, SWS-4, and SWS-5 within the extended study area, as these impacts would be less than significant for all action alternatives.

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Chapter 15
Hydrology – Surface Water Quality

This chapter describes the environmental setting for surface water quality, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the project alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

This section includes discussion of existing water quality conditions and related conditions that directly affect water quality, such as soils, climate, and current and historical land uses. The discussion encompasses the primary and extended study areas.

Primary Study Area

The following is a description of surface water quality in the primary study area, including within the area of project features, the Temperance Flat Reservoir Area, and in Millerton Lake, from the Temperance Flat Dam Site to Friant Dam.

Area of Project Features

Most of the area of project features is characterized by undeveloped land with steep slopes, granitic soils, rocky outcrops, and ephemeral streams. Rural residences are located along Sky Harbour Road on the south side of the San Joaquin River, and on Millerton Lake. Roads in this area include paved (Sky Harbor Road and associated turnoffs) and unpaved roads. While few data are available on the water quality of runoff or ephemeral streams within the area of project features, the water quality conditions can be inferred to some extent from the geologic, soils, and topographic conditions, as well as from the quality of water in the Temperance Flat Reservoir Area and Millerton Lake during runoff events.

Temperance Flat Reservoir Area

Water quality within the Temperance Flat Reservoir Area is generally of high quality, with low turbidity, high dissolved oxygen, and low concentrations of chlorophyll-a, arsenic, and other constituents. Water quality in this reach is generally suitable for most designated beneficial uses.

Historical water temperature data from the CDEC station located about 1 mile upstream from Kerckhoff Powerhouse, Station SJK, were acquired for the period from May 6, 2008, through December 19, 2012. This station is located within the Temperance Flat Reservoir Area. Average monthly water temperatures recorded at Station SJK peak in June through September, reaching 72°F to 73°F. Monthly average temperatures in July range from 72°F to 79°F. In November, the average monthly water temperature recorded at Station SJK is 57°F. Minimum average monthly water temperatures at Station SJK occur in January, reaching 44°F.

Measurements taken in 2004, 2005, 2010, and 2011 found that dissolved oxygen concentrations in the Temperance Flat Reservoir Area are generally higher than in Millerton Lake. Dissolved oxygen measured in 2010 and 2011 ranged from 10.19 mg/L to 12.64 mg/L (see the Physical Resources Appendix). Relatively low conductivity, TDS, and turbidity observed in 2010 and 2011 may be due in part to the influence of Kerckhoff Dam and other upstream dams. The construction and operation of dams and reservoirs, including Kerckhoff Dam and several projects located farther upstream, have altered sediment transport and storage processes in the upper San Joaquin River Basin. The reservoirs capture and permanently store nearly all of the bedload sediment that is transported to them, reducing the amount of sand and gravel that would have naturally been available for recruitment to downstream reaches. Dam operations also limit the release of flows to downstream reaches, reducing the frequency of sediment-transporting flows in most years (SCE 2007).

More than 90 percent of the precipitation in Fresno falls between October and April, with the heaviest rainfall occurring from December through March. Based on a comparison of water quality conditions in the Temperance Flat Reservoir Area and Millerton Lake between November 3, 2010, and July 26, 2011, as sampled by Reclamation, concentrations of mercury, arsenic, and other constituents in the San Joaquin River and Millerton Lake may increase during precipitation events after an extended dry period, but remain low (below drinking water

standards established by the EPA, and in some cases below minimum detection levels) (see the Physical Resources Appendix).

As measured in 2010 and 2011, pH in the Temperance Flat Reservoir Area ranged from 4.92 to 5.53, relatively low (acidic) compared to most surface waters (see the Physical Resources Appendix). The pH values measured in the Temperance Flat Reservoir Area are within the range of measured pH values of precipitation in the region, and are related to the low alkalinity conditions observed in the watershed (ranging from 7 mg/L to 13 mg/L). Measured alkalinity was lower than the EPA-recommended minimum limit for the protection of aquatic wildlife (20 mg/L) (EPA 2012), with a maximum measured value of 13 mg/L in the Temperance Flat Reservoir Area. The EPA recommends that waters with alkalinity naturally below the 20 mg/L criteria not be further reduced (EPA 1986). Hardness is also relatively low in the Temperance Flat Reservoir Area, measuring 9.5 mg/L calcium carbonate ($CaCO_3$) on November 3, 2010, and ranging from 4.9 to 5.1 mg/L $CaCO_3$ on July 26, 2011. Alkalinity and hardness are largely controlled by the geology and soils of the region, and these low values are consistent with the insolubility of the granitic soils within the upper San Joaquin River watershed. Low pH rainfall, which ranges from 5 to 6 in California (NADP/NTN 2010), may be a strong influence on pH within the upper San Joaquin River watershed.

The Basin Plan specifies water quality objectives to protect beneficial uses within the river basins, as required by the CWC (Section 13240) and supported by the Federal CWA (Central Valley Water Board 2011). The Basin Plan provides regulatory guidance for TMDL standards at locations along the San Joaquin River. Additionally, under Section 303(d) of the Federal CWA, the State Water Board and Central Valley Water Board assess water quality data for the San Joaquin River every two years to determine if any portions do not meet the established water quality standards. The existing and potential beneficial uses of surface water bodies within the primary and extended study areas, as defined by the Central Valley Water Board in 2011, are shown in Table 15-1. Designated beneficial uses within the Temperance Flat Reservoir Area include municipal, agriculture, industry, recreation, freshwater habitat, and wildlife habitat.

Table 15-1. Existing and Potential Beneficial Uses of Surface Water Bodies in the Primary and Extended Study Areas

Surface Water Body	Municipal and Domestic Supply	Agriculture		Industry			Recreation			Freshwater Habitat		Migration		Spawning		Wildlife Habitat	Navigation
		Irrigation	Stock Watering	Process	Service Supply	Power	Contact	Canoeing and Rafting	Other Noncontact	Warm	Cold	Warm	Cold	Warm	Cold		
San Joaquin River Sources to Millerton Lake	E	E	E	--	--	E	E	E	E	E	E	--	--	--	--	E	--
Millerton Lake	E	E	E	--	--	--	E	--	E	E	P	--	--	--	--	E	--
Friant Dam to Mendota Pool (Reaches 1 and 2)	E	E	E	E	--	--	E	E	E	E	E	E	E	E	P	E	--
Mendota Dam to Sack Dam (Reach 3)	P	E	E	E	--	--	E	E	E	E	--	E	E	E	P	E	--
Sack Dam to Mouth of Merced River (Reaches 4 and 5)	P	E	E	E	--	--	E	E	E	E	--	E	E	E	P	E	--

Source: Central Valley Water Board 2011

Key:
-- = not applicable
E = Existing beneficial use
P = Potential beneficial use

Water quality conditions within the Temperance Flat Reservoir Area measured in 2010 and 2011 indicate mercury concentrations within the water column ranging from 0.0008 to 0.0090 µg/L. Mercury concentrations were higher in 2010 (0.009 µg/L), and likely reflect elevated concentrations of mercury in runoff occurring in the upper San Joaquin River watershed (see the Physical Resources Appendix). One possible source of mercury contamination within the watershed is resource extraction (State Water Board 2010b). Mercury itself is not mined within the watershed, but was historically used in the extraction of gold throughout California. Today, mercury is recovered as a byproduct from small-scale gold dredging operations. Mercury and gold are also recovered as byproducts from some gravel mining operations, especially in areas affected by historical gold mining (Alpers et al. 2005).

Within the Millerton Lake watershed, there are 57 historical gold mines and one active mine; and two historical sand and gravel mines. A survey conducted in 2003 by BLM in support of the Investigation identified three abandoned mine sites within the Temperance Flat Reservoir Area, including the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. These mines include multiple adits and millsites. Based on qualitative assessment of samples taken during this survey, as well as review of available historical literature and personal interviews, Springer concluded that the probability of substantial toxic contamination, both naturally occurring and imported, from mining and related activities at these sites, is very low (Springer 2005).

A second likely source of mercury within the watershed is atmospheric deposition. Atmospheric deposition of mercury in the high Sierra Nevada has been shown to be high, relative to other locations in the United States (Heyvaert et al., 2000). While mercury concentrations in surface water may remain low, mercury accumulates in biological tissues and tissue concentrations tend to increase higher in the food chain through biomagnification (Alpers et al. 2005). This is consistent with the observations noted above of low mercury concentrations within the water column and significantly higher concentrations in fish tissue.

Concentrations of primary plant nutrients analyzed in 2010 and 2011, including nitrogen and potassium, were below the minimum reporting limits (0.1 mg/L and 1 mg/L, respectively). Sulfur, a secondary nutrient, was detected at low levels in

2010, but was below the minimum reporting limit (0.5 mg/L) in 2011. The other secondary nutrients, calcium and magnesium, were detected in all samples at low levels. Low concentrations of calcium and magnesium are consistent with the relatively low hardness levels in these samples (as previously described). Chloride was detected in low levels in 2010, but not detected in 2011. Similarly, sodium decreased in concentration in July 2011 as compared to November 2010. This pattern likely reflects runoff occurring in the upper San Joaquin River watershed before the sampling event (California Department of a Transportation (Caltrans) applies deicing agents, including sodium and chloride, to roads in the upper San Joaquin River watershed) (see the Physical Resources Appendix).

Millerton Lake Below RM 274

As discussed for the Temperance Flat Reservoir Area, water quality within Millerton Lake is generally of high quality, with low temperatures, low turbidity, high dissolved oxygen, and low concentrations of chlorophyll-a, arsenic, and other constituents. Millerton Lake water quality is generally suitable for most designated beneficial uses.

Historical water temperatures at Station SJK during the month of July range from 72°F to 79°F, while the average monthly water temperature recorded at Station SJK in November is 57°F. These temperatures are lower than the temperature measured within Millerton Lake in July 2011 (81°F) or November 2010 (57°F to 59°F) (see the Physical Resources Appendix). Most of Millerton Lake becomes thermally stratified during spring and summer months. Complete mixing of the water column likely occurs during winter months (Reclamation 2008).

Measurements taken in 2004, 2005, 2010, and 2011 found that dissolved oxygen concentrations in Millerton Lake are generally high during most of the year, with lowest concentrations typically exhibited during November at depths greater than 175 feet (see the Physical Resources Appendix). Relatively low conductivity, TDS, and turbidity observed in 2010 and 2011 may be due in part to the influence of Kerckhoff Dam and other upstream dams, as previously described.

As described for the Temperance Flat Reservoir Area, concentrations of mercury, arsenic, and most constituents may increase within the primary study area during a major storm

after an extended dry period, but overall remain low. Comparison of water quality conditions between sampling sites within the Temperance Flat Reservoir Area and Millerton Lake indicates that concentrations of most constituents decrease as water enters Millerton Lake. This is likely due to a high rate of mixing within the river as compared with Millerton Lake, where slower water movement allows these constituents to settle out of the water column more easily. This interpretation is supported by the relatively low turbidity observed within Millerton Lake as compared to within the San Joaquin River.

As measured in 2010 and 2011, pH in Millerton Lake ranged from 5.90 to 6.18, relatively low (acidic) compared to most surface waters (see the Physical Resources Appendix). The pH values measured in Millerton Lake are within the range of measured pH values of precipitation in the region, and are related to the low alkalinity conditions observed in the watershed (ranging from 7 mg/L to 13 mg/L). Measured alkalinity was lower than the EPA-recommended minimum limit for the protection of aquatic wildlife (20 mg/L) (EPA 2012). The EPA recommends that waters with alkalinity naturally below the 20 mg/L criteria not be further reduced (EPA 1986). Hardness is also relatively low in the watershed, ranging from 8.6 to 9.4 mg/L $CaCO_3$ on November 3, 2010, and from 7.8 to 8.3 mg/L $CaCO_3$ on July 26, 2011. Alkalinity and hardness are largely controlled by the geology and soils of the region, and these low values are consistent with the insolubility of the granitic soils within the upper San Joaquin River watershed, as previously described. Low pH rainfall, which ranges from 5 to 6 in California (NADP/NTN 2010), may be a strong influence on pH within the upper San Joaquin River watershed.

The existing and potential beneficial uses of Millerton Lake are shown in Table 15-1, and include municipal, agriculture, recreation, freshwater habitat, and wildlife habitat.

Millerton Lake is listed for mercury in the 2010 CWA Section 303(d) list of impaired waters requiring TMDLs, as shown in Table 15-2. This listing is based on a 2007 sampling of mercury accumulation in 33 tissue samples from largemouth bass. This study found that 18 out of 33 samples exceeded the Office of Environmental Health Hazard Assessment (OEHHA) Screening Value of 0.3 milligrams per kilogram to protect human health for frequent consumers of sport fish (Brodberg and Pollock 1999, Davis et al. 2009 and 2010, State Water Board 2010b). The same study found lower concentrations of

mercury in largemouth bass at a location downstream from Friant Dam, suggesting that Millerton Lake may act as a mercury sink for the San Joaquin River (Davis et al. 2010). Water quality conditions detected in 2010 and 2011 indicate mercury concentrations within the water column of less than 0.0005 to 0.0006 µg/L.

As previously described for the Temperance Flat Reservoir Area, two possible sources of mercury contamination within the watershed are resource extraction and atmospheric deposition.

Table 15-2. 2010 Clean Water Act Section 303(d) List of Water Quality Limited Segments Within the Primary and Extended Study Areas

Segment	Pollutant/Stressor	Affected Area/ Reach Length
Millerton Lake	Mercury	4,366 acres
San Joaquin River, Friant Dam to Mendota Pool (Reaches 1 and 2[1])	Invasive Species	70 miles
Mendota Pool (Reach 2[1])	Mercury Selenium	3,045 acres
San Joaquin River, Mendota Pool to Bear Creek (Reaches 3 and 4[1])	Boron Chlorpyrifos DDT Diazinon Group A Pesticides Unknown Toxicity	13 miles
San Joaquin River, Bear Creek to Mud Slough (Reach 5[1])	Arsenic Boron Chlorpyrifos DDT Electrical Conductivity *Escherichia coli (E. coli)* Group A Pesticides Mercury Unknown Toxicity	14 miles
San Joaquin River, Mud Slough to Merced River (Reach 5[1])	Boron Chlorpyrifos DDT Diazinon Electrical Conductivity *Escherichia coli (E. coli)* Group A Pesticides Mercury Selenium Unknown Toxicity	3 miles

Table 15-2. 2010 Clean Water Act Section 303(d) List of Water Quality Limited Segments Within the Primary and Extended Study Areas (contd.)

Segment	Pollutant/Stressor	Affected Area/ Reach Length
Bear Creek, from Bear Valley to San Joaquin River	*Escherichia coli (E. coli)* Unknown Toxicity	43 miles
Mud Slough (downstream from San Luis Drain)	Boron Electrical Conductivity Pesticides Selenium Unknown Toxicity	13 miles
Mud Slough (upstream from San Luis Drain)	Boron Electrical Conductivity *Escherichia coli (E. coli)* Pesticides Unknown Toxicity	22 miles
Salt Slough	Boron Chlorpyrifos Electrical Conductivity Escherichia coli (E. coli) Mercury Prometryn Unknown Toxicity	10 miles

Source: State Water Board 2010a.

Note:
[1] See Chapter 5, "Biological Resources – Fisheries and Aquatic Resources" for a map of Reaches 1 through 5 of the San Joaquin River
Key:
DDT = dichloro-diphenyl-trichloroethane

As described for the Temperance Flat Reservoir Area, concentrations of primary plant nutrients analyzed in 2010 and 2011, including nitrogen and potassium, were below the minimum reporting limits (0.1 mg/L and 1 mg/L, respectively). Sulfur, a secondary nutrient, was detected at low levels in 2010, but was below the minimum reporting limit (0.5 mg/L) in 2011. The other secondary nutrients, calcium and magnesium, were detected in all samples at low levels. Low concentrations of calcium and magnesium are consistent with the relatively low hardness levels in these samples (as previously described). Chloride was detected in low levels in 2010, but not detected in 2011. Similarly, sodium decreased in concentration in July 2011 as compared to November 2010. This pattern likely reflects runoff occurring in the upper San Joaquin River watershed before this sampling event (Caltrans applies deicing agents, including sodium and chloride, to roads in the upper San Joaquin River watershed). Concentrations of

the micronutrient chloride decreased in Millerton Lake as compared to the Temperance Flat Reservoir Area (see the Physical Resources Appendix).

Extended Study Area

Water quality in various segments of the San Joaquin River downstream from Friant Dam is degraded because of low flow and lower quality discharges from agricultural areas and wastewater treatment plants. The following sections describe water quality in the San Joaquin River from Friant Dam to the Merced River, in the San Joaquin River from the Merced River to the Delta, in the Delta, and in the CVP/SWP water service areas.

San Joaquin River from Friant Dam to Merced River

Water quality in Reach 1 is influenced by releases from Friant Dam, with minor contributions from agricultural return flows and storm-water runoff. Water quality data collected from the San Joaquin River downstream from Friant Dam demonstrate the generally high quality of water released at Friant Dam from Millerton Lake to Reach 1. Temperatures of San Joaquin River water releases to Reach 1 are dependent on the cold-water volume available at Millerton Lake (see Modeling Appendix). Since fall 2009, limited flows have reached Mendota Pool as part of the SJRRP. As part of the SJRRP, Reclamation collects and reports on water quality conditions from Friant Dam to the Merced River confluence. Project data collected to date indicate that there are few contaminants of concern in Reaches 1 and 2 (SJRRP 2012a, 2012b). Beneficial uses within Reaches 1 and 2 include municipal, agriculture, industry, recreation, freshwater habitat, and wildlife habitat, as shown in Table 15-1.

During the irrigation season, water released at Mendota Dam to Reach 3 generally has higher concentrations of TDS than in reaches 1 and 2. Increased EC and concentrations of total suspended solids demonstrate the effect of Delta contributions to San Joaquin River flow. Water quality criteria applicable to some beneficial uses are not currently met within Reaches 3 and 4. Beneficial uses within Reaches 3 and 4 include municipal, agriculture, industry, recreation, freshwater habitat, and wildlife habitat, as shown in Table 15-1.

During water quality monitoring as part of the Interim Flows Program, several trace elements (e.g., mercury, selenium) were measured in the San Joaquin River downstream from Mendota

Dam, likely due in part to inflow of water from the DMC and other tributaries.

Water temperatures downstream from Mendota Dam are dependent on water temperatures of inflow from the DMC and, occasionally, the Kings River system via James Bypass (Reclamation 2007). Because water temperature is a limiting factor for native fish, including Chinook salmon at different life stages, water temperature data collection studies are underway as part of the SJRRP. Water temperature data loggers are currently placed at various locations in a longitudinal array throughout the Restoration Area to record data in a variety of fish habitats (SJRRP 2011).

Reach 5 typically has the poorest water quality of any reach of the river from Friant Dam to the Merced River confluence. Beneficial uses within Reach 5 include municipal, agriculture, industry, recreation, freshwater habitat, and wildlife habitat, as shown in Table 15-1. Reach 5 and its tributaries (Bear Creek, Mud Slough, and Salt Slough) do not meet water quality standards applicable to some designated beneficial uses, as shown in Table 15-2. Water quality data collected at Salt Slough, Mud Slough, and San Joaquin River sites within Reach 5 demonstrate the effects of irrigation runoff contributions from west-side tributaries. San Joaquin River water temperatures within Reach 5 are influenced greatly by the water temperature of Salt Slough inflow, which contributes the majority of streamflow in the reach (see Modeling Appendix). As described for Reaches 3 and 4, preliminary data do not show a measureable improvement in water quality in Reach 5 because of the arrival of Interim Flows (SJRRP 2012a, 2012b).

CWA Section 303(d) listings for Reaches 1 and 2 include invasive species, as shown in Table 15-2. Mendota Pool is listed for mercury and selenium (State Water Board 2010a). The CWA Section 303(d) listings for these reaches include boron, chlorpyrifos, diazinon, dichloro-diphenyltrichloroethane (DDT), diazinon, Group A pesticides, and unknown toxicity, as shown in Table 15-2. TMDL and Basin Plan amendments are currently in place for diazinon and chlorpyrifos runoff into Reaches 3, 4, and 5; for selenium in Reach 5; salt and boron in Reach 3, 4, and 5; and oxygen-demanding substances in Reaches 1 through 5 (State Water Board 2013). TMDLs and Basin Plan amendments are currently being developed for additional pesticides (State Water Board 2010a). The CWA Section 303(d) listings for Reach 5 include arsenic, boron, chlorpyrifos, DDT, EC, *Escherichia coli* (*E. coli*), Group A

pesticides, mercury, selenium, and unknown toxicity. TMDLs and Basin Plan amendments are currently being developed for arsenic, boron, DDT, EC, *E. coli*, Group A pesticides, and mercury (State Water Board 2010a).

Pesticides, fertilizers, and nitrate in this portion of the extended study area are further regulated under WDRs issued by the Central Valley Water Board for waste discharges from irrigated lands. Within this portion of the extended study area, the Central Valley Water Board has issued general WDRs for the Eastern San Joaquin River Watershed and Western San Joaquin River Watershed. WDRs are also in place for individuals not participating in the general WDRs.

San Joaquin River from Merced River to the Delta

Downstream from its confluence with the Merced River, San Joaquin River water quality generally improves at successive confluences with east-side rivers draining the Sierra Nevadas, particularly at confluences with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, mineral concentrations tend to increase because of inflows of agricultural drainage water, other wastewaters, and effluent groundwater (DWR 1965). TDS in the San Joaquin River near Vernalis has historically (from 1951 to 1962) ranged from 52 mg/L (at high flows) to 1,220 mg/L (DWR 1965).

CWA Section 303(d) listings for the San Joaquin River from the Merced River to the Delta are provided in Table 15-3 (State Water Board 2010a). TMDL and Basin Plan amendments are currently in place for salinity, boron, selenium, diazinon, and chlorpyrifos in the lower San Joaquin River upstream from Vernalis. A Basin Plan amendment is also in place for dissolved oxygen; water quality objectives for the San Joaquin River upstream from the Stockton Deep Water Ship Channel to address this amendment are being developed by the stakeholder group CV-SALTS and its Lower San Joaquin River Committee (State Water Board 2013).

Table 15-3. Clean Water Act Section 303(d) List of Water Quality Limited Segments, San Joaquin River System from Merced River to Delta

Segment	Pollutant/ Stressor	Potential Source	Affected Area/Reach Length
San Joaquin River, Merced River to Tuolumne River	alpha-BHC	Source Unknown	29 miles
	Boron	Agriculture	
	Chlorpyrifos	Agriculture	
	DDE	Agriculture	
	DDT	Agriculture	
	Electrical Conductivity	Agriculture	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Unknown Toxicity	Agriculture	
San Joaquin River, Tuolumne River to Stanislaus River	Chlorpyrifos	Agriculture	8.4 miles
	DDT	Agriculture	
	Diazinon	Agriculture	
	Electrical Conductivity	Agriculture	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Unknown Toxicity	Agriculture	
San Joaquin River, Stanislaus River to Delta	Chlorpyrifos	Agriculture	3 miles
	DDE	Agriculture	
	DDT	Agriculture	
	Diuron	Agriculture	
	Electrical Conductivity	Agriculture	
	Escherichia coli (*E. coli*)	Source Unknown	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Toxaphene	Source Unknown	
	Unknown Toxicity	Agriculture	

Source: State Water Board 2010a.
Key:
alpha-BHC= alpha-benzene hexachloride
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane

Pesticides, fertilizers, and nitrate are further regulated under WDRs issued by the Central Valley Water Board for waste discharges from irrigated lands. Within the extended study area, the Central Valley Water Board has issued general WDRs for the Eastern San Joaquin River Watershed, Western San Joaquin River Watershed, and Tulare Lake Basin Area. WDRs are also in place for individuals not participating in the general WDRs.

Delta

Water quality in the Delta is highly variable, temporally and spatially. It is a function of complex circulation patterns that are affected by inflows, pumping for Delta agricultural operations and exports, operation of flow control structures, and tidal action. The existing water quality problems of the Delta system may be categorized as the presence of toxic materials, eutrophication and associated fluctuations in dissolved oxygen, presence of suspended sediments and turbidity, salinity, and presence of pathogenic bacteria (State Water Board 1999).

Delta waterways fall within the jurisdiction of both the Central Valley Water Board and the San Francisco Bay Water Board. Various Delta waterways in the areas under jurisdiction of the Central Valley Water Board are listed under CWA Section 303(d) as impaired for chlordane, chlorpyrifos, DDT, diazinon, dieldrin, EC, Group A pesticides, invasive species, mercury, polychlorinated biphenyls (PCB), and unknown toxicity (State Water Board 2010a). TMDLs are currently in place for diazinon, chlorpyrifos, and methylmercury in the Delta (State Water Board 2013). Delta waterways in the area under jurisdiction of the San Francisco Bay Water Board are listed under CWA Section 303(d) as impaired for chlordane, DDT, dieldrin, dioxin, furan compounds, invasive species, mercury, PCBs, and selenium (State Water Board 2010a).

The north Delta tends to have better water quality primarily because of inflow from the Sacramento River, though some water quality parameters, such as mercury, may be more impaired than in other portions. The quality of water in the west Delta is strongly influenced by tidal exchange with San Francisco Bay; during low-flow periods, seawater intrusion results in increased salinity. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, and effects of diversions that can

sometimes increase seawater intrusion from San Francisco Bay.

The Sacramento and San Joaquin rivers contribute approximately 61 percent and 33 percent, respectively, to tributary inflow TDS concentrations within the Delta. TDS concentrations are relatively low in the Sacramento River, but because of its large volumetric contribution, the river provides the majority of the TDS load supplied by tributary inflow to the Delta (DWR 2001). Although actual flow from the San Joaquin River is lower than from the Sacramento River, TDS concentrations in San Joaquin River water average approximately 7 times those in the Sacramento River. The influence of this relatively poor San Joaquin River water quality is greatest in the south Delta channels and in CVP and SWP exports. Water temperature in the Delta is only slightly influenced by water management activities (i.e., dam releases) (Reclamation and DWR 2005).

Delta exports contain elevated concentrations of disinfection byproduct precursors (e.g., dissolved organic carbon), and the presence of bromide increases the potential for formation of brominated compounds in treated drinking water. Organic carbon in the Delta originates from runoff from agricultural and urban land, drainage water pumped from Delta islands that have soils with high organic matter, runoff and drainage from wetlands, wastewater discharges, and primary organic carbon production in Delta waters. Delta agricultural drainage can also contain high levels of nutrients, suspended solids, organic carbon, minerals (salinity), and trace chemicals such as organophosphate, carbamate, and organochlorine pesticides.

CVP and SWP Water Service Areas

Water delivered to Friant Division contractors via the Friant-Kern and Madera canals from Millerton Lake is representative of water quality conditions at Millerton Lake and the upper San Joaquin River watershed—generally soft with low mineral and nutrient concentrations. As described in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations,” water from the Delta is delivered to the Arvin-Edison WSD via the California Aqueduct in exchange for water delivered from Millerton Lake, when conditions permit. Water delivered to Arvin-Edison WSD is representative of a mixture of Delta and Millerton Lake water quality conditions.

Surface water quality in the other CVP and SWP water service areas is affected by fluctuations of water quality in the Delta,

which in turn are influenced by climate, water quality in the San Joaquin and Sacramento rivers, and local agricultural diversions and drainage water. Water quality concerns of particular importance are those related to salinity and drinking water quality. Salinity is an issue because excessive salinity may adversely affect crop yields and require more water for salt leaching, may require additional M&I treatment, may increase salinity levels in agricultural soils and groundwater, and is the primary water quality constraint to recycling wastewater (CALFED 2000). Constituents that affect drinking water quality are of more concern within the SWP water service areas because of high demand for M&I water supplies for SWP contractors, and include bromide, natural organic matter, microbial pathogens, nutrients, TDS, hardness, alkalinity, pH, organic carbon, disinfection byproducts, and turbidity.

Pesticides, fertilizers, and nitrate in this portion of the extended study area are further regulated under WDRs issued by the Central Valley Water Board for waste discharges from irrigated lands. Within this portion of the extended study area, the Central Valley Water Board has issued general WDRs for the Western San Joaquin River Watershed and Tulare Lake Basin Area. WDRs are also in place for individuals not participating in the general WDRs.

Environmental Consequences and Mitigation Measures

This section describes environmental consequences on surface water quality associated with implementation of the alternatives. The potential direct and indirect impacts to surface water quality and associated mitigation measures are summarized in Table 15-4.

Table 15-4. Summary of Impacts and Mitigation Measures for Surface Water Quality

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-2: Temporary Construction-Related Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 15-4. Summary of Impacts and Mitigation Measures for Surface Water Quality (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-3: Temporary Construction-Related Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	SWQ-4: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	San Joaquin River from Friant Dam to the Merced River Confluence	No Action Alternative	LTS and Beneficial	None Required	LTS and Beneficial
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	San Joaquin River from the Merced River Confluence to the Delta	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 15-4. Summary of Impacts and Mitigation Measures for Surface Water Quality (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
Impact SWQ-6: Long-Term Effects on Delta Salinity that would Violate D-1641 Salinity Objectives	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 15-4. Summary of Impacts and Mitigation Measures for Surface Water Quality (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
Impact SWQ-7: Long-Term Effects on Delta Salinity that would Violate the X2 Standard	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
Impact SWQ-8: Long-Term Effects on Water Quality that would Violate Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Key:
NI = no impact
LTS = less than significant

Methods and Assumptions

Water quality monitoring data and computer modeling were used to aid in evaluating potential impacts on surface water quality. Both temporary, construction-related effects and long-term operational effects were considered as part of this evaluation. Temporary construction impacts were evaluated qualitatively based on anticipated construction practices, materials, locations, and duration of project construction and related activities. Long-term effects were evaluated using computer modeling tools. Specifically, CalSim II was used to simulate CVP and SWP operations, determining surface water flows, storages, and deliveries associated with each alternative. These data were applied as inputs for computer models used for surface water quality impact assessments.

Computer models were used to evaluate impacts for each alternative on reservoir water temperature at Millerton Lake, San Joaquin River water temperature from Friant Dam to the Merced River, San Joaquin River salinity (EC) from the Mendota Pool to the Delta, and salinity and the X2 position in the Delta. The long-term effects analysis focuses on water temperature and salinity. Water temperature is an important water quality parameter for fisheries. Salinity is an important water quality parameter for multiple beneficial uses. The modeling tools used in this assessment are the best available modeling tools. They were selected because they are publicly available, have a knowledgeable user community, and are widely accepted for use in similar systemwide analyses of resources in the California Central Valley.

Reservoir Temperature

All the action alternatives increase the total volume of cold water in Millerton Lake and provide for cold-water storage (defined as water at or below 52°F for this analysis) at Temperance Flat RM 274 Reservoir, with larger available cold-water pools in action alternatives with planned operations for higher carryover storage. Additionally, the SLIS included in Alternative Plan 4 also allows for better management of the cold-water pool, resulting in improved water temperature conditions for anadromous fish in the San Joaquin River.

Daily water temperatures in the Temperance Flat Reservoir and Millerton Lake were modeled using a two-dimensional model based on the CE-QUAL-W2 (W2) modeling platform. The model uses daily water operations data from the daily disaggregation tool and historical meteorology to simulate

water temperatures every 6 hours from January 1, 1980, to September 30, 2003. This time period is shorter than the CalSim model time period to reduce the volume of output, allow acceptable model execution times, and still cover the full range of water temperature operations expected over the longer CalSim time period.

Reservoir water temperature effects on fisheries habitat are described in Chapter 5.0, "Biological Resources – Fisheries and Aquatic Ecosystems."

River Temperature

Daily Millerton Lake water operations data were used in a water temperature model to generate daily release temperatures into the Friant-Kern Canal, Madera Canal, and San Joaquin River. Daily water releases (flow and temperature) from Millerton Lake to the San Joaquin River were used in a temperature model of the San Joaquin River to route releases through the system from Friant Dam to the Merced River, and to compute the water temperature at various locations. The river temperature model is based on the HEC-5Q modeling platform. The model performs two separate functions. The first, based on the HEC-5 model embedded in the HEC-5Q modeling platform, routes water through the San Joaquin River and bypass system from Millerton Lake to the confluence with the Merced River. This portion of the model develops daily flows throughout the San Joaquin River system by modeling the physical diversion of water between the Chowchilla, Eastside, and Mariposa bypasses and the San Joaquin River, local accretions and depletions along the channels, and hydrologic routing of water. The second function uses flows and historical meteorology to simulate water temperatures every 6 hours from January 1, 1980, to September 30, 2003. Additional details on the river temperature model can be found in the Modeling Appendix.

River water temperature effects on fisheries habitat are described in Chapter 5.0, "Biological Resources – Fisheries and Aquatic Ecosystems."

San Joaquin River Salinity

The CalSim II San Joaquin River water quality module was used to simulate salinity (EC) on the main stem San Joaquin River from the Mendota Pool to Vernalis. CalSim II includes the Link-Node approach algorithm, implemented in March 2004, to estimate San Joaquin River salinity at Vernalis by replacing the single regression equation with a series of salt

balances from Friant Dam to Vernalis. The salt balances dynamically account for all inflows and outflows along a given reach, and assume perfect mixing of different waters. Westside inflows to the San Joaquin River are disaggregated into various flow components and each component is assigned an EC value. San Joaquin River salinity results simulated for alternatives with the CalSim II San Joaquin River water quality module were used only for comparative analysis of alternatives.

Delta Water Quality

DSM2 was used with CalSim II results to describe Delta water quality for each alternative, including EC values and chloride concentrations. DSM2 is a hydrodynamic model of the Delta developed by DWR that simulates flow and salinity changes throughout the Delta caused by changes in Delta inflow or CVP/SWP pumping. The model uses monthly CalSim II results and produces mean monthly flow and salinity values. The analysis of potential impacts on Delta water quality evaluates potential impacts on surface water quality for all in-Delta water users. Parameters used in the evaluation include simulated changes in X2 location, Delta outflow, I:E ratio, salinity, chloride ion concentrations, dissolved organic carbon concentrations, and flows in the Old and Middle rivers.

The water quality impact assessment focuses on salinity as EC, expressed in micromhos per centimeter (µmhos/cm), and chloride ion concentrations in mg/L, as indicators of Delta water quality because they are the primary water quality constituents most likely to be affected by temporal shifts in Delta pumping operations. Water year types used to present results related to Delta water quality are defined according to the Sacramento Valley Index Water Year Hydrologic Classification unless specified otherwise.

CalSim II uses a statistical model, known as an artificial neural network model (ANN), to estimate Delta salinity (measured as EC). The ANN is trained to mimic the physically based hydrodynamic model, DSM2. CalSim II uses the ANN to determine releases from upstream reservoirs to meet Delta salinity and X2 requirements. Simulated CalSim II mean monthly Delta inflows and Delta exports are subsequently used as inputs to DSM2 to generate Delta channel stage, velocity, flow, and salinity estimates. The ANN only approximates the Delta flow-salinity relationship as simulated by DSM2, so that there are small salinity differences between the ANN-determined values used in CalSim II to drive reservoir operations and the final DSM2 values used for impact

studies/effects analysis. Differences in simulated Delta salinity between the two models may result in occasional violations of water quality standards in the DSM2 simulation, although none would occur under actual operations. The apparent violation of standards in DSM2 results are therefore referred to as "potential violations" because they occur in DSM2 but would not occur under actual operations. While there is some loss of accuracy in using the ANN to determine flow-salinity relationships in CalSim II, resulting DSM2 salinity values are useful for comparing relative changes between alternatives. This comparative analysis is an appropriate way of using model results.

Sediment

Potential temporary, construction-related sediment effects that would violate water quality standards or adversely affect beneficial uses are evaluated qualitatively in this chapter, based on the types and locations of potential construction activities. The potential impacts from sediment associated with erosion and geomorphology are analyzed in Chapter 11, "Geology and Soils."

Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and the range of action alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project and a reasonable range of alternatives, if required. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

Overall Impact Indicators for Water Quality

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. These significance criteria were applied to the qualitative assessment and quantitative modeling results and used to determine impact significance. The analysis

of water quality impacts and benefits focuses on water temperature, metals, and sediment because they are important water quality constituents in both the primary and extended study areas.

Reclamation developed the impact significance criteria for Delta water quality variables that have regulatory objectives or numerical standards, such as those contained in the 2006 WQCP, using the general considerations listed below (State Water Board 2006).

Impacts of an alternative on water quality would be significant if project implementation would do any of the following:

- Violate existing water quality standards or otherwise substantially degrade water quality
- Result in substantial water quality changes that would adversely affect beneficial uses
- Result in substantive undesirable impacts on public health or environmental receptors

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise.

Impact Indicators for Delta Salinity

If changes in salinity within the Delta during months of increased pumping, due to any of the action alternatives, would result in an increase in salinity, relative to the basis of comparison, of sufficient frequency and magnitude over the long term to adversely affect designated beneficial uses, to increase the frequency that existing regulatory standards are exceeded, or to substantially degrade water quality at the locations below, then the impact would be considered significant. Stations selected within the Delta are as follows:

- Contra Costa Canal Pumping Plant No. 1
- San Joaquin River at Antioch Water Works Intake
- West Canal at the mouth of the Clifton Court Forebay
- DMC at Jones Pumping Plant
- Barker Slough at North Bay Aqueduct Intake
- San Joaquin River at Jersey Point

- San Joaquin River near Vernalis
- San Joaquin River at Brandt Bridge
- Old River near the Middle River
- Old River Barrier at Tracy Road Bridge
- Sacramento River at Emmaton
- Sacramento River at Collinsville

These stations were selected to provide a thorough understanding of the changes in the San Joaquin River and Delta. Using the assumptions discussed in the Methods and Assumptions section, and detailed in the Modeling Appendix, the DSM2 model calculated changes in monthly mean EC values and chloride concentrations for the alternatives, relative to the bases of comparison. Monthly EC values and chloride concentrations were derived for an 82-year simulation period, extending from 1922 through 2003.

DSM2 model output was used to evaluate potential changes in salinity under the alternatives, relative to the bases of comparison. Changes in salinity were evaluated in the Delta during months of increased pumping under the alternatives, relative to the bases of comparison. The potential to violate D-1641 salinity objectives was considered for each alternative. D-1641 establishes maximum salinity objectives, including EC values and chloride concentrations, at several locations in the Delta, as shown in Table 15-5 and including the same locations listed above.

Figure 15-1 shows the major Delta islands, waterways, water quality control stations, and M&I intakes within the Delta with D-1641 salinity objectives. CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the alternatives.

Table 15-5. D-1641 Salinity Objectives at Selected Compliance Locations

Compliance Location	Parameter	Description[1]	Water Year Type[2]	Time Period/ Date	Value[3]	Unit
• Contra Costa Canal Pumping Plant No. 1 • San Joaquin River at Antioch Water Works Intake	Chloride	Maximum mean daily 150 mg/L chloride for at least the number of days shown during the calendar year. Must be provided in intervals of not less than 2 weeks duration.	Wet Above Normal Below Normal Dry Critical	All year	240 190 175 165 155	days
• Contra Costa Canal Pumping Plant No. 1 • West Canal at Mouth of Clifton Court Forebay • Delta-Mendota Canal at Jones Pumping Plant • Barker Slough at North Bay Aqueduct Intake	Chloride	Maximum mean daily concentration.	All	Oct–Sept	250	mg/L
• West Canal at mouth of Clinton Court Forebay • Delta-Mendota Canal at Jones Pumping Plant	EC	Maximum monthly average of mean daily EC.	All	Oct–Sept	1.0	mmhos /cm
• San Joaquin River at Jersey Point	EC	Maximum 14-day running average of mean daily EC equal to 0.45 EC from April 1 to date shown, and EC from date shown to August 15.	Wet Above Normal Below Normal Dry Critical	Aug 15 Aug 15 June 20 June 15 --	-- -- 0.74 1.35 2.20	mmhos /cm
• San Joaquin River at Airport Way Bridge, Vernalis • San Joaquin River at Brandt Bridge • Old River near Middle River • Old River at Tracy Road Bridge	EC	Maximum 30-day running average of mean daily EC.	All	Apr–Aug Sept–Mar	0.7 1.0	mmhos /cm mmhos /cm
• Sacramento River at Emmaton	EC	Maximum 14-day running average of mean daily EC equal to 0.45 EC from April 1 to date shown, and EC from date shown to August 15.	Wet Above Normal Below Normal Dry Critical	Aug 15 July 1 June 20 June 15 --	-- 0.63 1.14 1.67 2.78	mmhos /cm
• Sacramento River at Collinsville	EC	Maximum monthly average of both daily high tide EC values, or demonstrate that equivalent or better protection will be provided at the location.	All	Oct–Sept Nov–Dec Jan Feb–Mar Apr–May	19.0 15.5 12.5 8.0 11.0	mmhos /cm

Source: State Water Resources Control Board 2000.

Notes:

[1] Determination of compliance with an objective expressed as a running average begins on the last day of the averaging period. The averaging period commences with the first day of the time period for the applicable objective. If the objective is not met on the last day of the averaging period, all days in the averaging period are considered out of compliance.

[2] Year types defined by Sacramento Valley Index.

[3] When no date is shown, EC limit continues from April 1.

Table 15-5. D-1641 Salinity Objectives at Selected Compliance Locations (contd.)

Key:
-- = not applicable
Apr = April
Aug = August
Dec = December
EC = electrical conductivity
Feb = February
Jan = January
Mar = March
mg/L = milligrams per liter
mmhos/cm = millimhos per centimeter
No. = number
Oct = October
Sept = September
Nov = November

Node ID	Description
1	Sacramento River at Rio Vista
2	Sacramento River at Emmaton
3	Sacramento River at Collinsville
4	Sacramento River at Chipps Island
5	Sacramento River at Port Chicago (Roe Island)
6	Old River near Middle River
7	Old River at Tracy Road Bridge
8	Delta Mendota Canal at Tracy Pumping Plant
9	West Canal at mouth of Clifton Court Forebay Intake
10	Old River at CCWD Los Vaqueros Intake
11	CCWD Proposed Alternative Intake
12	Middle River east of Victoria Island
13	Woodward Canal
14	Old River at Rock Slough
15	Contra Costa Canal at Pumping Plant #1
16	San Joaquin River near Vernalis
17	San Joaquin River at Brandt Bridge
18	San Joaquin River downstream of Calaveras River
19	Stockton Proposed Intake
20	San Joaquin River at Prisoners Point
21	San Joaquin River at San Andreas Landing
22	San Joaquin River at Jersey Point
23	San Joaquin River at Antioch Ship Channel
24	Mokelumne River at Terminous
25	Barker Slough at North Bay Aqueduct Intake
26	Head of Old River Barrier
27	Middle River Barrier
28	Grant Line Canal Barrier
29	Old River Barrier at Tracy Road Bridge

Figure 15-1. Major Delta Islands, Waterways, Water Quality Control Stations, and Municipal and Industrial Intakes

Impact Indicators for X2 Position

If a change in the mean monthly position of X2, relative to the bases of comparison, would be of sufficient frequency and magnitude to adversely affect water quality, then it would be considered a significant impact.

The X2 parameter represents the geographical location of the 2 ppt near-bottom salinity isohaline in the Delta, which is measured in distance upstream from the Golden Gate Bridge in Suisun Bay. The location of the estuarine salinity gradient is regulated from February through June by the location of the X2 objective, and is required to be maintained at not more than 75 km (approximately 47 miles) from February through June. If the alternatives would contribute to exceedence of this standard, the impact is considered significant.

Topics Eliminated from Further Consideration

No topics related to surface water quality were eliminated from further consideration.

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives. Where the action alternatives would have similar impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Primary Study Area

No Action Alternative Under the No Action Alternative, no construction activities would occur in the primary study area that would have the potential to affect Millerton Lake or the San Joaquin River upstream from Millerton Lake water quality. Therefore, there would be no short-term increases in turbidity, suspended sediment, or nutrients in Millerton Lake or the San Joaquin River upstream from Millerton Lake that would violate water quality standards or adversely affect beneficial uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives The construction-related activities described in Chapter 2, “Alternatives,” would result in short-term changes in the amount of exposed area that would be

subject to erosion. Construction of Temperance Flat RM 274 Dam, powerhouse, batch plant, and transmission facilities would require the excavation, transport, stockpiling, grading, drilling, blasting, and use of bedrock, alluvium, and soil obtained from the aggregate quarry. Other activities would include the demolition and removal of existing facilities within the inundation zone, installation of support structures, construction of permanent access roads and temporary haul roads, and use of staging areas. Additionally, about 3,580 acres of vegetation in parts of the new inundation area would be partially or completely removed. Removal of vegetation would reduce the amount of effective ground cover (e.g., duff, large woody debris), thereby increasing the potential for short-term erosion and sedimentation along the shoreline. Soils disturbed by these activities as well as materials stockpiled for use during construction would be susceptible to erosion.

Temporary, construction-related erosion will be avoided and minimized via implementation of the erosion and sediment control plans and SWPPP (i.e., erosion and sediment control plans, including site revegetation) that are a part of the environmental commitments common to all action alternatives (see Chapter 2, “Alternatives”). These plans will address the necessary local jurisdiction requirements regarding erosion control and site revegetation, and would implement BMPs for erosion and sediment control. The plans would include site-specific structural and operational BMPs to prevent and control short-term and long-term erosion and sedimentation effects, stabilize soils and vegetation in areas affected by construction activities, and prevent and control impacts on runoff quality. Types of BMPs to be included in the plans may include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, silt fencing, sediment basins, fiber rolls, sandbag barriers, straw bale barriers, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam and related physical features would not be constructed and water supplies from the proposed Temperance Flat RM 274 Reservoir would not be conveyed in the San Joaquin River.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction under the action alternatives is not anticipated to affect water quality conditions in the extended study area under any of the action alternatives. Construction effects are anticipated to be localized within the primary study area, and would be further minimized with appropriate BMPs. The residual effect to waters in the extended study area would be further minimized through mixing and dilution. Therefore, construction is anticipated to have little effect on water quality conditions downstream in the extended study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-2: Temporary Construction-Related Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Primary Study Area

No Action Alternative Under the No Action Alternative, no construction activities would occur in the primary study area that would have the potential to affect water temperatures in Millerton Lake or the San Joaquin River upstream from Millerton Lake. Therefore, there would be no changes in water temperature conditions within Millerton Lake due to construction activities.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, construction activities associated with constructing Temperance Flat RM 274 Dam and other physical features would result in sizeable areas that would be subject to surface disturbance. Environmental commitments and BMPs for the various construction activities have been incorporated into all action alternatives. These activities could include removal of riparian vegetation, thereby exposing water bodies to increased solar radiation for various time periods. As described in Chapter 2, “Alternatives,” a riparian revegetation program would be implemented at all streamside construction and relocation sites as applicable to ensure that shade is quickly reestablished after construction is completed.

Because of the large water surface area of Millerton Lake, coupled with the isolated and discrete nature of the

construction activities, temporary construction-related effects are not expected to modify water temperature in a manner that would have a negative effect on beneficial uses or result in a water quality violation.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area
No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be constructed and water supplies from the proposed Temperance Flat RM274 Reservoir would not be conveyed in the San Joaquin River.

There would be **no impact** under the No Action Alternative.

Action Alternatives As previously described for the primary study area, due to the large water surface area of Millerton Lake, coupled with the isolated and discrete nature of the construction activities, temporary construction-related effects are not expected to modify water temperature in Millerton Lake in a manner that would have a negative effect on beneficial uses or result in a water quality violation. The action alternatives would not modify water temperature in a manner that would have a negative effect on beneficial uses or result in a water quality violation in the primary study area, and no additional construction would occur in the extended study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-3: Temporary Construction-Related Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Primary Study Area
No Action Alternative Under the No Action Alternative, no construction activities would occur in the primary study area that would have the potential to affect Millerton Lake or the San Joaquin River upstream from Millerton Lake water quality. Therefore, there would be no construction-related water quality effects in Millerton Lake or the San Joaquin River upstream from Millerton Lake that would violate water quality standards or adversely affect beneficial uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction activities in the primary study area could accidentally discharge waste petroleum products or other construction-related substances containing metals that could enter waterways in runoff. In addition, chemicals associated with operating heavy machinery would be used, transported, and stored on site during construction activities.

As described in Chapter 2, "Alternatives," Reclamation would prepare and implement a SWPPP before construction, identifying BMPs to prevent or minimize the discharge of sediments and other contaminants with the potential to affect beneficial uses or lead to violations of water quality objectives of surface waters. The SWPPP would include development of site-specific structural and operational BMPs to prevent and control impacts on runoff quality, and measures to be implemented before, during, and after each storm event. As part of the SWPPP, Reclamation would develop and implement a spill prevention and control plan to minimize effects from spills of hazardous, toxic, or petroleum substances for project-related construction activities occurring in or near waterways. The accidental release of chemicals, fuels, lubricants, and nonstorm drainage water into water bodies would be prevented to the greatest extent feasible. BMPs for the project could include, but would not be limited to, silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, stabilized construction entrances, double containment of hazardous materials, and proper disposal of hazardous materials.

The action alternatives also include permanent disposal of waste rock from diversion tunnel and powerhouse excavation, in an area located approximately 3,200 feet southwest of the powerhouse within the existing inundation area of Millerton Lake. The disposal site would be approximately 21.5 acres in size, and would require permits under CWA, including a NPDES permit under CWA Section 402. The Central Valley Water Board controls the discharge of wastes to surface waters from industrial processes or construction activities through the NPDES permit process. WDRs are established in the permit to protect beneficial uses. Reclamation would comply with the terms of all permits to minimize the effects of waste rock disposal.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam and related physical features would not be constructed and water supplies from the proposed Temperance Flat RM 274 Reservoir would not be conveyed in the San Joaquin River.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction is not anticipated to affect water quality conditions in the extended study area under any of the action alternatives. Construction effects are anticipated to be localized within the primary study area, and would be further minimized with appropriate BMPs. The residual effect to waters in the extended study area would be further minimized through mixing and dilution. Therefore, construction is anticipated to have little effect on water quality conditions downstream in the extended study area.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River

The potential impacts of the alternatives on water quality conditions in the primary study area, within the extended study area from Friant Dam to the Merced River confluence, and from the Merced River confluence to the Delta are described as part of this impact. Water temperature impacts in the primary study area and in the San Joaquin River are described separately under Impact SWQ-5. Impacts within the Delta would be related to changes in salinity and are described under Impacts SWQ-6 and SWQ-7. Impacts within the CVP and SWP water service areas are described under Impact SWQ-8.

Primary Study Area

No Action Alternative Under the No Action Alternative, variation in reservoir levels of Millerton Lake due to reoperation of Friant Dam under the SJRRP would continue within the range of historical annual reservoir water surface elevations, as modified by climate change in the extended future (see Chapter 8, “Climate Change”). Therefore, there would be no long-term changes in constituent concentrations (including turbidity, suspended sediment, nutrients

concentrations, and metals concentrations) in Millerton Lake or the San Joaquin River upstream from Millerton Lake that would violate water quality standards or adversely affect beneficial uses.

There would be **no impact** under the No Action Alternative.

Action Alternatives Once Temperance Flat RM 274 Dam is constructed and the reservoir filled, shoreline erosion would occur along the zone of reservoir-elevation fluctuation between the top-of-active-storage capacity (elevation 985) and the top of minimum carryover storage capacity (elevation 674 under Alternative Plans 1, 2, and 3; elevation 734 under Alternative Plan 4; and elevation 603 under Alternative Plan 5). As described in Chapter 11, "Geology and Soils," substantial soil erosion and loss of topsoil would occur in the shoreline area, subject to fluctuating water levels. Water surface elevations in Temperance Flat RM 274 Reservoir theoretically could fluctuate between the top-of-active-storage capacity and the top-of-minimum-carryover-storage capacity within a single year. This fluctuation comprises an area of about 4,300 acres under Alterative Plans 1, 2, and 3; about 3,700 acres under Alternative Plan 4; and about 5,000 acres under Alternative Plan 5.

The actual fluctuation in any single year is a function of the starting storage for that year, the inflow, and the operational diversions and releases, and is limited by, but not driven by, the maximum physical fluctuation potential. The maximum theoretical fluctuation of Temperance Flat RM 274 Reservoir in any action alternative occurs in Alternative Plan 5, and is 382 feet. From the CalSim II operation modeling, Temperance Flat RM 274 Reservoir elevation reached the maximum theoretical fluctuation in a single year of the 83 year simulation period once under each action alternative under existing conditions, and did not reach the maximum theoretical fluctuation under future conditions. The simulated fluctuation under Alternative Plan 5 is below 300 feet in about 96 percent of the simulated years, and below 245 feet in about 90 percent of the years, with an average annual fluctuation of about 150 feet. The amount of sediment that could be delivered under each action alternative is not quantifiable because of the number of variables that influence sediment transport and delivery.

Much of the topography in the general vicinity of the Temperance Flat RM 274 Reservoir is steep, increasing

susceptibility to erosion, particularly the first several miles downstream from Kerckhoff Dam and the north side of Millerton Lake just upstream from RM 274. Although environmental commitments and BMPs are incorporated into the project description, the project would result in an incremental increase in the delivery of suspended sediment and turbidity to the receiving waters. The rate of shoreline erosion would be greatest during the first several years after construction and would reduce over time as the new shoreline stabilizes. Sediment would be largely retained within the reservoir and would not adversely affect beneficial uses in the primary study area.

Temperance Flat RM 274 Reservoir would increase the residence time of water in the primary study area, as compared with existing conditions. Increased residence time would promote primary productivity in these waters. While increased residence time can contribute to eutrophication in some environments, eutrophication is not anticipated in the proposed Temperance Flat RM 274 Reservoir, due to low concentrations of primary nutrients such as nitrogen and potassium (see the Affected Environment section of this chapter) in the San Joaquin River.

A survey conducted in 2003 by BLM in support of the Investigation identified three abandoned mine sites within the Temperance Flat Reservoir Area, including the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. These mines include multiple adits and millsites. Potential contamination from gold mines may occur from natural or imported elements. Natural contamination is generally from high concentrations of metallic sulfides and/or sulfosalts typically associated with gold deposits. Imported contaminates are primarily mineral processing chemicals such as mercury, commonly used as an amalgamation reagent. Based on qualitative assessment of samples taken during this survey, as well as review of available historical literature and personal interviews, Springer concluded that the probability of substantial toxic contamination after inundation, both naturally occurring and imported, from mining and related activities at these site, is very low (Springer 2005). However, further site investigation would be required to determine the level of toxic contamination that could occur from inundation of these sites.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

San Joaquin River from Friant Dam to the Merced River Confluence

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam and related physical features would not be constructed and water supplies from the proposed Temperance Flat RM 274 Reservoir would not be conveyed in the San Joaquin River. Surface water quality conditions would be improved in some areas through the continued release of Restoration Flows under the SJRRP, through effects on constituent concentrations.

Changes in operation of Friant Dam under the SJRRP would not introduce new contaminants to the San Joaquin River system. However, by changing the timing and location of flows, changes in operation would change the relative concentrations of constituents in various segments of the river. The SJRRP PEIS/R describes the potential changes anticipated for the various river segments and bypasses. These findings are summarized below.

Surface water quality conditions within the San Joaquin River would be similar to or improved relative to existing conditions. Under the No Action Alternative, increased flows in many months would dilute concentrations of water quality constituents in those reaches that currently convey water. Under the existing conditions, water quality criteria applicable to some beneficial uses are not met within Reaches 3, 4, and 5 because of constituent loading to and within these reaches. Under the No Action Alternative, concentrations of these constituents may decrease, but it is not anticipated that water quality criteria would be met.

In other months, flows would be reduced due to a decrease in the release of flood flows. The reduction of flows in the bypass system would likely result in increased constituent concentrations, but would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health.

Reach 4B does not convey San Joaquin River flow under existing conditions. It is dry in some segments, and where it does flow, it conveys agricultural return flows and local runoff.

On a long-term basis, the SJRRP would improve San Joaquin River water quality conditions within Reach 4B compared to existing conditions. Increased flow through Reach 4B under the SJRRP would decrease concentrations of constituents in San Joaquin River flows.

Overall, this impact would be **less than significant and beneficial** under the No Action Alternative.

Action Alternatives Under the action alternatives, surface water quality conditions would be improved in some areas through the increased release of flows from Friant Dam, and adversely affected in other areas due to the reduction in flood flows. Surface water quality conditions within the San Joaquin River would be similar to the No Action Alternative. Under the action alternatives, increased flows in many months would dilute concentrations of water quality constituents in Reaches 1 and 2.

Sediment would be retained within Temperance Flat RM 274 Reservoir, as previously described. This sediment would not be transported further downstream or released from Friant Dam to the San Joaquin River, and could lead to reduced primary productivity in these waters. However, this would be somewhat offset by the effects of increased residence time in Temperance Flat RM 274 Reservoir as compared with existing conditions. Increased residence time would promote primary productivity in these waters, as previously described.

Under existing conditions, water quality criteria applicable to some beneficial uses are not met within Reaches 3, 4, and 5 because of constituent loading to and within these reaches. Under the action alternatives, flows would be reduced due to a decrease in the release of flood flows in some months. The reduction of flows in the bypass system would likely result in increased constituent concentrations, but would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

San Joaquin River from the Merced River Confluence to the Delta

No Action Alternative Under the No Action Alternative, EC in the San Joaquin River downstream from the Merced River and downstream from the Tuolumne River would be less than under existing conditions due to increased flows from Restoration Flows, particularly during March and April. Although in some months of some years small increases in EC would occur, on a long-term average basis, simulated EC in the San Joaquin River at Vernalis was less than under existing conditions in all months, across all year types (see Modeling Appendix). Overall, San Joaquin River water quality conditions from the Merced River to the Delta would improve under the No Action Alternative.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, EC in the San Joaquin River downstream from the Merced River and downstream from the Tuolumne River would be similar to the No Action Alternative. On a long-term average basis, all increases in simulated EC in the San Joaquin River at Vernalis were 1 percent, or less, in all months and across all year types, and less than 1 percent in Dry and Critical years.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Primary Study Area

No Action Alternative Under the No Action Alternative, the operations of Millerton Lake would change from the existing condition, including changes in the volume and timing of releases to the San Joaquin River associated with Restoration Flows and flood management, and to the Friant-Kern and Madera canals associated with water supply deliveries. Accordingly, the reservoir levels and water temperatures in Millerton Lake would also change. Analysis of water temperature modeling results indicates that, on a long-term average basis, the volume of the cold-water pool would decrease by less than 10 percent in all months, across all year types, as compared to the existing conditions.

Under the No Action Alternative, Temperance Flat RM 274 Dam and Reservoir would not be constructed. No changes would be anticipated to occur to water temperatures in the San Joaquin River upstream from Millerton Lake.

Because the volume of cold water in Millerton Lake would remain similar to existing conditions, and no changes would occur to water temperatures in the San Joaquin River upstream from Millerton Lake, this impact would not cause violations of water quality standards or adversely affect beneficial uses.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives All action alternatives would increase the total combined volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in action alternatives with higher carryover storage in most months. Analysis of water temperature modeling results indicates that, on a long-term average basis, the volume of the cold-water pool would increase in most months under all action alternatives. In all but Wet years, the volume of the cold-water pool would decrease by up to 60 percent in January under Alternative Plans 1 through 3 and 5 (as compared to the existing condition and No Action Alternative). Under Alternative Plan 5, the cold-water pool volume would also decrease in February, by up to 11 percent, in all but Wet years. The winter months, including January and February, have the largest volumes of cold-water pool under the existing condition and No Action Alternative, and this would not change under the action alternatives.

The SLIS included in Alternative Plan 4 would allow for better management of the cold-water pool. Accordingly, water temperature modeling results indicate that, on a long-term average basis, the volume of the cold-water pool would increase in all months (as compared to the existing condition and No Action Alternative).

Because the total combined volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir would increase in most months, and decrease by less than 1 percent under some action alternatives in winter months only, this impact would not cause violations of water quality standards or adversely affect beneficial uses.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area Potential impacts of the alternatives on water temperatures within the extended study area would not extend beyond the Delta to the CVP and SWP water service areas, as discussed in Chapter 2, "Alternatives." Therefore, the discussion below is limited to the San Joaquin River from Friant Dam to the Merced River confluence, the San Joaquin River from the Merced River confluence to the Delta, and the Delta.

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam and related physical features would not be constructed and additional water supplies from the proposed Temperance Flat RM 274 Reservoir would not be conveyed in the San Joaquin River. Downstream from the Merced River confluence, monthly average San Joaquin River water temperatures under the No Action Alternative would be similar to existing conditions. Water temperature in the Delta is only slightly influenced by water management activities (i.e., dam releases) (Reclamation and DWR 2005), and would not change under the No Action Alternative.

This impact would be **less than significant** under the No Action Alternative. Mitigation is not required for the No Action Alternative.

Action Alternatives The action alternatives would improve San Joaquin River release temperatures from September through December, as shown in Chapter 2, "Alternatives." Winter releases would be slightly warmer than under the No Action Alternative; however, in the winter months, release temperatures would still be cooler than needed for anadromous fish (see Modeling Appendix for further details on reservoir and river temperatures). Inclusion of an SLIS in Alternative Plan 4 would reduce release temperatures by up to 5°F more than without the SLIS during fall months, providing a greater benefit to salmonid spawning and rearing. The colder release temperatures anticipated under all action alternatives would also extend the distance downstream from Friant Dam where mean daily river temperatures would stay below 55°F, a water temperature suitable for salmonid spawning and rearing (see Chapter 2, "Alternatives," and the Modeling Appendix).

The Basin Plan specifies that at no time or place will the temperature of intrastate waters be increased more than 5°F above the natural receiving-water temperature (Central Valley Water Board 2011). Analysis of water temperature modeling results indicates that this standard would be met under all action alternatives, as shown in the Modeling Appendix. Therefore, this impact would not cause violations of water quality standards or adversely affect beneficial uses.

The action alternatives would reduce the frequency, magnitude, and duration of Friant Dam releases greater than Restoration Flows. This in turn would reduce river continuity with some gravel pits, which may have a warming effect on water in the San Joaquin River (SJRRP 2012c).

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-6: Long-Term Effects on Delta Salinity that would Violate D-1641 Salinity Objectives

Extended Study Area

No Action Alternative The No Action Alternative would cause both increases and decreases in salinity as compared with existing conditions, as shown in the Modeling Appendix. On a long-term average basis, all increases in simulated EC were less than 5 percent across all year types, and less than 7 percent in Dry and Critical years. On a long-term average basis, all increases in simulated chloride concentrations were less than 18 percent across all year types, and less than 10 percent in Dry and Critical years. However, none of the changes would result in any additional violations of the Delta salinity standards.

D-1641 establishes maximum salinity objectives, including objectives for salinity (measured as EC) and chloride concentrations, at several locations in the Delta, as shown in Table 15-5. CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the No Action Alternative. It is therefore anticipated that the No Action Alternative would not result in any additional violations of the D-1641 salinity objectives.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would cause both increases and decreases in salinity as compared with existing conditions and No Action Alternative, as shown in the Modeling Appendix. Under the action alternatives, on a long-term average basis, all increases in simulated EC, as compared with existing conditions, were less than 2 percent across all year types, and less than or equal to 2 percent in Dry and Critical years. On a long-term average basis, all increases in simulated chloride concentrations, as compared with existing conditions, were less than 2 percent across all year types, and less than 1 percent in Dry and Critical years. As compared with the No Action Alternative, on a long-term average basis, all increases in simulated EC were less than 2 percent across all year types and in Dry and Critical years. On a long-term average basis, all increases in simulated chloride concentrations, as compared with the No Action Alternative, were less than 2 percent across all year types and in Dry and Critical years. However, none of these changes would result in any violations of the Delta salinity standards.

As previously described, D-1641 establishes maximum salinity objectives, including objectives for salinity (measured as EC) and chloride concentrations, at several locations in the Delta, as shown in Table 15-5. CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the action alternatives. Therefore, the action alternatives are not anticipated to result in any additional violations of the D-1641 salinity objectives.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-7: Long-Term Effects on Delta Salinity that would Violate the X2 Standard

Extended Study Area

No Action Alternative The No Action Alternative would shift X2 upstream and downstream in comparison with existing conditions. On a long-term average basis, all upstream shifts in simulated X2 were less than 0.3 km across all year types, and less than 0.5 km in Dry and Critical years, as shown in the Modeling Appendix. None of the anticipated changes would result in any violations of the X2 standard.

As previously described, D-1641 establishes the X2 standard. The location of the estuarine salinity gradient is regulated from February through June by the location of the X2 objective, and is required to be maintained at not more than 75 km (approximately 47 miles) from February through June.

CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the No Action Alternative. It is therefore anticipated that the No Action Alternative would not result in any violations of the D-1641 salinity objectives.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The action alternatives would shift X2 upstream and downstream in comparison with existing conditions and the No Action Alternative. On a long-term average basis, all upstream shifts in the simulated X2 were less than 0.1 km across all year types. In Dry and Critical years, simulated X2 remained the same as under existing conditions and the No Action Alternative, or shifted downstream, depending on the month, as shown in the Modeling Appendix. None of the anticipated changes would result in any violations of the X2 standard, because the CVP and SWP would release more water upstream to meet standards.

As previously described, D-1641 establishes the X2 standard. The location of the estuarine salinity gradient is regulated from February through June by the location of the X2 objective, and is required to be maintained at not more than 75 km from February through June.

CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the action alternatives. It is therefore anticipated that the action alternatives would not result in any violations of the D-1641 salinity objectives.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SWQ-8: Long-Term Effects on Water Quality that would Violate Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas

Extended Study Area

No Action Alternative Under the No Action Alternative, the recapture and recirculation of full Restoration Flows under the SJRRP would affect water quality in the Friant Division of the CVP. These changes would be associated with differences in constituent concentrations of water supplies diverted from the Delta and/or San Joaquin River and potentially delivered to Friant Division contractors compared to water delivered via the Friant-Kern and Madera canals. Water quality conditions within the CVP and/or SWP water service areas, where water pumped from the San Joaquin River may mix or be exchanged with water delivered from the Delta, would also be affected. Surface water quality impacts are not likely to result in additional violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives As described for Impact SWQ-4, the action alternatives would increase flows in many months in Reaches 1 and 2 and would dilute concentrations of water quality constituents in those reaches. The action alternatives include the delivery of new water supplies from Temperance Flat via the San Joaquin River through diversion at Mendota Pool. The contribution of relatively high-quality water from the San Joaquin River would dilute concentrations of water quality constituents in Mendota Pool, improving the quality of water supplies to entities receiving water from Mendota Pool, including CVP SOD (under Alternative Plans 2, 3, 4, and 5) and SWP M&I contractors (under Alternative Plans 1, 2, 3, and 4). The quality of water delivered to CVP and SWP water service areas would remain similar to the existing conditions and No Action Alternative, and would not result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health.

This impact would be **less than significant** under the action alternatives. Mitigation is not required and is therefore not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 15-4.

No mitigation is required for Impacts SWQ-1 through SWQ-3, or Impact SWQ-5 within the primary study area, or for Impacts SWQ-1 through SWQ-8 within the extended study area, as these impacts would be less than significant or less than significant and beneficial for all action alternatives. There would be no impact under the action alternatives under Impacts SWQ-6, SWQ-7, and SWQ-8 in the primary study area.

Impact SWQ-4 would be potentially significant within the primary study area. Mitigation Measure SWQ-4, below, is proposed to minimize the potential for Impact SWQ-4 to occur.

Mitigation Measure SWQ-4: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation

Reclamation will prepare and implement a plan to remove or otherwise remediate the Patterson, San Joaquin, and Sullivan mine sites, which have the potential to introduce metals into the proposed Temperance Flat RM 274 Reservoir. This plan will include requirements to coordinate with Federal, State, and local agencies and landowners to ensure that measures taken will reduce the potential for a discharge of contaminants into the proposed Temperance Flat RM 274 Reservoir. Reclamation will obtain any required permits, approvals, and authorizations before any ground-disturbing remediation activity occurs.

Implementation of this mitigation measure would reduce Impact SWQ-4 to a **less-than-significant** level.

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Chapter 16
Indian Trust Assets

This section describes the affected environment related to ITAs for the proposed actions of the Investigation. ITAs are legal interests in property held in trust by the U.S. for Federally recognized Indian tribes or individual Indians.

The affected environment for ITAs is the primary study area, within which all construction activities will take place. No effects to ITA's outside the primary study area would occur, and are not discussed herein. A detailed description of both the primary and extended study areas was provided to BIA's Regional ITA Coordinator. The Regional ITA Coordinator examined both the project area descriptions and records held by BIA and Reclamation, and determined that the proposed action does not have potential to affect ITAs outside of the primary study area. Therefore, the extended study area is not discussed further in this chapter.

Affected Environment

There are no tribes possessing legal property interests held in trust by the United States in the Study Area for any of the action alternatives. Public Domain Allotments and Rancherias held privately in fee ownership with tribal affiliation are located near the primary study area. These fee properties are not ITAs, and any potential impacts to these properties will be addressed with all other non-ITA property interests in the primary and extended study areas (see Chapter 17, "Land Use Planning and Agricultural Resources"). Figure 16-1 identifies the Public Domain Allotments, Reservations, Rancherias, private and public land parcels within and adjacent to the primary study area. Table 16-1 lists the Federally Recognized Tribes with property interests in proximity to the primary study area.

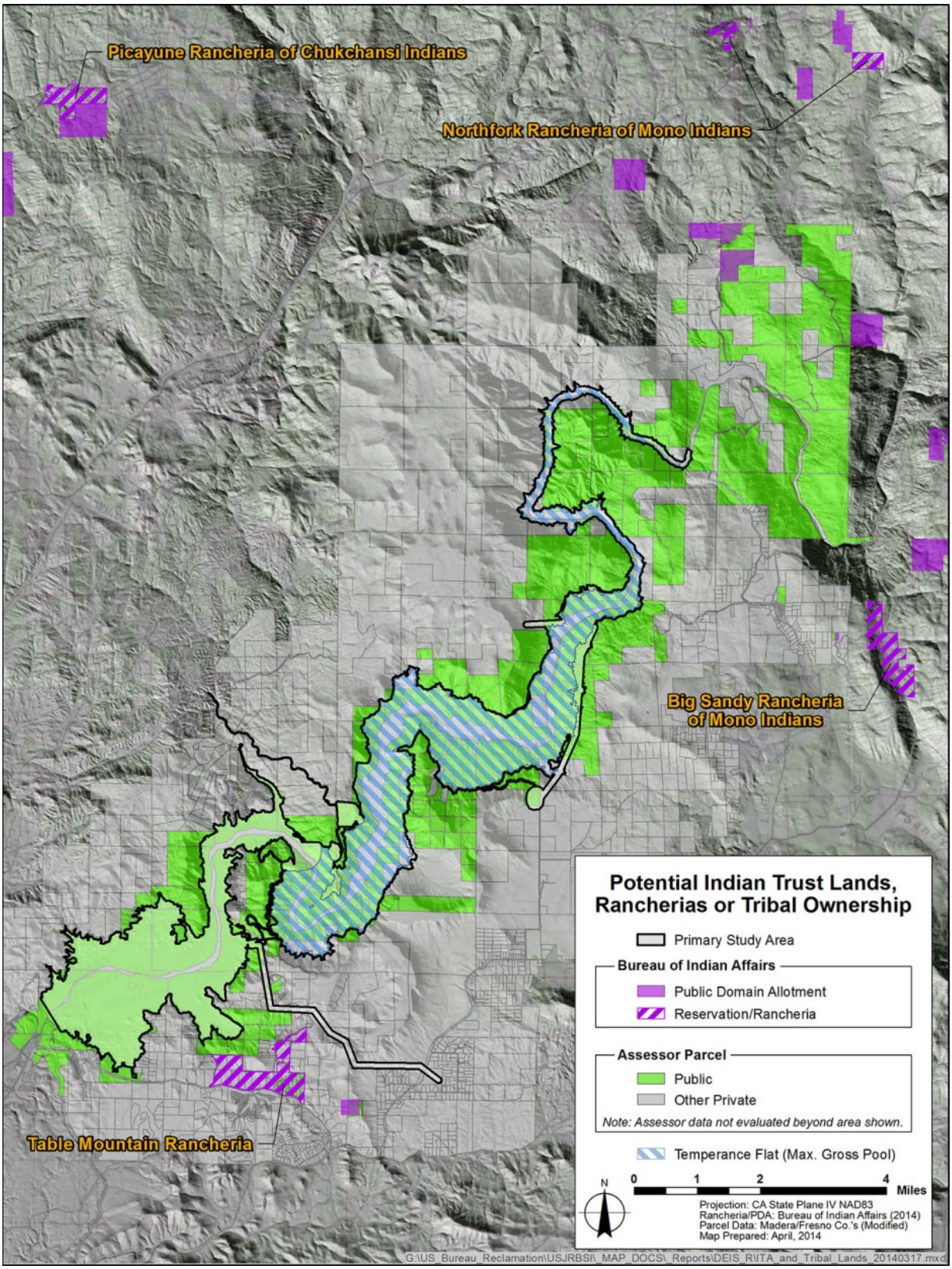

Figure 16-1. Reservations, Rancherias, Public Domain Allotments, Public and Private Property near the Primary Study Area

Table 16-1. Federally Recognized Tribes in Region with Property Interests in Proximity to Primary Study Area

Tribe	Location
Table Mountain Rancheria	Southwest of Primary Study Area
Picayune Rancheria of Chukchansi Indians	Northwest of Primary Study Area
North Fork Rancheria	North of Primary Study Area
Big Sandy Rancheria of Mono Indians	East of Primary Study Area

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on ITAs that could result from implementing any of the alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on ITAs. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on ITAs and associated mitigation measures are summarized in Table 16-2.

Table 16-2. Summary of Impacts and Mitigation Measures for Indian Trust Assets

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ITA-1: Interfere with the Exercise of a Federally Reserved Water Right, or Degrade Water Quality Where There is a Federally Reserved Water Right	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
ITA-2: Interfere with the Use, Value, Occupancy, Character or Enjoyment of an ITA	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 16-2. Summary of Impacts and Mitigation Measures for Indian Trust Assets (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
ITA-3: Failure to Protect ITAs from Loss, Damage, Waste, Depletion, or Other Negative Effects	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact

Methods and Assumptions

A qualitative assessment of the ITAs in the primary study area was performed. Records held by BIA and Reclamation were compared to the footprint of the alternatives, and the potential for each alternative to affect ITAs was determined.

As previously mentioned, a detailed description of both the primary and extended study areas was provided to BIA's Regional ITA Coordinator. The Regional ITA Coordinator examined both the project area descriptions and records held by BIA and Reclamation, and determined that the proposed action does not have potential to affect ITAs outside of the primary study area.

Criteria for Determining Significance of Effects

An impact to an existing ITA is considered potentially significant if implementation of a project alternative would adversely affect ITAs by resulting in the following:

- Interfere with the exercise of a Federally reserved water right, or degrade water quality where there is a Federally reserved water right
- Interfere with the use, value, occupancy, character or enjoyment of an ITA
- Failure to protect ITAs from loss, damage, waste, depletion, or other negative effects

Environmental measures have been incorporated into the project description, which are consistent with the CALFED ROD (2006) and the Department of Interior Departmental Manual Part 512, Chapter 2 (1995), to reduce any effects on ITAs potentially occurring near the primary study area. ITAs are not located within the primary study area.

1) If there is potential to affect an identified ITA, consultation will be initiated as defined therein before any actions are authorized and implemented. The purpose of the tribal consultation will be to further identify the nature of the effect and to identify appropriate mitigation measures.
2) The tribal consultation process will take place with the affected Federally-recognized Indian tribe(s). Appropriate avoidance and/or mitigation strategies will be discussed on a government-to-government basis.

Separate mitigation measures may be required for different types of trust assets.

Topics Eliminated from Further Consideration

As previously mentioned, the Regional ITA Coordinator examined both the project area descriptions and records held by BIA and Reclamation, and determined that the proposed action does not have potential to affect ITAs outside of the primary study area. Therefore, no impacts are anticipated in the extended study area, and this area is not discussed further.

Direct and Indirect Effects

The following section describes the potential environmental consequences of the project. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact ITA-1: Interfere with the Exercise of a Federally Reserved Water Right, or Degrade Water Quality Where There is a Federally Reserved Water Right

Primary Study Area

No Action Alternative Under the No Action Alternative, there would be no impacts to ITAs because there are no ITAs in the primary study area. Additionally, no new facilities would be constructed and existing operations would continue to operate as they have historically occurred.

There would be **no impact** under the No Action Alternative.

Action Alternatives There are no ITAs in the primary study area. There are no tribes possessing legal property interests held in trust by the United States in the primary study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Impact ITA-2: Interfere with the Use, Value, Occupancy, Character or Enjoyment of an ITA

Primary Study Area

No Action Alternative Under the No Action Alternative, there would be no impacts to ITAs because there are no ITAs in the primary study area. Additionally, no new facilities would be constructed and existing operations would continue to operate as they have historically occurred.

There would be **no impact** under the No Action Alternative.

Action Alternatives There are no ITAs in the primary study area. There are no tribes possessing legal property interests held in trust by the United States in the primary study area. Public Domain Allotments held privately in fee ownership with tribal affiliation are located near the primary study area, however these fee properties are not ITAs, and any potential impacts to these properties are addressed with all other non-ITA property interests in the primary and extended study areas (see Chapter 17, "Land Use Planning and Agricultural Resources").

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Impact ITA-3: Failure to Protect ITAs from Loss, Damage, Waste, Depletion, or Other Negative Effects

Primary Study Area

No Action Alternative Under the No Action Alternative, there would be no impacts to ITAs because there are no ITAs in the primary study area. Additionally, no new facilities would be constructed and existing operations would continue to operate as they have historically occurred.

There would be **no impact** under the No Action Alternative.

Action Alternatives There are no ITAs in the primary study area. There are no tribes possessing legal property interests held in trust by the United States in the primary study area. Public Domain Allotments held privately in fee ownership with tribal affiliation are located near the primary study area, however these fee properties are not ITAs, and any potential impacts to these properties are addressed with all other non-ITA property interests in the primary and extended study areas (see Chapter 17, "Land Use Planning and Agricultural Resources").

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 11-7.

No mitigation is required for Impacts ITA-1 through ITA-3 within the primary or extended study areas, as there would be no impact under any of the action alternatives.

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Chapter 17
Land Use Planning and Agricultural Resources

This chapter describes the affected environment for land use planning and agricultural resources, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. It focuses primarily on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The affected environment for land use planning and agricultural resources includes discussion of existing land use conditions; private and public ownership of lands in the primary study area; agricultural resources, including Important Farmland, Williamson Act contract lands, and Farmland Security Zones (FSZ); and forestry resources.

Primary Study Area

Land Use

The primary study area encompasses the San Joaquin River upstream from Friant Dam to Kerckhoff Dam, including Millerton Lake (see Chapter 1, “Introduction”). Recreation, agriculture, open space, forestland, and rural residential development make up the majority of land uses in the primary study area (Figure 17-1).

Within the primary study area, the rural communities of Auberry and Prather are located in Fresno County. Outside of the primary study area, the town of Friant is located approximately 1 mile south of Friant Dam, and the City of Fresno is the nearest urban area of significant size, located approximately 10 miles southwest of the primary study area via Friant Road, while the City of Madera and SR 99 are about 22 miles to the west.

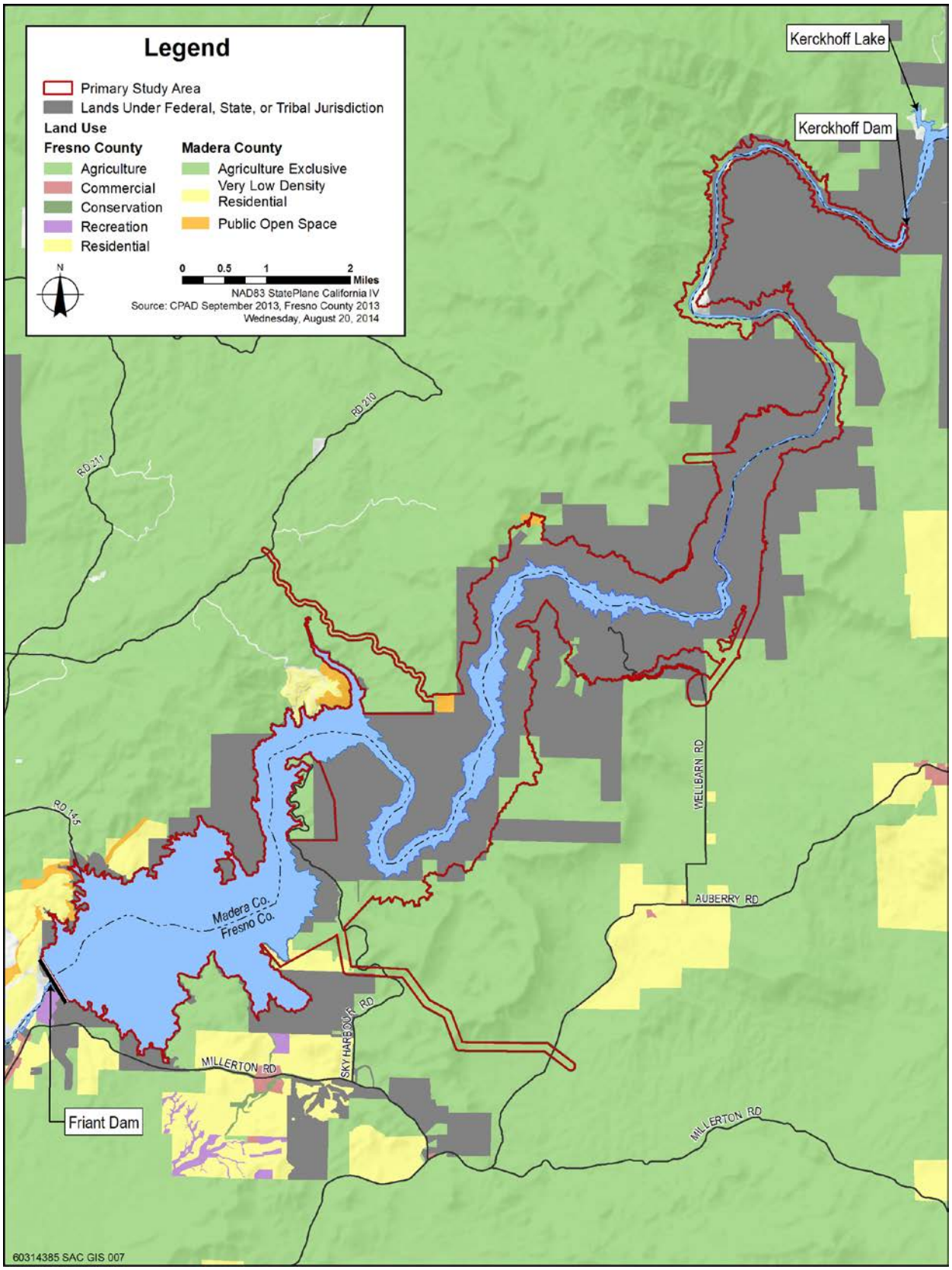


Figure 17-1. Planned Land Uses in the Primary Study Area and Vicinity

The following discussion characterizes the existing land uses within the primary study area, summarizes the Fresno County and Madera County general plan land use designations and county zoning, and identifies land ownership and management.

Existing Land Uses in and Adjacent to the Primary Study Area

Area of Project Features The majority of the area of project features is located in undeveloped open space and forestland within the Millerton Lake SRA.

The proposed new and relocated transmission line corridors are located in undeveloped open space and forestland. Approximately 1.6 miles of the southern portion of the new transmission line corridor is located on land owned and managed by the Sierra Foothill Conservancy. Rural residences are located at the southern terminus of the transmission line corridor along both sides of Cherokee Road and along both side of Caballero Road just east of Auberry Road. The relocated transmission line corridor is located on lands managed by the BLM and lands in private ownership. No residences are located within or immediately adjacent to the proposed relocated transmission line corridor.

Temperance Flat Reservoir Area Land uses within the Temperance Flat Reservoir Area include open space, forestland, grazing, and recreational areas.

There are a few isolated recreational facilities upstream from Millerton Lake within the Millerton Lake SRA. The North Finegold and Temperance Flat boat-in campgrounds are located approximately 4 miles and 9 miles, respectively, upstream from RM 274.

Located 5 miles northwest of Auberry, the SJRG SRMA, managed by BLM, covers approximately 6,700 acres of land on both the north and south sides of the San Joaquin River. The SJRG SRMA offers several educational and recreation facilities, concentrated in the Squaw Leap area on the south side of the river, accessible via Smalley Road from Auberry. Recreational activities in the SJRG SRMA include hiking, mountain biking, horseback riding, angling, whitewater rafting, and cave exploration (see Chapter 22, “Recreation,” for a detailed discussion of the lands and waters used for recreation and the recreational access and facilities that support those uses). The land in the SJRG SRMA is also leased to local property owners for cattle grazing. Four BLM grazing lessees

use 4,000 acres in six grazing allotments and could use up to 1,200 animal-unit months of public land forage annually during various seasons of use (Doran 2013).

Cattle are grazed on lands in the Temperance Flat Reservoir Area. Approximately 4,000 acres in the northwestern portion of the Temperance Flat Reservoir Area are currently grazed at Kennedy Table during winter. In addition, Reclamation owns several grazing parcels in the general vicinity of Kennedy Table, two of which are currently leased to PG&E and the rest, although not currently leased, remain available for future grazing (see the Agricultural Resources and Grazing Lands section below for further discussion).

At the northern most boundary of the Temperance Flat Reservoir Area, Kerckhoff Dam impounds Kerckhoff Lake, which serves as the forebay for both Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse. The Kerckhoff Dam and powerhouses are owned and operated by PG&E. Wishon Powerhouse, also owned and operated by PG&E, is located on the east shore of Kerckhoff Lake and releases water to the lake.

In 2010, the BLM Bakersfield Field Office determined that 5.4 miles of the San Joaquin River from the Kerckhoff Dam downstream to the Kerckhoff Powerhouse was eligible and suitable for designation as a Federal Wild and Scenic River based on its free-flowing character and outstandingly remarkable values (ORV). If this portion of the river is designated, the hydroelectric facilities along the segment would continue to operate according to existing plans and policies. However, without Congressional authorization or Secretarial designation, restrictions under the Wild and Scenic Rivers Act would not apply (see Chapter 28, “Other NEPA and CEQA Considerations”) for further discussion of the BLM RMP land use goals and policies related to wild and scenic rivers).

Eligibility for designation as a wild and scenic river is based on whether a river segment is “free-flowing” and whether it possesses at least one ORV, which could be a scenic, recreation, geologic, fish, wildlife, cultural, historic, or other value. In the case of this segment of the San Joaquin River, the scenic quality rating of “A” contributed to the finding that the segment is eligible to be included in the NWSRS. Other qualities contributing to the river segment’s eligibility included wildlife and cultural ORVs (BLM 2010).

Figure 17-2 shows the extent of the lands anticipated to be included in the Wild and Scenic River designation corridor, including a zone extending up to one-quarter mile from either river shoreline. This zone would establish restrictions on land management activities that would adversely affect the free-flowing character of the river or ORVs.

Millerton Lake Below RM 274 The majority of lands surrounding Millerton Lake below RM 274 are located in the 10,500-acre Millerton Lake SRA. Recreational uses in the Millerton Lake SRA include water-based activities, such as motor boating, sailing, water skiing, jet skiing, swimming, and fishing, and shoreline activities, such as picnicking, hiking, biking, camping, and nature watching. The developed areas around Millerton Lake consist of park and park-related facilities.

The park-related facilities on the south shore are the administrative buildings and maintenance facilities, Millerton Courthouse, Winchell Cove Marina, the South Finegold day-use area, boat ramps, and picnic and swimming areas. The north shore of Millerton Lake primarily consists of camping facilities, accessible via Road 145. Camping sites are located at Rocky Point, Mono, Fort Miller, Dumna Strand, Valley Oak, and Meadows Campgrounds (see Chapter 22, “Recreation,” for a detailed discussion of the lands and waters used for recreation and the recreational access and facilities that support those uses).

Two residential subdivisions are located along the shoreline of Millerton Lake. Sky Harbor subdivision (also known as the Millerton Lake Park Estates) is located 6 miles north of the intersection of Sky Harbour Road and Millerton Road in Fresno County. The Sky Harbor subdivision includes 231 parcels, of which 59 parcels are developed with single-family residences (LAFCO 2011). Hidden Lake Estates subdivision is located on the northwestern shoreline of Millerton Lake in Madera County. The Hidden Lake Estates subdivision includes 208 parcels, with 46 developed with single-family residences (Madera County 2013).

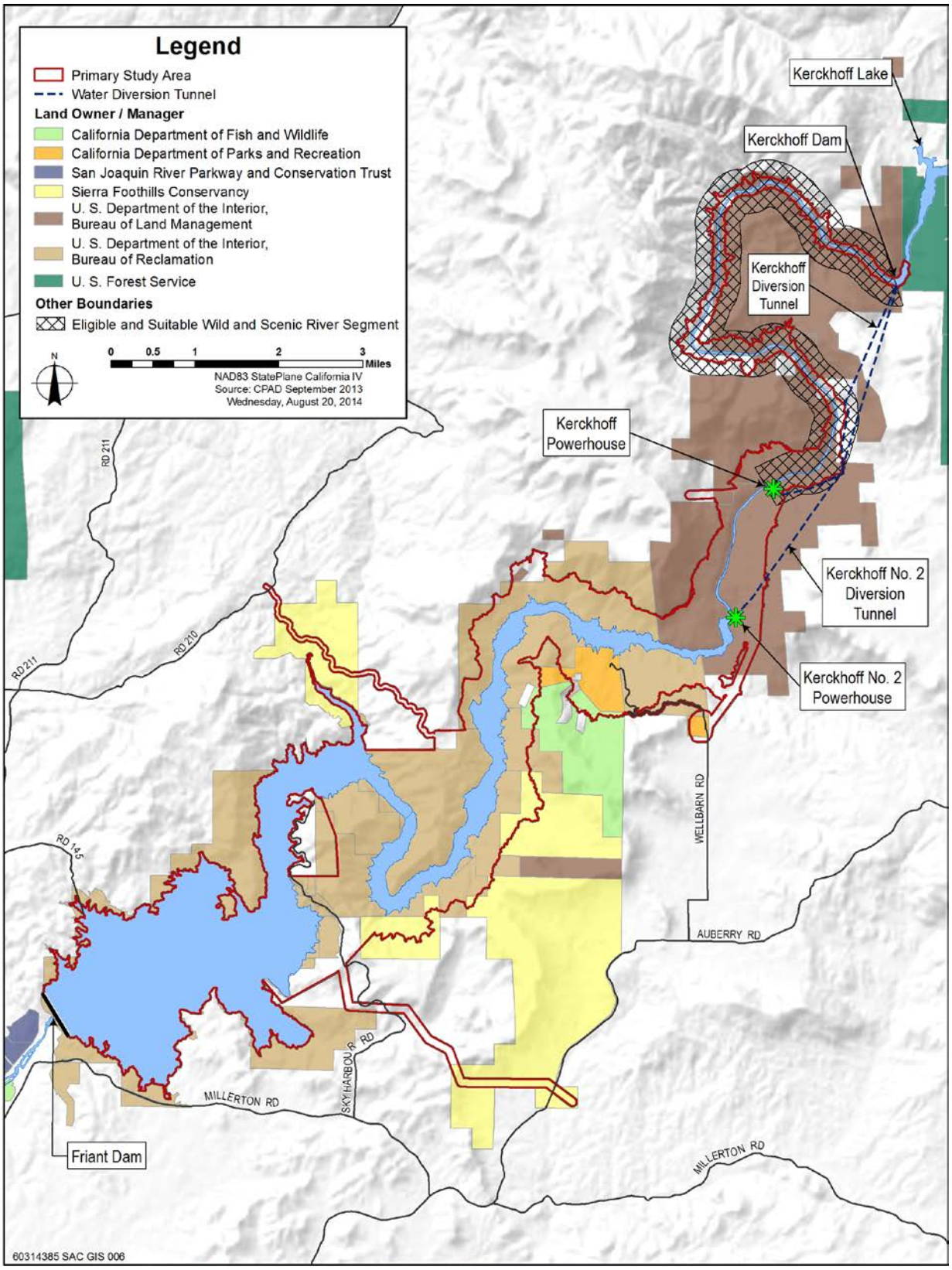


Figure 17-2. Land Ownership and Management in the Primary Study Area

Land Use Designations and Zoning Land use designations identify the proposed distribution, location, and extent of planned land uses. Figure 17-1 shows the *Madera County General Plan* (Madera County 1995) land use designations in the primary study area and vicinity. Figure 17-1 also presents planned land uses for Fresno County (Fresno County 2000a, 2000b), characterized by five categories of land use using combinations of similar zoning districts. Table 17-1 defines each land use designation and planned land uses in the primary study area and vicinity.

Zoning ordinances establish land use zoning districts that are then applied to land within the local jurisdiction. Typically, zoning ordinances will, for each land use designation, establish allowable land uses and requirements for development in each designation.

Land Ownership and Management Most land in the primary study area is publicly administered or owned by BLM, Reclamation, and the CDFW. To a lesser extent, privately owned lands, including lands owned by the Sierra Foothill Conservancy and PG&E, are located throughout the primary study area. Land ownership and management authority in the primary study area is shown in Figure 17-2 and described below.

U.S. Department of the Interior, U.S. Bureau of Land Management Located 5 miles northwest of Auberry, the BLM-managed SJRG SRMA covers approximately 6,700 acres of land on both the north and south sides of the San Joaquin River. As described above, the SJRG SRMA offers several educational and recreation facilities and Federal grazing leases.

U.S. Department of the Interior, Bureau of Reclamation Millerton Lake, Friant Dam and the majority of adjacent lands are owned by Reclamation. As described above, Millerton Lake provides a variety of water-based recreational activities as well as shoreline activities.

California Department of Fish and Wildlife Most of Big Table Mountain is owned by CDFW and managed by State Parks for protection of endangered species and interpretive opportunities. Relatively small parts of Big Table Mountain are owned by Reclamation and BLM.

Table 17-1. Fresno County and Madera County Planned Land Uses

Planned Land Use	Definition
Fresno County	
Agriculture	This category is a combination of the Agriculture, Exclusive Agriculture, Limited Agriculture, and Resource Conservation zoning districts.
Residential	This category is a combination of the Rural Residential, Single-Family Residential, Single-Family Residential Agriculture, Low Density Multiple Family Residential, and Trailer Park Residential zoning districts.
Recreation	This category is a combination of the Recreation and Commercial Recreation zoning districts.
Conservation	This category is the Open Conservation zoning district.
Commercial	This category is a combination of the Neighborhood Shopping Center, General Commercial, Central Trading, Residential and Professional Office, Rural Commercial Center, Agricultural Commercial Center, and Commercial and Light Manufacturing zoning districts.
Madera County	
Agriculture Exclusive	The Agriculture Exclusive provides for agricultural uses, limited agricultural support uses (i.e., barns, silos, stables, and fruit stands), timber production, mineral extraction, and one to two single-family dwelling units per parcel.
Public Open Space	The Open Space land use designation provides for low-intensity agricultural uses, grazing, forestry, recreational uses, major electrical trunk and communication transmission lines, habitat protection, reservoirs, refuse disposal, mining, and public and quasi-public uses.
Very Low Density Residential	The Very Low Density Residential land use designation provides for single-family detached and attached residential uses at densities of two dwelling units per acre, bed-and-breakfast establishments, limited agricultural uses, and public and quasi-public uses.

Sources: Fresno County 2000a, 2000b; Madera County 1995

Note:

The area of project features includes the proposed dam and appurtenant structures, power generation facilities, and other construction areas.

California State Parks State Parks manages the Millerton Lake SRA through agreements with Reclamation and CDFW, and most of Big Table Mountain is managed by State Parks through agreements with CDFW.

Sierra Foothill Conservancy The Sierra Foothill Conservancy owns and manages the Austin & Mary Ewell Memorial Preserve and McKenzie Table Mountain Preserve:

- The 718-acre Austin & Mary Ewell Memorial Preserve on Fine Gold Creek is located west of Millerton Lake in Madera County. The Sierra Foothill Conservancy holds a conservation easement for the preserve in favor of CDFW to protect Fine Gold Creek and Willow Creek, preserve sensitive plant and wildlife species of the Central Valley floor and Sierra Nevada foothills, and to maintain existing wildlife corridors (Sierra Foothill Conservancy 2013).

- The 2,960-acre McKenzie Table Mountain Preserve is located east of Millerton Lake between Friant and Prather, on the north side of Auberry Road. The preserve offers opportunities for hiking, wildlife viewing, and nature appreciation. In addition to the main body of the preserve on the north side of the road, the preserve also includes a 47-acre parcel along the creek on the south side. This smaller piece is being developed as a nature center which will host classes and school field trips (Sierra Foothill Conservancy 2013).

Pacific Gas and Electric Company PG&E owns approximately 200 acres in and around Kerckhoff Lake north of the SJRG SRMA. This area includes open space, grazing land, and recreational areas (Pacific Forest and Watershed Lands Stewardship Council 2007). Smalley Cove at Kerckhoff Lake, operated by PG&E, is located just east of the SJRG SRMA and offers day use and campsites with fire pits, potable water, and vault toilets.

Kerckhoff and Kerckhoff No. 2 powerhouses and Wishon Powerhouse are owned by PG&E and operated under FERC License No. 96 and No. 1354, respectively.

Agricultural Resources and Grazing Land

Agriculture is the prevalent land use in Fresno County and Madera County and contributes substantially to these counties' economy. Agriculture not only contributes to the local economy, but also helps to define the county's visual and social character, maintains productive land in open space, supports wildlife habitats and migration corridors, and provides access to a local food source.

Grazing is a traditional land use in public and private lands in the primary study area (Figure 17-3). Dairy and beef cattle represented Madera County's fifth highest individual commodity while cattle represent Fresno County's seventh

highest individual commodity. Cattle accounted for $352 million and $4.5 million of the total gross valuation of agricultural commodities in Fresno and Madera counties, respectively (Fresno County 2011; Madera County 2011).

There are no active grazing lands within the area of project features or the Millerton Lake below RM 274. Approximately 4,000 acres in the northwestern portion of the Temperance Flat Reservoir Area are currently grazed at Kennedy Table during winter. In addition, Reclamation owns several parcels in the general vicinity of Kennedy Table, two of which are currently leased to PG&E; the rest, although not currently leased, remain available for future grazing. One of the currently leased grazed parcels is on rugged terrain on the north side of the San Joaquin River (Reclamation and State Parks 2010).

Grazing at Big Table Mountain was reestablished in 2000 on the experimental portion of the Big Table Mountain as part of an ongoing CDFW grazing study (Reclamation and State Parks 2010).

The grazing season in the primary study area is from October 15 to May 31. The carrying capacity of the grazing property is approximately 200 animal units or cow/calf pairs per grazing season, which is equivalent to 1,500 animal unit-months. If sufficient dry forage is available, grazing may also take place between June 1 and October 15, but at the much lower carrying capacity (Reclamation and State Parks 2010).

Important Farmland The California Department of Conservation (DOC) Important Farmland classifications—Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance—recognize the land's suitability for agricultural production by considering physical and chemical characteristics of the soil, such as soil temperature range, depth of the groundwater table, flooding potential, rock fragment content, and rooting depth. The classifications also consider location, growing season, and moisture available to sustain high-yield crops. Together, Important Farmland and Grazing Land are defined by DOC as "Agricultural Land" (see the Regulatory Setting section for more information).

The following discussion identifies the 2008 and 2010 acreages of agricultural land, including Important Farmland and Grazing Land, in Fresno and Madera counties and describes the factors

contributing to the conversion of irrigated agricultural land to nonirrigated uses in both counties.

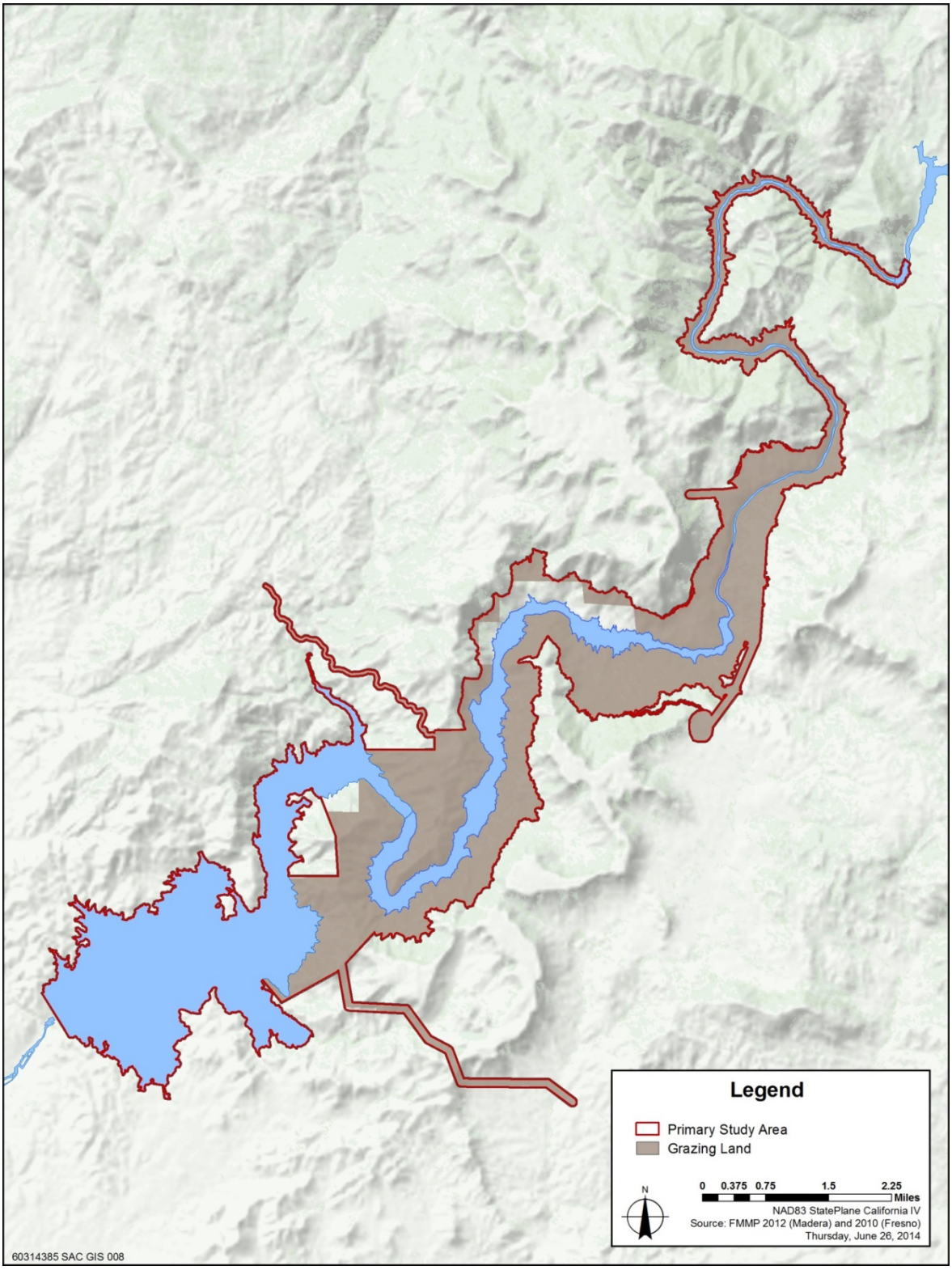


Figure 17-3. Grazing Land in the Primary Study Area

In 2008, DOC estimated that Fresno County had approximately 2,203,231 acres of agricultural land, of which approximately 1,376,278 acres were identified as Important Farmland and 826,953 acres were identified as Grazing Land. In 2010, Fresno County had approximately 2,016,095 acres of agricultural land, of which approximately 1,370,273 acres were identified as Important Farmland and 825,752 acres were identified as Grazing Land. Overall, the Important Farmland acreage decreased by approximately 0.4 percent between 2008 and 2010, and the overall decrease in agricultural land was 9.2 percent (Table 17-2).

Table 17-2. Summary of Agricultural Land Conversion in Fresno and Madera Counties, 2008–2010

Important Farmland Category	Acres		Net Change (2008–2010)	
	2008	2010	Acres	Percent
Fresno County				
Prime Farmland	693,174	685,411	-7,763	-1.1
Farmland of Statewide Importance	439,020	415,689	-23,331	-5.6
Unique Farmland	94,177	92,649	-1,528	-1.6
Farmland of Local Importance	149,907	176,524	26,617	17.8
Important Farmland Subtotal	1,376,278	1,370,273	-6,005	-0.4
Grazing Land	826,953	825,752	-1,201	-0.1
Agricultural Land Total	2,203,231	2,016,095	-7,206	-9.2
Madera County				
Prime Farmland	97,461	97,095	-396	-0.4
Farmland of Statewide Importance	85,136	84,755	-381	-0.4
Unique Farmland	163,973	165,931	1,958	1.2
Farmland of Local Importance	16,143	13,801	-2,342	17.0
Important Farmland Subtotal	362,743	361,582	-1,161	-0.3
Grazing Land	399,501	400,604	1,103	0.3
Agricultural Land Total	762,244	762,186	-58	0.001

Sources: DOC 2010a, 2010b

In 2008, DOC estimated that Madera County had approximately 762,244 acres of agricultural land, of which approximately 362,743 acres were identified as Important Farmland and 399,501 acres were identified as Grazing Land. In 2010, Madera County had approximately 762,186 acres of agricultural land, of which approximately 361,582 acres were identified as Important Farmland and 400,604 acres were identified as Grazing Land. Overall, the Important Farmland acreage decreased by approximately 0.3 percent between 2008 and 2010, and the overall decrease in agricultural land was 0.001 percent (Table 17-2).

Based on the California Division of Land Resource Protection Important Farmland Map for Fresno and Madera counties, no agricultural land designated as Important Farmland (i.e., Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance) is located within the primary study area.

As shown in Figure 17-3, the majority of the primary study area is designated as Grazing Land, which is considered by DOC as "Agricultural Land." Approximately 1,630 acres, 5,170 acres, and 126 acres of Grazing Land are located within the area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 274 area, respectively.

Williamson Act, Including Farmland Security Zones The State has developed processes to discourage conversion of agricultural land to nonagricultural uses. The use of Williamson Act contracts and FSZ (also known as Super Williamson Act lands) enables local governments to provide private landowners with tax incentives to continue agricultural or related open space uses (see the Regulatory Setting section for more information).

Figure 17-4 shows the locations of Williamson Act lands within the primary study area. Lands under Williamson Act contracts are located within the Temperance Flat Reservoir Area and Millerton Lake below RM 274 and FSZ lands are located within the Temperance Flat Reservoir Area. The following discussion summarizes the acreages of Williamson Act lands and FSZ lands and identifies the general location of these lands within each area.

Area of Project Features Approximately 161 acres of land under Williamson Act contracts and less than 1 acre of FSZ lands are located in the vicinity of Sky Harbour Road and Auberry Road. This total includes land under Williamson Act contracts that would be uses for permanent access roads, the intake structure, construction staging areas, and the relocated transmission line.

The corridor for the new transmission line includes approximately 79 acres of land under Williamson Act contracts and approximately 80 acres of land under FSZ lands. The majority of the Williamson Act contract lands are located along the northern and central portions of the corridor for the new transmission line while FSZ lands are located along the southern portion of that corridor. A portion of the relocated

transmission line corridor is located on Williamson Act lands northeast of the transmission line terminus on Wellbarn Road.

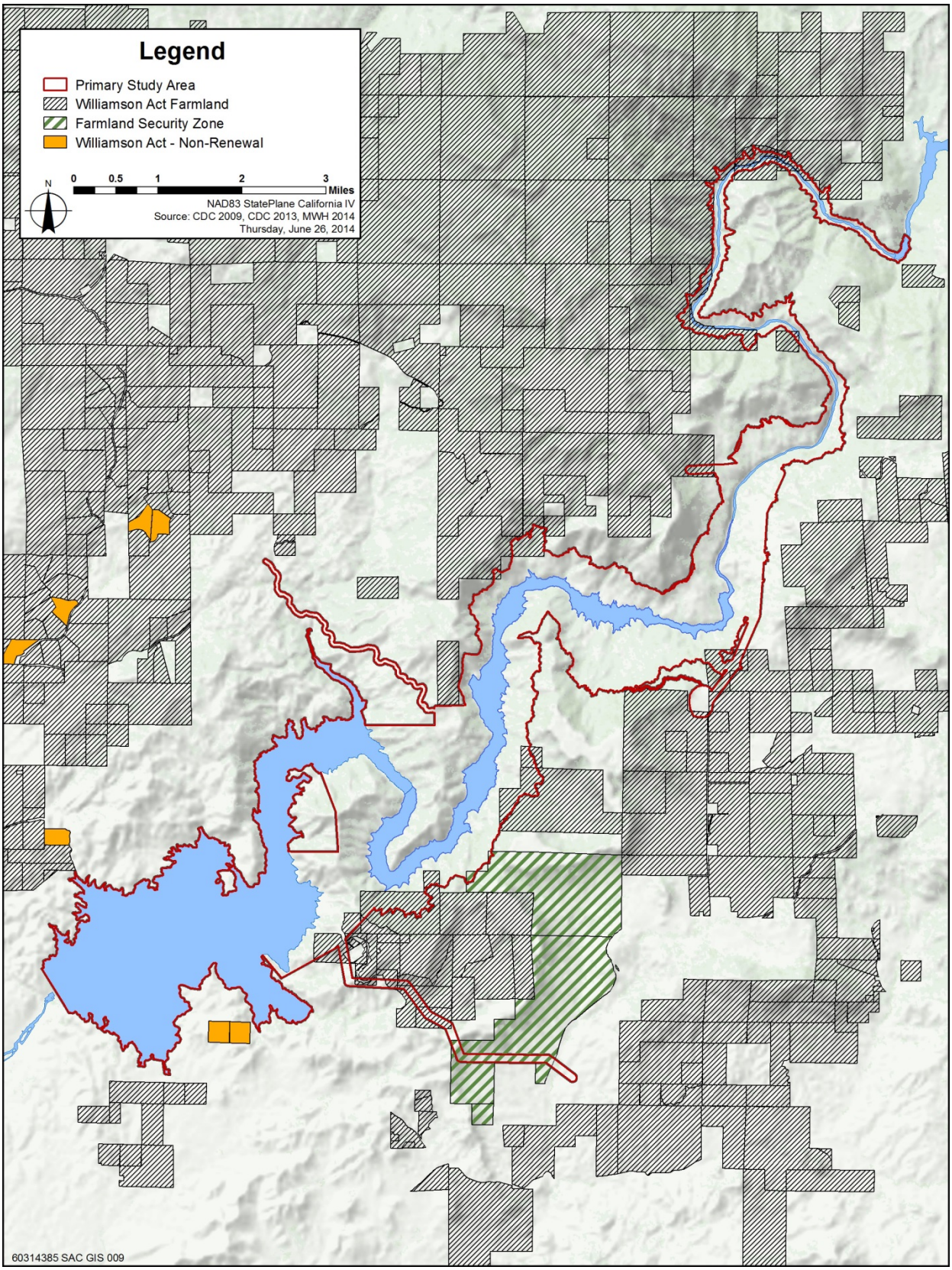


Figure 17-4. Williamson Act Contract Lands in the Primary Study Area

Temperance Flat Reservoir Area There are approximately 616 acres of land under Williamson Act contracts within the Temperance Flat Reservoir Area, with the majority of these lands located southwest of Kerckhoff Lake.

Approximately 10 acres of FSZ lands are located within the southeastern area of the Temperance Flat Reservoir Area.

Millerton Lake Below RM 274 There are no lands under Williamson Act or FSZ lands within Millerton Lake below RM 274.

Forestry Resources

Forests can serve as high-quality habitat for fish and wildlife species, sequester carbon to mitigate climate change impacts, capture vital runoff for agricultural and domestic water supply, and provide a variety of outdoor recreation and education opportunities. Many rural communities depend on income and employment opportunities resulting from working timber industries, or on amenity values that support a tourist industry and attract new residents seeking a better lifestyle. In metropolitan areas, urban forests contribute to improved air quality, cooling of heat islands for energy conservation, and local employment (CAL FIRE 2010).

Forestland is defined as native tree cover greater than 10 percent that allows for management of timber, aesthetics, fish and wildlife, recreation, and other public benefits (California PRC Section 12220[g]). Natural forest and woodland vegetation types in the primary study area typically have greater than 10 percent cover by native trees (Chapter 6, “Biological Resources – Botanical and Wetlands,” displays the distribution of natural forest and woodland vegetation in the primary study area).

Forestland in the primary study area is located within the area of project features and Temperance Flat Reservoir Area; it consists of upland woodland. A detailed description of upland woodland habitat and associated species is provided in Chapter 6, “Biological Resources – Botanical and Wetlands.”

Area of Project Features As shown in Table 17-3, upland woodland habitat occupies approximately 1,519 acres of the area of project features. The upland woodland habitat in this area is characterized by foothill pine oak woodland and blue oak woodland.

Table 17-3. Summary of Upland Woodland Habitat in the Area of Project Features

Dominant Species	Acres[1,2]
Foothill Pine Oak Woodland	1,215
Blue Oak Woodland	298
Live Oak	6
Total	**1,519**

Notes:
[1] Acreage of habitat identified for the area of project features does not include acreage overlapped by the Temperance Flat Reservoir Area.
[2] Acres have been rounded to the nearest whole number.

Temperance Flat Reservoir Area As shown in Table 17-4, upland woodland habitat occupies approximately 4,963 acres of the Temperance Flat Reservoir Area. The upland woodland habitat in this area is characterized by foothill pine oak woodland, blue oak woodland, live oak woodland, foothill pine woodland, and foothill pine chaparral woodland.

Table 17-4. Upland Woodland Habitat in the Temperance Flat Reservoir Area

Dominant Species	Acres[1,2]
Foothill Pine Oak Woodland	3,809
Blue Oak Woodland	1,089
Live Oak Woodland	51
Foothill Pine Woodland	9
Foothill Pine Chaparral Woodland	5
Total	**4,963**

Notes:
[1] Acreage of habitat identified includes the portion of the area of project features overlapped by the Temperance Flat Reservoir Area.
[2] Acres have been rounded to the nearest whole number.

Millerton Lake Below RM 274 There is no forestland mapped within Millerton Lake below RM 274.

Extended Study Area

The extended study area encompasses the San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas that would receive water supplies released from new storage capacity created by the alternatives. Each area could be affected during project operation as a result of enhanced water supply reliability, increased water supplies above those currently available, and changes to instream flows of the San Joaquin River.

San Joaquin River from Friant Dam to Merced River

This section describes land uses and agricultural and forestry resources in the vicinity of the San Joaquin River from Friant Dam to the Merced River. The San Joaquin River from Friant Dam to the Merced River is located in Fresno, Madera, and Merced counties.

The land uses and agricultural and forestry resources are not expected to substantially be directly or indirectly affected because the only changes that occur in this segment would be a change in flows that would be limited to the active stream channel. Therefore, this section briefly discusses land uses and agricultural and forestry resources in the vicinity of the San Joaquin River from Friant Dam to the Merced River.

Land Use The primary land uses along the San Joaquin River from Friant Dam to the Merced River are open space, recreational, and agricultural. Annual crops, vineyards, and orchards account for nearly all agricultural land uses in this area.

Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River from Friant Dam to the Merced River. The river flows adjacent to the City of Fresno and the communities of Friant and Herndon, and passes near the unincorporated communities of Biola and Mendota in Fresno County and the City of Firebaugh in Madera County. Developed recreational areas are located from Friant Dam to SR 99. The San Joaquin River Parkway extends along both banks of the river, and the parkway includes multiple recreation sites and use areas, including Lost Lake Park, Fort Washington Beach, Sycamore Island Ranch, and Camp Pashayan, among others. Although these urban areas and developed recreational areas are located within the vicinity of the San Joaquin River, changes in operations would not increase flood flows that could affect urban or recreational land uses.

South of SR 99 to the Madera County line, land uses in Fresno County are agricultural and open space. Within Madera County, the majority of land uses consist of agricultural and open space. Most of the lands adjacent to the San Joaquin River in Merced County are agricultural and provide important open space and wildlife values to Merced County. Open space is protected by wildlife refuges, wildlife areas, ecological reserves, wildlife management areas, and California state parks.

Most of the land along the San Joaquin River from Friant Dam to the Merced River is privately owned. Publicly owned and managed lands include the U.S. Fish and Wildlife Service's San Luis National Wildlife Area and Grasslands Wildlife Management Area; the CDFW's North Grasslands Wildlife Area; and the California State Parks' San Joaquin River Ecological Reserve, Great Valley Grasslands State Park, and George J. Hatfield SRA. Other publicly owned State and county lands include State Lands Commission public trust and fee title lands and lands managed by the Lower San Joaquin River Levee District and Fresno County Parks.

The San Joaquin River portion of the extended study area from Friant Dam to the confluence with the Merced River is now subject to changed instream flows associated with implementing the Settlement. Restoration Flows could change the duration and seasonality of inundation, or soil saturation, which could potentially affect crop production (SJRRP 2012).

Agricultural Resources Agricultural resources in Fresno and Madera counties, which also include Friant Dam to the Merced River area, are described above the "Primary Study Area" section. Therefore, the following discussion summarizes agricultural resources, including Important Farmland and Williamson Act contract lands, in Merced County.

In 2008, DOC estimated that Merced County had approximately 1,160,833 acres of agricultural land, of which approximately 593,491 acres were identified as Important Farmland and 597,392 acres were identified as Grazing Land. In 2010, Merced County had approximately 1,158,988 acres of agricultural land, of which approximately 596,527 acres were identified as Important Farmland and 562,461 acres were identified as Grazing Land. Overall, the Important Farmland acreage increased by approximately 1 percent between 2008 and 2010 as a result of the addition of irrigated row crops and vineyards on lands previously designated as Grazing Land (DOC 2010c).

In Merced County, approximately 467,679 acres of land were under Williamson Act contracts in 2009 (DOC 2010d). As of 2009, approximately 6,081 acres were in the nonrenewal process. No land under Williamson Act contracts entered the nonrenewal process and no contracts were land terminated by nonrenewal expirations (DOC 2010d). Merced County does not participate in the FSZ program.

As described above, the San Joaquin River from Friant Dam to the Merced River is now subject to changed instream flows associated with implementing the Settlement. Restoration Flows could change the duration and seasonality of inundation, or soil saturation, which could potentially affect crop production (SJRRP 2012).

Forestry Resources Forestland along the San Joaquin River from Friant Dam to the Merced River generally consists of riparian forest that has been classified into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest. There are no commercial forestry management uses present along this portion of the extended study area; therefore, forestry resources are not discussed further in this section.

San Joaquin River from Merced River to the Delta

This section describes land uses and agricultural and forestry resources in the vicinity of the San Joaquin River from the Merced River to the Delta. The San Joaquin River from the Merced River to the Delta is located in Merced, Stanislaus, San Joaquin, Contra Costa, and Sacramento counties.

The land uses and agricultural and forestry resources are not expected to substantially be directly or indirectly affected because the only changes that occur in this segment would be a change in flows that would be limited to the active stream channel. Therefore, this section briefly discusses land uses and agricultural and forestry resources in the vicinity of the San Joaquin River from the Merced River to the Delta.

Land Use The primary land uses along the San Joaquin River from the Merced River to the Delta are open space, recreational, and agricultural. Annual crops, vineyards, and orchards account for nearly all agricultural land uses in this area.

Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River from the Merced River to the Delta. The river flows adjacent to the Cities of Lathrop and Stockton, and passes near the City of Tracy and the unincorporated community of Grayson.

North of the unincorporated community of Grayson in Stanislaus County is the San Joaquin River NWR. The NWR is

7,000 acres in size and managed with a focus on migratory birds and endangered species (USFWS 2012).

Beyond the City of Stockton, there are many islands located along the San Joaquin River. Land uses on these islands include agriculture, recreation, and open space.

Agricultural Resources Agricultural resources in Merced County are described above. Agricultural resources are also found along the San Joaquin River in Stanislaus, San Joaquin, Contra Costa, and Sacramento counties.

Forestry Resources Forestland along the San Joaquin River from the Merced River to the Delta generally consists of riparian forest that has been classified into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest. There are no commercial forestry management uses present along this portion of the extended study area; therefore, forestry resources are not discussed further in this section.

Delta

The Delta falls within Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties. Land use within the Delta includes recreation, agriculture, residential, commercial, wildlife habitat, and public facilities (Delta Protection Commission 2014). The history of the Delta is closely tied to its abundance of rich agricultural lands. Forestlands within the Delta are limited to small areas of riparian forest.

CVP and SWP Water Service Areas

Together, the water service areas of the CVP and SWP cover a large portion of California. Land uses within the CVP and SWP water service areas vary and include residential, commercial, industrial, agriculture, recreational, public facilities, open space, grazing, and timber production.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on land use planning and agricultural resources. It then discusses the potential impacts of the alternatives and proposes mitigation where appropriate. The

potential impacts on land use planning and agricultural resources and associated mitigation measures are summarized in Table 17-5.

Methods and Assumptions

Evaluation of potential impacts on land use planning and agricultural resources was based in part on the following planning documents pertaining to the Study Area:

- *Fresno County General Plan* (Fresno County 2000a, 2000b)
- *Madera County General Plan Policy Document* (Madera County 1995)
- *BLM Bakersfield Proposed Resource Management Plan* (BLM 2012)
- *Millerton Lake Land Resource Management Plan and General Plan* (Reclamation and State Parks 2010).

Information for this analysis was supplemented through review of aerial imagery, field reconnaissance review, and consultation and coordination with appropriate agencies. The Important Farmland maps of DOC and California Land Conservation Act (Williamson Act) maps for Fresno and Madera counties were used to determine the agricultural significance of the lands in the primary and extended study areas. The area and distribution of riparian forests are based on review of aerial photographs, studies by DWR (2002), and GIS data.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, the No Action Alternative or implementing any action alternative. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A “[s]ignificant effect on the environment” means “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project” (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

Table 17-5. Summary of Impacts and Mitigation Measures for Land Use Planning and Agricultural Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
LUP-1: Disruption of Existing Land Uses	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-1: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
LUP-2: Conflict with Adopted Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-2: Conduct Conflict Resolution with Land Managers	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 17-5. Summary of Impacts and Mitigation Measures for Land Use Planning and Agricultural Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	LUP-3: Protect Agricultural Land Productivity	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
LUP-4: Conversion of Forest Land	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	None Available	PSU
		Alternative Plan 2	PS		PSU
		Alternative Plan 3	PS		PSU
		Alternative Plan 4	PS		PSU
		Alternative Plan 5	PS		PSU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact
PS = potentially significant
PSU = potentially significant and unavoidable

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. Based on these criteria, impacts on land use planning and agricultural resources would be significant if implementing an alternative under consideration would do any of the following:

- Physically divide an established community or disrupt existing land uses
- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental impact
- Conflict with any applicable HCP or Natural Community Conservation Plan
- Convert Important Farmland (i.e., Prime Farmland, Unique Farmland, or Farmland of Statewide Importance), as shown on the maps prepared pursuant to the FMMP of the California Resources Agency, to nonagricultural use
- Conflict with existing zoning for agricultural use or a Williamson Act contract
- Conflict with existing zoning for, or cause rezoning of, forestland (as defined in PRC Section 12220[g]), timberland (as defined in PRC Section 4526), or timberland zoned Timberland Production (as defined in PRC Section 51104[g])
- Result in the loss of forestland or conversion of forestland to nonforest use
- Involve other changes in the existing environment that, because of their location or nature, could result in conversion of Important Farmland to nonagricultural use or the substantial diminishment of agricultural land resource quality or importance

Conflicts with applicable land use plans are not necessarily adverse alterations of the physical environment and thus not

necessarily impacts. Therefore, with regard to applicable land use plans, conclusions are “consistent” or “inconsistent” not “less than significant,” “potentially significant,” or “significant.” If the inconsistency relates to a plan, policy, or regulation adopted to avoid environmental impacts, then an inconsistency could result in a significant impact under CEQA.

Topics Eliminated from Further Consideration

The primary study area is not located within an HCP or Natural Community Conservation Plan area; therefore, no impacts related to this threshold would occur under any alternative and no further discussion of this issue is necessary.

Implementing any action alternative would increase the amount of water available for delivery from Millerton Lake. Portions of this water would be conveyed directly to Friant Division contractors or down the San Joaquin River and rediverted or exchanged for delivery to SOD CVP and SWP contractors. The conveyance of these water supplies would not exceed channel capacity of the San Joaquin River or Delta waterways. No change in existing use of adjacent lands would occur. Additional flows within the San Joaquin River and the Delta would not affect land use, agriculture, or forestry resources because increased reliability of existing water supplies would not necessitate changes in land use patterns, nor would the flows be sufficient to support increased production of agricultural or forestry resources. Therefore, none of the action alternatives would impact land use, agriculture, or forestry resources found in the San Joaquin River or Delta when compared to the No Action Alternative. The land use, agriculture, and forestry resources found in these areas are not discussed further in this analysis.

As described in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations,” of this Draft EIS, implementing any action alternative would increase water reliability for the Friant Division and/or SOD CVP and SWP contractors during most water-year types. The delivery of this additional water would not exceed historical maximum deliveries or existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment. Additional deliveries to the CVP and SWP water service areas would not affect land use, agriculture, or forestry resources because the potential increased supplies would not be sufficient to support a change in land use patterns, additional growth or additional agriculture or forestry operations. Therefore, no

action alternative would impact land use, agriculture, and forestry resources found in the CVP or SWP water service areas when compared to the No Action Alternative. The land use, agriculture, and forestry resources found in these areas are not discussed further in this analysis.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any alternative. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact LUP-1: Disruption of Existing Land Uses

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities would be expanded, altered, or demolished. Future development of lands in Fresno and Madera counties would conform to the respective county general plans. Such development is not expected to physically divide communities established in the primary study area. No changes or only minor changes to land use or acreage of agricultural lands would occur. Federal lands being managed in accordance with adopted resource management plans would not be subject to any substantial change from their current use.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction of the proposed Temperance Flat RM 274 Dam, relocation of transmission lines, and construction and operation of project access roads, recreational facilities, the aggregate quarry, and the batch plant would not physically divide an established community; however, the establishment of these facilities could result in short-term and long-term disruptions to existing land uses by interfering with the ability to access or use certain lands within the primary study area.

The proposed Temperance Flat RM 274 Reservoir would extend approximately 18.5 miles from RM 274 upstream to Kerckhoff Dam. Inundation of this 18.5-mile stretch would affect existing San Joaquin River crossings, trails, and roads that would be within the inundation area following reservoir filling.

As previously described and shown in Figure 17-1, land use in and surrounding the primary study area in Fresno County is predominantly designated agricultural and the primary study area in Madera County are predominantly designated as open space. The aggregate quarry, batch plant, and haul road proposed under Option A located within Madera county are on land currently identified by Madera County as public open space. The aggregate quarry, batch plant, and haul road proposed under Options B and C located within Fresno County are on land currently identified by Fresno County as agricultural.

The significance of disruptions to existing land uses was assessed based on the magnitude of the proposed disruption. For example, the change of an industrial use to commercial use within an area of predominantly commercial use would not be a significant impact. However, the change of a residential parcel to industrial use within an area of single-family homes would have a major impact. Implementing any action alternative would permanently change existing land uses, such as recreational land that would be inundated, and would not allow some lands to be used consistent with current planning designations.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact LUP-2: Conflict with Adopted Plans

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities would be expanded, altered, or demolished. No changes or only minor changes to land use or acreage of agricultural lands would occur. Future development of private lands would be consistent with the applicable plans of Fresno and Madera counties. Federal lands being managed in accordance with adopted resource management plans would not be subject to any substantial change from their current use.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementing any action alternative would result in inundation of land along the San Joaquin River between RM 274 and Kerckhoff Dam, as well as relocation of transmission lines, construction and operation of roads,

recreational facilities, the aggregate quarry, and the batch plant. These activities could conflict with adopted land use plans, policies, goals, or ordinances of affected jurisdictions.

As discussed in the Affected Environment section above, much of the land within the primary study area is owned by Federal, State, or tribal agencies. For this reason, land owned by these agencies is subject to the plans, policies, goals, and regulations of each agency/owner.

The action alternatives would affect resources covered by the following adopted land use plans, policies, goals, or ordinances:

- **BLM Bakersfield Proposed Resource Management Plan** – Much of the land at the northern end of the primary study area is administered by BLM. In 2010, BLM determined that 5.4 miles of the San Joaquin River from the Kerckhoff Dam downstream to the Kerckhoff Powerhouse was eligible and suitable for designation as a Federal Wild and Scenic River based on its free-flowing character and outstandingly remarkable values. The proposed RMP would establish a corridor along this portion of the river wherein future actions that would alter the free-flowing nature, diminish the stream's ORVs, or otherwise modify the level of watershed development to a degree that would change the classification would require congressional approval. Implementing any action alternative would result in inconsistency with the proposed RMP, particularly the determination that the San Joaquin River downstream from Kerckhoff Dam is suitable and eligible for wild and scenic river status. The inconsistency between the action alternatives and the BLM RMP involves a conflict of policies to protect the ORVs maintained by the free-flowing San Joaquin River.

- **Millerton Lake Resource Management Plan and General Plan** – Much of the primary study area between Friant Dam and BLM-administered land falls within the Millerton Lake SRA. The BLM's SJRG SRMA RMP/general plan prepared for Millerton Lake states that the agreement between Reclamation and State Parks allows for recreation that is consistent with the primary purpose of the project for water supply (Reclamation and State Parks 2010). Because use of

Reclamation land as part of the Millerton Lake SRA is based on the primary purpose of water supply, use of land within the Millerton Lake SRA for the proposed dam would not be inconsistent with the Millerton Lake RMP/general plan.

- **Big Table Mountain Ecological Reserve** – As shown in Figure 17-2, CDFW owns and manages an area of land in the primary study area known as the Big Table Mountain Reserve. Implementing any action alternative would include direct impacts on this land, including relocation of trails across reserve land. Additionally, trees and vegetation could be removed as part of project construction. Implementing any action alternative would be inconsistent with the ecological reserve.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities would be expanded, altered, or demolished. No changes or only minor changes to land use or acreage of agricultural lands would occur. Future development of private lands is not expected to conflict with established Williamson Act contracts unless the contracts are cancelled by the respective county. The conversion of existing farmlands would not take place unless authorized by the respective county general plan. Federal lands being managed in accordance with adopted resource management plans would not be subject to any substantial change from their current use.

There would be **no impact** under the No Action Alternative.

Action Alternatives As previously discussed in the Affected Environment section, implementing any action alternative would result in inundation of agricultural lands. None of the land within the primary study area is classified as Important Farmland. However, as shown in Figure 17-4, Williamson Act lands and FSZ (also known as Super Williamson Act lands) lands within the primary study area would be inundated or otherwise used for the project.

Approximately 856 acres of land under Williamson Act contracts and approximately 91 acres of FSZ lands are located within the primary study area. Of these amounts, 433 acres of land under Williamson Act contracts and 5 acres within an FSZ would be subject to inundation under any action alternative. The area of project features, excluding the new transmission line corridor, consists of 161 acres of land under Williamson Act contracts. This total includes land under Williamson Act contracts that would be used for permanent access roads, the intake structure, construction staging areas, and the relocated transmission line. Agricultural land within the primary study area would likely be precluded from future agricultural productivity because the land would be inundated or include project features, such as roads, trails, and/or other recreational features.

The new transmission line corridor includes 79 acres of land under Williamson Act contracts and 80 acres within the FSZ. Much of the agricultural lands within the transmission line corridors would be only temporarily affected, with most of the ground-disturbing impacts ending on completion of construction.

This impact would be **potentially significant**. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact LUP-4: Conversion of Forest Land

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities would be expanded, altered, or demolished. No changes or only minor changes to land use or acreage of forestlands would occur. Federal lands being managed in accordance with adopted resource management plans would not be subject to any substantial change from their current use.

There would be **no impact** under the No Action Alternative.

Action Alternatives As discussed above in the Affected Environment section, approximately 5,850 acres of upland woodland are located within the primary study area. PRC Section 12220 defines forestland as land that can support native tree cover under natural conditions and can be managed for one or more forest resources. The upland woodland meets

the criteria in PRC Section 12220 and is therefore considered forestland for purposes of this Draft EIS.

Implementing any action alternative would involve clearing approximately 5,110 acres of forestland within the new reservoir inundation zone and areas to be used for project features, including roads, trails, the quarry, and the batch plant. The conversion of these forestlands would be permanent and constitute a loss in timber production.

This impact would be **potentially significant** under the action alternatives. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 17-5.

No mitigation is required for Impacts LUP-1 through LUP-4 in the extended study area because there would be no impact under any action alternative in the extended study area.

Impact LUP-4 within the primary study area would be potentially significant. No feasible mitigation measures are available at the time of preparation of this Draft EIS to reduce this impact to a less-than-significant level. Therefore, Impact LUP-4 (within the primary study area) would be **potentially significant and unavoidable**.

Impacts LUP-1, LUP-2, and LUP-3 within the primary study area would be significant or potentially significant. The following Mitigation Measures LUP-1, LUP-2, and LUP-3 are required for Impacts LUP-1, LUP-2, and LUP-3, respectively, in the primary study area for all action alternatives. Implementing Mitigation Measures LUP-1, LUP-2, and LUP-3 would reduce these impacts, but not to a less-than-significant level. No additional feasible mitigation measures are available at the time of preparation of this Draft EIS to further reduce these impacts to a less-than-significant impact. Therefore, Impacts LUP-1, LUP-2, and LUP-3 (within the primary study area) would be **potentially significant and unavoidable**.

Mitigation Measure LUP-1: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan

Impacts on existing land uses would be minimized by preparing and implementing a traffic management plan to reduce construction-related traffic impacts on the roadways at or near the work site. The traffic management plan would help ensure connectivity within the Study Area, thereby minimizing impacts on the existing community. As described in Chapter 22, Recreational facilities that would be closed because of project construction would be relocated and reopened following the conclusion of construction activities.

Implementing Mitigation Measure LUP-1 would reduce Impact LUP-1, but not to a less-than-significant level. No additional feasible mitigation measures are available at the time of preparation of this Draft EIS to further reduce this impact to a less-than-significant level. Therefore, Impact LUP-1 (within the primary study area) would be **potentially significant and unavoidable**.

Mitigation Measure LUP-2: Conduct Conflict Resolution with Land Managers

To minimize or avoid conflict with adopted land use plans, goals, policies, and ordinances of affected jurisdictions, Reclamation will consult with BLM and CDFW, and enter into agreements, as appropriate, to resolve potential conflicts with the BLM Bakersfield Proposed Resource Management Plan and the Big Table Mountain Ecological Reserve, respectively.

Implementing Mitigation Measure LUP-2 would reduce Impact LUP-2, but not to a less-than-significant level. No additional feasible mitigation measures are available at the time of preparation of this Draft EIS to further reduce this impact to a less-than-significant level. Therefore, Impact LUP-2 (within the primary study area) would be **potentially significant and unavoidable**.

Mitigation Measure LUP-3: Protect Agricultural Land Productivity

To reduce impacts on land under a Williamson Act contract or within an FSZ, Reclamation will minimize development on such lands under a Williamson Act contract or within an FSZ. Reclamation will coordinate with landowners and agricultural operators to sustain existing agricultural operations, at the landowners' discretion, until the individual agricultural parcels are needed for project purposes.

Implementing Mitigation Measure LUP-3 would reduce Impact LUP-3, but not to a less-than-significant level. No additional feasible mitigation measures are available at the time of preparation of this Draft EIS to further reduce this impact to a less-than-significant level. Therefore, Impact LUP-3 (within the primary study area) would be **potentially significant and unavoidable**.

Chapter 18
Noise and Vibration

This chapter describes the affected environment for noise and vibration, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion of noise focuses on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas). Noise and vibration fundamentals are presented in the Physical Resources Appendix.

Affected Environment

This section describes the affected environment related to noise and vibration.

Noise Descriptors

The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of the noise. The noise descriptors most often encountered when dealing with traffic, community, and environmental noise are defined below (Caltrans 2009):

- **L_{max} (maximum noise level)** – The maximum noise level during a specific period of time. The L_{max} may also be referred to as the "highest (noise) level."

- **L_{min} (minimum noise level)** – The minimum noise level during a specific period of time.

- **L_X (statistical descriptor)** – The noise level exceeded X percent of a specific period of time.

- **L_{eq} (equivalent noise level)** – The energy mean (average) noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated,

which is then converted back to dBA to determine the L_{eq}.

- **L_{dn} (day-night noise level)** – The 24-hour L_{eq} with a 10-dBA "penalty" for the noise-sensitive hours between 10 p.m. and 7 a.m. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.

- **CNEL (community noise equivalent level)** – A noise level similar to the L_{dn} described above, but with an additional 5-dBA "penalty" for the noise-sensitive hours between 7 p.m. and 10 p.m., which are typically reserved for relaxation, conversation, reading, and television. If the same 24-hour noise data are used, the CNEL is typically approximately 0.5 dBA higher than the L_{dn}.

- **SEL (single-event (impulsive) noise level)** – A receiver's cumulative noise exposure from a single impulsive-noise event, which is defined as an acoustical event of short duration and which involves a change in sound pressure above some reference value.

Existing Noise Sources and Levels

The primary study area largely consists of vacant property. The existing ambient noise environment in the immediate vicinity is consistent with that of typical rural areas and is defined primarily by human (e.g., people walking and talking, yard maintenance equipment, dogs barking) and natural sounds, (e.g., wind, birds), but is also affected by local roadway traffic and boats in Millerton Lake. To describe ambient noise levels in the primary study area, seven short-term and two long-term (24-hour) ambient noise measurements were conducted throughout the primary study area. Sound level measurement locations are shown on Figure 18-1. Table 18-1 summarizes the seven short-term measurements. Table 18-2 summarizes the two 24-hour, long-term measurements. Figure 18-2 and Figure 18-3 depict how noise levels change over the 24-hour period that the long-term measurements were collected.

Table 18-1. Summary of Short-Term Existing Ambient Noise Level Measurements

Location[1]	Date/Start Time	Duration (minutes)	Noise Source(s)	Noise Level, decibels, A-weighted (dBA)		
				L_{min}	L_{eq}	L_{max}
Site ST1	August 8, 2013/ 1:50 PM	15	Occasional car drive-by, boat noise from lake, natural sources such as birds, leaves in the wind, and yard maintenance noise.	36.0	47.7	78.4
Site ST2	August 8, 2013/ 12:45 PM	20	Occasional car drive-by, boat noise from lake, natural sources such as birds, leaves in the wind, and yard maintenance noise.	31.4	58.5	86.4
Site ST3	August 8, 2013/ 11:40 AM	20	Occasional car drive-by, boat noise from lake, natural sources such as birds, leaves in the wind, and yard maintenance noise.	30.2	41.3	57.4
Site ST4	August 9, 2013/ 10:15 AM	15	Humming/vibration from powerhouse was audible. Primary noise was natural noise such as river water movement, wind, birds	42.2	45	56
Site ST5	August 9, 2013/ 10:45 AM	10	20 feet from switching station. Powerhouse was running. Noise was similar to HVAC units.	73.5	74.3	75.7
Site ST6	August 9, 2013/ 11:05 PM	15	Close to river bank. Powerhouse was not audible. Primary noise sources included flowing river water, wind, birds.	50.2	51.4	56
Site ST7	August 9, 2013/ 12:10 PM	15	Occasional car drive-by, boat noise from lake, natural sources such as birds, leaves in the wind, and yard maintenance noise.	34.7	49	74.7

Notes:
[1] Site numbers correspond to locations shown in Figure 18-1.

Key:
dBA = A-weighted decibels
L_{eq} = energy-equivalent noise level
L_{max} = maximum noise level
L_{min} = minimum noise level

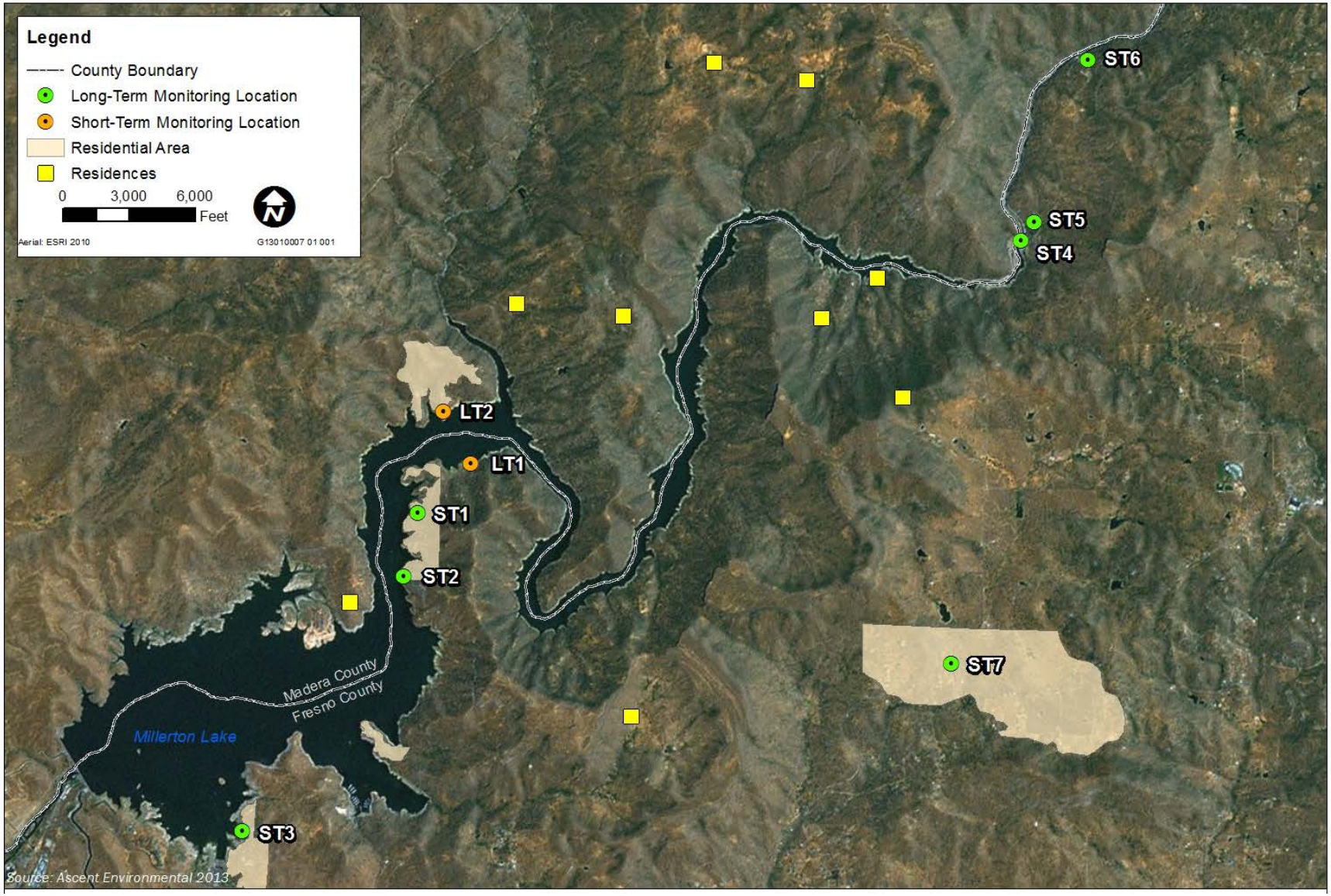


Figure 18-1. Noise Measurement Locations and Noise-Sensitive Receptor Locations

Table 18-2. Summary of Long-Term Existing Ambient Noise Level Measurements

Location[1]	Start Time (date/time)	Notes/Noise Source(s)	Noise Level (dBA)				
			CNEL/	Daytime		Nighttime	
			L_{dn}	L_{min}	L_{max}	L_{min}	L_{max}
Site LT1[2]	August 8, 2013/5:00 PM	Located in the Hidden Lake Estate residential neighborhood in Madera County. Noise sources included birds, leaves in the wind, yard maintenance equipment, the occasional car on residential streets, and boat noise during the day.	47.4/ 46.0	33.3	78.9	34.3	48.2
Site LT2[2]	August 9, 2013/ 6:00 PM	Located on the Fresno County side of Millerton Lake near the proposed dam construction site. Noise sources included birds, leaves in the wind, and people walking, swimming and talking. Boat noise was audible during the day.	46.0/ 45.9	17.9	70.3	30.1	53.0

Notes:

[1] Site numbers correspond to locations shown in Figure 18-1.

[2] Figures 18-3 and 18-4 depict how noise levels changed over the 24-hour period Long-Term Measurements 1 and 2, respectively.

Key:
CNEL = community noise equivalent level
dBA = A-weighted decibels
L_{dn} = day-night noise level
L_{max} = maximum noise level
L_{min} = minimum noise level

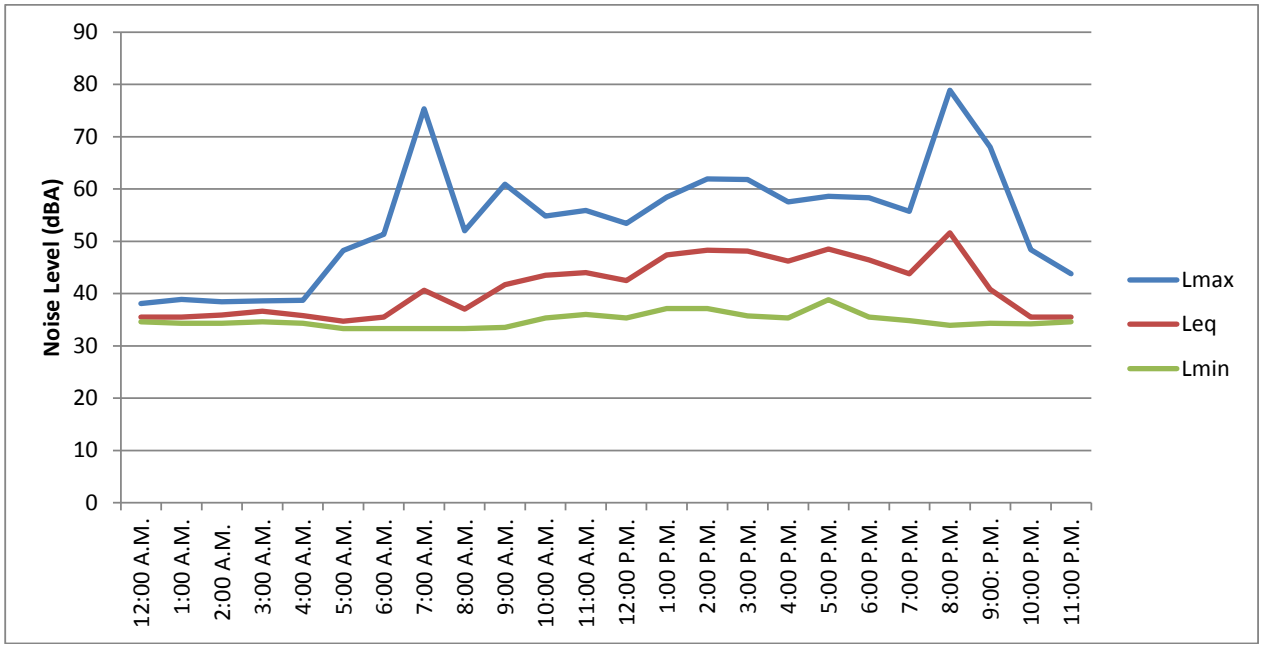


Figure 18-2. Hourly Summary of Long-Term Measurement 1

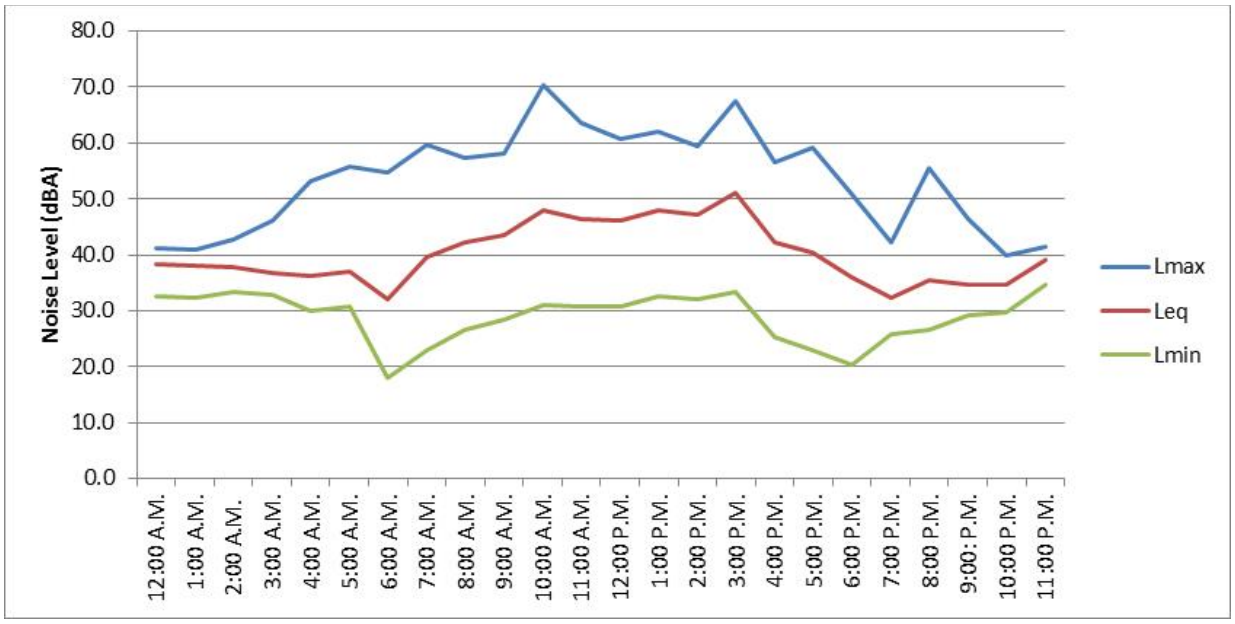


Figure 18-3. Hourly Summary of Long-Term Measurement 2

Existing Noise-Sensitive Land Uses

Noise-sensitive land uses generally include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Schools, historic sites, cemeteries, and recreation areas are also generally considered sensitive to increases in exterior noise levels. Places of worship, and other similar places where low interior noise levels are of great importance, are also considered noise sensitive. Noise-sensitive land uses are also considered to be sensitive to ground vibration, which can result in human annoyance. Commercial and industrial buildings where ground vibration (including vibration levels that may be well below those associated with human annoyance) could interfere with operations within the building would be most sensitive to ground vibration.

Land uses in the vicinity of the primary study area are shown and described in Chapter 17, “Land Use Planning and Agricultural Resources.” These include residences scattered around Millerton Lake and the community of Friant, to the southwest. Residences in Fresno County closest to the area of project features include homes on portions of Sky Harbour Road (and adjacent streets) north of Table Mountain

Rancheria, houses along Sky Harbour Drive (a separate street from Sky Harbour Road), and rural residences near the northern portion of Wellbarn Road.

Residences in Madera County include a house on Dumna Island, homes at Hidden Lake Estates, a house on Ralston Way, and a house located north of the proposed aggregate quarry.

Schools in the area include Auberry School on Wellbarn Road, New Life Christian Academy on Auberry Road, and Foothill Elementary School on Auberry Road – all in Fresno County; and Minarets High School on North Fork Road and Spring Valley Elementary School, located near the junction of Highway 41 and North Fork Road (County Road 200) – both in Madera County.

Extended Study Area

Noise sources within the extended study area range from those typically discussed above for the primary study area, to state and interstate highways, aircrafts, and construction activity. Sensitive receptors in the extended study area would not be affected by noise generated by the action alternatives. Due to the local nature of noise impacts, no noise-related effects are anticipated in the extended study area under the action alternatives. Therefore, the extended study area is not discussed further in this chapter.

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences to the noise environment that could result from implementing any alternative. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on noise-sensitive receptors. It then discusses the potential impacts and proposes mitigation where appropriate. The potential noise impacts and associated mitigation measures are summarized in Table 18-3.

Table 18-3. Summary of Impacts and Mitigation Measures for Noise and Vibration

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	NOI-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
NOI-2: Construction-Generated Ground Vibration	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	NOI-3: Install Sound Barriers along County Road 211 and County Road 210, and Restrict Truck Hauling on Public Roads to the Less-Sensitive Daytime Hours	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 18-3. Summary of Impacts and Mitigation Measures for Noise and Vibration (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
NOI-4: Long-Term Operational Stationary- and Area-Source Noise	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
NOI-5: Long-Term Increases in Traffic Noise	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	NOI-5: Implement Measures to Reduce Exposure to Operational Traffic Noise along Wellbarn Road and Smalley Road	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact
LTS = less than significant
S = significant
SU = significant and unavoidable

Methods and Assumptions

Construction Noise

To assess potential short-term construction noise impacts, sensitive receptors and their relative exposure were identified. Noise levels of specific construction activities were determined and resultant noise levels at those receptors were calculated based on their distance from the noise source, the type of land surface between the noise source and receptor (e.g., vegetated land, water), and the presences of any intervening topography that would effectively act as a noise barrier by blocking the line of sight between the noise source and receptor.

Ground Vibration

Ground vibration impacts were assessed based on existing documentation (e.g., vibration levels produced by specific construction equipment or activities) and the distance to buildings or structures from the given vibration source. Attenuated ground vibration levels at receptors were calculated using formulas and methodologies established by the Federal Transit Administration (FTA) (2006).

Potential long-term operational area-source and stationary-source noise impacts were assessed quantitatively using reference noise levels and attenuation calculations to compare levels of noise exposure at sensitive receptors to applicable noise standards established by Fresno and Madera counties. In addition, the potential for new or relocated transmission lines to produce corona noise that would adversely affect nearby receptors was assessed qualitatively.

Traffic Noise

The Federal Highway Association Traffic Noise Model (FHWA 2006) was used to model traffic noise levels along roadways that would be affected by construction-related worker and truck trips and/or increased operational traffic volumes. Long-term operational increases in visitation would increase because of both improved conditions at Millerton Lake and new recreational opportunities at the new Temperance Flat RM 274 Reservoir. Trip distribution estimates were based on data presented in Chapter 24, “Transportation, Circulation, and Infrastructure.” The project’s contribution to baseline traffic noise levels along area roadways was determined by comparing predicted noise levels at 50 feet from the roadway edge with and without project-generated traffic. Predicted traffic noise levels at particular sensitive receptors were calculated assuming a noise reduction of 3.0 dBA per doubling of distance (dBA/DD) from the roadway. As with the traffic

analysis presented in Chapter 24, because the number of truck trips under each action alternative is approximate, for a conservative analysis, construction trips associated with Alternative Plan 4 were used in this analysis to represent all five action alternatives.

Additional analysis is provided to address SELs from truck passbys on public roads during project construction. This analysis identifies an applicable threshold based on relevant court rulings and measured reference SELs from truck passbys.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, other Federal, State, and local guidance, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on noise would be significant if project implementation would do any of the following:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels.
- Permanently increase ambient noise levels in the project vicinity substantially above levels existing without the project.

- Temporarily or periodically increase ambient noise levels in the project vicinity substantially above levels existing without the project.

- Expose people residing or working in the project area to excessive aircraft-generated noise levels.

For noise-sensitive receptors located in Fresno County, attenuated noise levels were compared to Fresno County's exterior noise level standards of 50 dBA L_{50} (the noise level exceeded 50 percent of a specific period of time) during daytime hours (7 a.m. – 10 p.m.) and 45 dBA L_{50} during nighttime hours (10 p.m. – 7 a.m.), as shown in Table 18-3. However, construction noise generated between the hours of 6:00 AM to 9:00 PM on weekdays or 7:00 AM to 5:00 PM on Saturdays and Sundays is exempt from these standards.

For noise-sensitive receptors located in Madera County, attenuated noise levels were compared to Madera County's maximum allowable hourly L_{eq} standards for non-transportation noise sources of 50 dBA during daytime hours (7 a.m. – 10 p.m.) and 45 dBA during nighttime hours (10 p.m. – 7 a.m.), as shown in Table 18-7. However, based on the general noise regulations in the Section 9.58.020 of the Madera County Noise Ordinance, as described in the regulatory setting above, it is understood that construction noise generated between the hours of 7:00 AM to 7:00 PM on weekdays or 9:00 AM to 5:00 PM on Saturdays is exempt from these standards.

Ground vibration generated by construction activities would be significant if it would expose residential structures or other buildings used by people to ground vibration levels that exceed FTA's maximum acceptable vibration standard of 80 VdB for residential uses (e.g., annoyance, sleep disturbance) (FTA 2006) and/or the perception threshold of 0.1 inches/second peak particle velocity (PPV) established by Madera County General Plan Policy 7.A.9 (Madera County 1995). Because Fresno County does not specify a ground vibration threshold for evaluating the potential of human disturbance, the perception threshold of 0.1 inches/second PPV is used to evaluate the potential for human disturbance at locations in both Madera County and Fresno County. Ground vibration generated by construction activities would also be significant if it would exceed the Caltrans-recommended standard of 0.2 inches/second PPV with respect to the prevention of damage to older residential structures (Caltrans 2004).

For the analysis of both short-term construction-related traffic noise and long-term operational traffic noise resulting from increased recreational use, separate thresholds of significance were applied based on whether the nearest affected noise-sensitive receptor is located in Fresno County or Madera County. Based on the criteria outlined in Policy HS-G.7 of the Fresno General Plan, project-related traffic noise in Fresno County would be significant if it would result in a 5 dBA L_{dn} increase where existing noise levels are less than 60 dBA L_{dn}, a 3 dBA L_{dn} increase where existing noise levels are between 60 and 65 dBA L_{dn}, or a 1.5 dBA L_{dn} increase where existing noise levels are greater than 65 dBA L_{dn} at outdoor activity areas of noise-sensitive uses. Based on Policy 7.A.2 of the Madera County General Plan, traffic noise at noise-sensitive receptors in Madera County would be significant if levels exceed 60 dBA L_{dn} within the outdoor activity areas of existing or planned noise-sensitive-receptors. Because Madera County does not have a stated policy about traffic noise increases, the incremental increase standards of Fresno County are also used to determine the significance of traffic noise increases at noise-sensitive receptors located in Madera County.

In addition, a threshold of 65 dBA SEL is applied to determine whether truck passbys associated with material and equipment hauling on public roadways could result in sleep disturbance at residential dwellings.

The Federal, State, regional, and local policies that support the criteria discussed above are described below.

Federal

To address the human response to groundborne vibration, the FTA of the U.S. Department of Transportation has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses. These criteria include a velocity standard of 65 vibration decibels (VdB) root mean squared (RMS) for land uses where low ambient vibration is essential for interior operations (e.g., hospitals, high-tech manufacturing, and laboratory facilities), 80 VdB for residential uses and buildings where people normally sleep, and 83 VdB for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, and offices) (FTA 2006).

Standards have also been established to address the potential for groundborne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bio Acoustics, and Bio Mechanics at the request of

the EPA (FTA 2006). For fragile structures, the Committee of Hearing, Bio Acoustics, and Bio Mechanics recommends a maximum limit of 0.25 in/sec PPV(0.05 meters per second) (National Academy of Sciences 1977).

State

Governor's Office of Planning and Research The Governor's Office of Planning and Research published the *State of California General Plan Guidelines* (OPR 2003), which provides guidance for the acceptability of projects within specific L_{dn} contours. Table 18-4 summarizes acceptable and unacceptable community noise exposure limits for various land use categories.

Table 18-4. State Noise-Compatibility Guidelines by Land-Use Category

Land-Use Category	Community Noise Exposure (CNEL/L_{dn}, dBA)			
	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Residential – Low-Density Single-Family, Duplexes, Mobile Homes	< 60	55–70	70–75	75+
Residential – Multifamily	< 65	60–70	70–75	75+
Transient Lodging – Motels, Hotels	< 65	60–70	70–80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	< 70	60–70	70–80	80+
Auditoriums, Concert Halls, Amphitheaters	NA	< 70	65+	NA
Sports Arenas, Outdoor Spectator Sports	NA	< 75	70+	NA
Playgrounds, Neighborhood Parks	< 70	NA	68–75	72.5+

Table 18-4. State Noise-Compatibility Guidelines by Land-Use Category (contd.)

Land-Use Category	Community Noise Exposure (CNEL/L_{dn}, dBA)			
	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Golf Courses, Riding Stables, Water Recreation, Cemeteries	< 75	NA	70–80	80+
Office Buildings, Businesses, Commercial and Professional	< 70	68–78	75+	NA
Industrial, Manufacturing, Utilities, Agriculture	< 75	70–80	75+	NA

Source: OPR 2003

Notes:

[1] Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special noise-insulation requirements.

[2] New construction or development should be undertaken only after a detailed analysis of the noise-reduction requirements is made and needed noise-insulation features are included in the design. Conventional construction, but with closed windows and fresh-air supply systems or air conditioning, will normally suffice.

[3] New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise-reduction requirements must be made and needed noise-insulation features included in the design. Outdoor areas must be shielded.

[4] New construction or development should generally not be undertaken.

Key:
CNEL = community noise equivalent level
dBA = A-weighted decibels
L_{dn} = day-night noise level
NA = not applicable

Generally, residential uses (e.g., mobile homes) are considered to be acceptable in areas where exterior noise levels do not exceed 60 A-weighted decibels (dBA) L_{dn}, (where, as described in the Physical Resources Appendix, the dBA scale discriminates against frequencies in a manner approximating the sensitivity of the human ear when a source is at 50 dBA). Residential uses are normally unacceptable in areas exceeding 70 dBA L_{dn} and conditionally acceptable within 55–70 dBA L_{dn}. Schools are normally acceptable in areas up to 70 dBA L_{dn} and normally unacceptable in areas exceeding 70 dBA L_{dn}. Commercial uses are normally acceptable in areas up to 70 dBA CNEL. Between 67.5 and 77.5 dBA L_{dn}, commercial uses are conditionally acceptable, depending on the noise insulation features and the noise reduction requirements. With respect to water recreation uses, exterior noise levels that do not exceed

75 dBA CNEL/L_{dn} are considered normally acceptable, levels between 70 and 80 dBA CNEL/L_{dn} are normally unacceptable, and levels that exceed 80 dBA CNEL/L_{dn} are clearly unacceptable. The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards that reflect the noise-control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise issues.

California Department of Transportation For the protection of fragile, historic, and residential structures, Caltrans recommends a threshold of 0.2 in/sec PPV for normal residential buildings and 0.08 in/sec PPV for old or historically significant structures (Caltrans 2002). These standards are more stringent than the Federal standard established by Committee of Hearing, Bio Acoustics, and Bio Mechanics, presented above.

California Department of Boating and Waterways– Engine Noise Standards Section 654.06 of the Harbors and Navigation Code, which is part of California Boating Law, requires that all motorized recreational vessels sold in California shall not have noise levels at a distance of 50 feet that exceed 86 dBA if manufactured before 1974, 84 dBA if manufactured before 1976, or 82 dBA if manufactured before 1978 (California Department of Boating and Waterways 2012).

Regional and Local

Fresno County General Plan The Fresno County General Plan Health and Safety Element established acceptable noise level limits for both transportation and non-transportation noise sources (Fresno County 2014). The following noise-related policies are applicable to the proposed action:

- **Policy HS-G.2. Acceptable Roadway Noise Levels** – The County shall require new roadway improvement projects to achieve and maintain the normally acceptable noise levels shown in Chart HS-1 [shown in Figure 18-4 of this document].

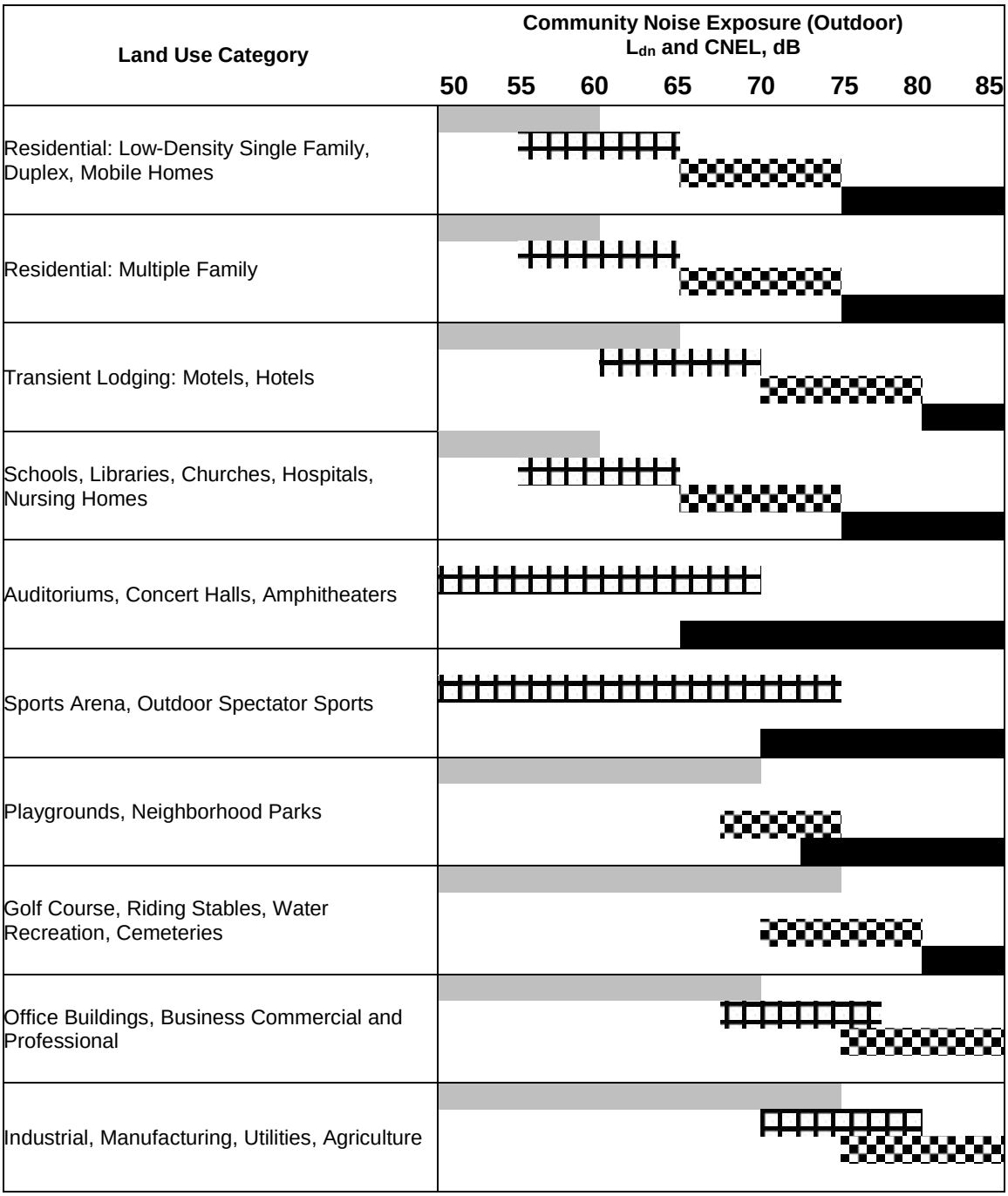
- **Policy HS-G.4. Noise Mitigation Design and Acoustical Analysis** – So that noise mitigation may be considered in the design of new projects, the County shall require an acoustical analysis as part of the environmental review process where:

a. Noise-sensitive land uses are proposed in areas exposed to existing or projected noise levels that are "generally unacceptable" or higher according to the Chart HS-1 [shown in Figure 18-4 of this document];

b. Proposed projects are likely to produce noise levels exceeding the levels shown in the County's Noise Control Ordinance at existing or planned noise-sensitive uses.

- **Policy HS-G.5. Noise Mitigation Measures** – Where noise mitigation measures are required to achieve acceptable levels according to land use compatibility or the Noise Control Ordinance, the County shall place emphasis of such measures upon site planning and project design. These measures may include, but are not limited to, building orientation, setbacks, earthen berms, and building construction practices. The County shall consider the use of noise barriers, such as sound walls, as a means of achieving the noise standards after other design-related noise mitigation measures have been evaluated or integrated into the project.

- **Policy HS-G.6. Construction-Related Noise** – The County shall regulate construction-related noise to reduce impacts on adjacent uses in accordance with the County's Noise Control Ordinance.



	NORMALLY ACCEPTABLE	Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
	CONDITIONALLY ACCEPTABLE	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirement is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.
	GENERALLY UNACCEPTABLE	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noised insulation features included in the design.
	LAND USE DISCOURAGED	New construction or development should generally not be undertaken.

Figure 18-4. Land Use Compatibility for Community Noise Environments, Fresno County

- **Policy HS-G.7. Noise Impacts to Sensitive Land Uses** – Where existing noise-sensitive uses may be exposed to increased noise levels due to roadway improvement projects, the County shall apply the following criteria to determine the significance of the impact:

  - Where existing noise levels are less than 60 dBA L_{dn} at outdoor activity areas of noise-sensitive uses, a 5 dBA L_{dn} increase in noise levels will be considered significant.

  - Where existing noise levels are between 60 and 65 dBA L_{dn} at outdoor activity areas of noise-sensitive uses, a 3 dBA L_{dn} increase in noise levels will be considered significant; and

  - Where existing noise levels are greater than 65 dBA L_{dn} at outdoor activity areas of noise-sensitive uses, a 1.5 dBA L_{dn} increase in noise levels will be considered significant.

- **Policy HS-G.8. Noise Level Compatibility** – The County shall evaluate the compatibility of proposed projects with existing and future noise levels through a comparison to Chart HS-1 [shown in Figure 18-4 of this document].

Fresno County Noise Ordinance The Fresno County Noise Ordinance (Chapter 8.40 of the Fresno County Ordinance Code) is applied to noise sources that can be regulated by local government, such as equipment related to commercial and industrial land uses. The Noise Ordinance does not apply to transportation noise sources such as traffic on public roads, rail operations, and aircraft in flight. Table 18-5 summarizes the Noise Ordinance Standards.

The Fresno County Noise Ordinance also states that it is unlawful for any person, at any location within the unincorporated area of the county to operate or cause to be operated within a dwelling unit, any source of sound or to allow the creation of any noise which causes the noise level when measured inside a receiving dwelling unit situated in either the incorporated or unincorporated are to exceed the noise level standards as set forth in Table 18-6.

Table 18-5. Exterior Noise Level Standards for Non-Transportation Noise Sources, dBA, Fresno County Noise Ordinance

Category	Cumulative Number of Minutes in Any One-Hour Time Period (L_X)	Daytime (7AM – 10PM)	Nighttime (10PM – 7AM)
1	30 (L_{50})	50	45
2	15 (L_{25})	55	50
3	5 ($L_{8.3}$)	60	55
4	1 ($L_{1.7}$)	65	60
5	0 (L_{max})	70	65

Source: Fresno County Ordinance Code 8.40.040

Notes:

In the event the measured ambient noise level exceeds the applicable noise level standard in any category above, the applicable standard shall be adjusted so as to equal the ambient noise level.

Each of the noise level standards specified above shall be reduced by five dBA for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises.

If the intruding noise source is continuous and cannot reasonably be discontinued or stopped for a time period whereby the ambient noise level can be measured, the noise level measured while the source is in operation shall be compared directly to the noise level standards.

Key:

dBA = A-weighted decibel

L_{max} = maximum noise level

L_X = the noise level exceeded X percent of a specific period of time

Table 18-6. Interior Noise Level Standards for Non-Transportation Noise Sources, dBA, Fresno County Noise Ordinance

Category	Cumulative Number of Minutes in Any One-Hour Time Period (L_X)	Daytime (7AM – 10PM)	Nighttime (10PM – 7AM)
1	5 ($L_{8.3}$)	45	35
2	1 ($L_{1.7}$)	50	40
3	0 (L_{max})	55	45

Source: Fresno County Ordinance Code 8.40.050

Notes:

In the event the measured ambient noise level exceeds the applicable noise level standard in any category above, the applicable standard shall be adjusted so as to equal the ambient noise level.

Each of the noise level standards specified above shall be reduced by five dBA for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises.

If the intruding noise source is continuous and cannot reasonably be discontinued or stopped for a time period whereby the ambient noise level can be measured, the noise level measured while the source is in operation shall be compared directly to the noise level standards.

Key:

dBA = A-weighted decibel

L_{max} = maximum noise level

L_X = the noise level exceeded X percent of a specific period of time

Section 8.40.060 of the Fresno County Ordinance Code exempts certain noise-generating activities from the standards listed in Table 18-5 and Table 18-6, including construction activity that takes place during the daytime hours from 6:00 AM to 9:00 PM on weekdays or between the hours of 7:00 AM and 5:00 PM on Saturday and Sunday.

Madera County General Plan Noise Element The Madera County General Plan Noise Element establishes acceptable noise level limits for both transportation and non-transportation noise sources (Madera County 1995). The following policies are relevant to the proposed action:

- **Policy 7.A.2** – Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so as not to exceed 60 dBA L_{dn} within the outdoor activity areas of existing or planned noise-sensitive land uses and 45 dBA L_{dn} in interior spaces of existing or planned noise-sensitive land uses.

- **Policy 7.A.5** – Noise which will be created by new non-transportation noise sources, or existing non-transportation noise sources which undergo modifications that may increase noise levels, shall be mitigated so as not to exceed the noise level standards of Table 7.A.4 [reproduced as Table 18-7 below] on lands designated for noise-sensitive uses. This policy does not apply to noise levels associated with agricultural operations.

Table 18-7. Maximum Allowable Noise Exposure for Non-Transportation Noise Sources in Madera County

Noise Level[1]	Daytime 7AM – 10PM	Nighttime 10PM – 7AM
Hourly L_{eq}, dB	50	45
Maximum level (L_{max}), dB	70	65

Source: Madera County General Plan 1995.

Note:
[1] As determined at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards may be applied on the receptor side of noise barriers at the property line. Each of the noise levels specified above shall be lowered by 5 dBA for pure tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).

Key:
dBA= A-weighted decibel
L_{eq} = the average noise level during a specified time period

Madera County General Plan Noise Element - Vibration Standards The Madera County General Plan also contains the following policies regarding exposure to ground vibration (Madera County 1995):

- **Policy 7.A.9 –** Vibration perception threshold: The minimum ground or structure-borne vibrational motion necessary to cause a normal person to be aware of the vibration by such direction means as, but not limited to, sensation by touch or visual observation of moving objects. The perception threshold shall be presumed to be a motion velocity of one-tenth (0.1) inches per second over the range of one to one hundred Hz. (Resolution No. 2010-043)

- **Policy 7.A.10 –** Projects should not be permitted if they result in the] operation or permitting the operation of any device that creates a vibration which is above the vibration perception threshold of an individual at the location where the sensitivity exists such as the property line of a residential development or from the location of residence constructed on agricultural property. (Resolution No. 2010-043)

Madera County Noise Ordinance Section 9.58.020 of the Madera County Code contains general noise regulations for noise sources located within Madera County. This section contains general regulations geared towards residences, schools, generation of motor vehicles, and car horns, but does not contain numeric noise level standards for use in evaluating the compatibility of new projects with its surroundings. Section 9.58.020.G in the general noise regulations states that construction activities are limited to the hours between 7:00 AM and 7:00 PM Monday through Friday and between 9:00 AM to 5:00 PM on Saturdays and construction activities are prohibited on Sundays.

California State Parks Superintendent's Posted Order No. 378-001-12 for the Millerton Lake State Recreation Area The Millerton Lake SRA is managed by State Parks. Day use activities, including the operation of motorized watercraft, is limited to the hours between 6:00 AM and 10:00 PM April 1st through September 30th, 6:00 AM and 7:00 PM October 1st through October 31st, 6:00 AM and 6:00 PM November 1st through February 29th, 6:00 AM and 7:00 PM March 1st through March 31st (State Parks 2012).

Park rangers also enforce boating rules on the lake including those required by California Boating Law, discussed above.

Topics Eliminated from Further Consideration

None of the action alternatives would expose people residing or working in the primary study area to excessive aircraft-generated noise levels because of the distance of existing airports to the primary study area. In addition, none of the action alternatives would place new sensitive receptors near any aircraft-related facilities. There would also be no change in railway traffic as a result of any action alternative. Therefore, potential effects on the primary study area related to these issues are not discussed further in this Draft EIS.

While many materials used during project construction under the action alternatives may be hauled to the city of Fresno by rail, these rail trips would occur on existing rail lines and would not be expected to result in substantial changes to rail noise levels. Therefore, potential effects on the primary and extended study areas related to these issues are not discussed further in this Draft EIS.

Due to the local nature of noise impacts, no noise-related effects are anticipated in the extended study area under the action alternatives, other than in the area from Fresno to the primary study area. Therefore, the effects of noise-related effects between Fresno and the primary study area are described together with the primary study area impacts, and the extended study area is not discussed further in this chapter.

Direct and Indirect Effects

Impact NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction

Primary Study Area

No Action Alternative No project-related construction activities would occur under the No Action Alternative. Therefore, sensitive receptors would not be exposed to noise generated by facility construction.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction noise levels in the primary study area would fluctuate depending on the particular type, number, and duration of usage for the varying equipment. The effects of construction noise largely depend on the type of construction activities occurring on any given day; noise levels

generated by those activities; distances to noise-sensitive receptors; potential noise-attenuating features such as topography, vegetation, and existing structures; and the existing ambient noise environment in the receptor's vicinity. Construction activities would occur in several discrete stages, each phase requiring a specific complement of equipment with varying equipment type, quantity, and intensity. These variations in operational characteristics of equipment change the effect they have on the noise environment of the area of project features and in the surrounding area for the duration of the construction process.

Construction activities would be concentrated at particular locations, depending on the phase, including the dam site and associated staging area, temporary coffer dams, the aggregate quarry, the batch plant between the dam site and aggregate quarry, the existing powerhouses, the powerhouse, the intake structure, the batch plant between the powerhouse and intake structure, the tunnels, the corridors of new or relocated transmission lines, as well as the construction of temporary haul roads and permanent access roads (see Chapter 2, "Alternatives"). Reference noise levels associated with the construction of these facilities are provided in Table 18-8.

Table 18-8. Construction Activity Noise Levels, dBA

Building Activity	L_{eq} dBA[1]	Reference Distance (feet)
Aggregate Quarry	85	100
Batch Plant	90	50
Building of Haul Road or Access Road	88	50
Coffer Dams	89	50
Dam Site and Staging Area	89	50
Powerhouse	89	50
Reservoir Clearing	83	50
Helicopter Use	72	50

Notes:
[1] Refer to the Physical Resources Appendix for assumptions and sources used to develop these reference noise levels.

Key:
dBA = A-weighted decibel
L_{eq} = the average noise level during a specified time period

Noise-sensitive receptors in Fresno County that could be adversely affected by construction activity at these facility locations include the residences near the intersection of Perkins Avenue and Sky Harbour Road, the residences on streets near the intersection of El Lado Road and Sky Harbour Road,

houses near Winchell Bay, and two houses on Sky Harbour Drive (not to be confused with Sky Harbour Road).

Noise-sensitive receptors in Madera County that could be adversely affected by construction activity include the residences in Hidden Lake Estates, a house located on Ralston Way, a house located approximately 3,000 feet north of the northernmost aggregate quarry site (Option A1) proposed under quarry, batch plan, and haul road Option A, and a house on Dumna Island.

Noise exposure levels at each receptor location were estimated for the closest construction activities and are summarized in Table 18-9. The calculations account for the distances between the receptors and nearest construction-related activities, whether the intervening landscape is vegetated land or water, and whether any intervening hills block the line of sight between the receptor and noise source. Detailed calculations and modeling parameters are provided in the Physical Resources Appendix.

Table 18-9. Summary of Modeled Construction Noise Levels at Noise-Sensitive Receptors (dBA L_{eq}/L_{50})

Location of Construction-Related Activity[1]	Noise-Sensitive Receptors in Fresno County					Noise-Sensitive Receptors in Madera County			
	Houses Near Perkins Avenue	Two Houses On Sky Harbour Drive	Houses Near El Lado Road	Five Houses on North End of Sky Harbour Road	Houses on North East Side of Winchell Bay	House North of Aggregate Quarry Site under Quarry, Batch Plant, and Haul Road Option A	House on Dumna Island	Hidden Lake Estates	House on Ralston Way
Building of Access Road #1	32	--[2]	50	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]
Building of Access Road #3	--[2]	--[2]	47	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]
Building of Aggregate Quarry Haul Road north of the proposed dam site	--[2]	--[2]	--[2]	--[2]	--[2]	42	--[2]	41	72
Building of Haul Road from the Staging Area to the Left Abutments of the Dam and Cofferdams	42	--[2]	--[2]	64	--[2]	--[2]	49	54	--[2]

Table 18-9. Summary of Modeled Construction Noise Levels at Noise-Sensitive Receptors (dBA L_{eq}/L_{50}) (contd.)

Location of Construction-Related Activity[1]	Noise-Sensitive Receptors in Fresno County					Noise-Sensitive Receptors in Madera County			
	Houses Near Perkins Avenue	Two Houses On Sky Harbour Drive	Houses Near El Lado Road	Five Houses on North End of Sky Harbour Road	Houses on North East Side of Winchell Bay	House North of Aggregate Quarry Site under Quarry, Batch Plant, and Haul Road Option A	House on Dumna Island	Hidden Lake Estates	House on Ralston Way
Aggregate Quarry (Quarry, Batch Plant, and Haul Road Option A only)	--[2]	--[2]	--[2]	--[2]	--[2]	36	--[2]	38	34
Aggregate Quarry (Quarry, Batch Plant, and Haul Road Option C only)	--[2]	--[2]	--[2]	--[2]	--[2]	43	--[2]	--[2]	--[2]
Batch Plant on Madera County Side (Quarry, Batch Plant, and Haul Road Option A only)	--[2]	--[2]	--[2]	--[2]	--[2]	28	--[2]	42	25
Batch Plant near Dam Staging Area (Quarry, Batch Plant, and Haul Road Options B & C only)	32	--[2]	--[2]	42	--[2]	--[2]	--[2]	--[2]	--[2]
Batch Plant near Diversion Tunnel (Quarry, Batch Plant, and Haul Road Options B & C only)	--[2]	--[2]	33	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]
Coffer Dam, downstream	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]	48	26
Dam Site and Staging Area	38	--[2]	--[2]	37	--[2]	--[2]	--[2]	50	31
Waste Area	--[2]	--[2]	--[2]	--[2]	76	--[2]	--[2]	--[2]	--[2]
Intake Structure	--[2]	25	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]
Powerhouse Area	33	20	41	--	51	--[2]	50	--[2]	--[2]
Transmission Line	--[2]	--[2]	--[2]	--[2]	38	--[2]	--[2]	--[2]	--[2]
Ventilation Shaft	--[2]	27	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]
Reservoir Clearing	--[2]	--[2]	--[2]	--[2]	--[2]	48	--[2]	42	28

Source: Data modeled by Ascent Environmental in 2014.

Table 18-9. Summary of Modeled Construction Noise Levels at Noise-Sensitive Receptors (dBA L_{eq}/L_{50}) (contd.)

Notes:

[1] Locations of construction activity are shown in Chapter 2, "Alternatives."

[2] Many cells are blank because noise attenuation calculations were only performed for the closest areas of construction activity to each receptor or receptor group. Refer to the Physical Resources Appendix for detailed calculations, modeling parameters, reference noise levels, and related sources.

Key:
-- = Not applicable
dBA = A-weighted decibel
L_{50} = the noise level exceeded 50 percent of a specific period of time
L_{eq} = the average noise level during a specified time period

As shown in Table 18-9, construction noise levels would not exceed Fresno County's exterior daytime and nighttime noise standards at the houses located on and near Perkins Avenue, including the houses on Pahmit Road and nearby segments of Sky Harbour Road, or at the houses located on Sky Harbour Drive.

Some of the houses located on and near El Lado Road could be exposed to noise levels of 50 dBA during the construction of Access Road #1 and noise levels of 47 dBA during the construction of Access Road #3. While these exceedances would occur only while the closest portions of these access roads are being constructed, these noise levels would exceed Fresno County's nighttime noise standard of 45 dBA L_{50}, which applies to the hours of 7:00 AM to 10:00 PM daily.

The five houses located on the north end of Sky Harbour Road could be exposed to noise levels as high as 64 dBA during the construction of the haul road between the staging area to the left abutments of the dam and cofferdams, particularly the segment of the haul road between the existing South Finegold Day Use Area and the proposed dam staging area. This noise level would exceed Fresno County's exterior daytime noise standard of 50 dBA L_{50} and nighttime standard of 45 dBA L_{50}. Assuming the average exterior-to-interior noise level reduction of 20 dBA provided by wood frame buildings with the windows closed (Caltrans 2011), the interior noise level at these houses would be approximately 44 dBA, which would exceed Fresno County's nighttime interior noise standard of 35 dBA $L_{8.3}$.

The houses located on the northeast side of Winchell Bay could be exposed to noise levels from the proposed waste area as high as 76 dBA and noise from construction activity at the powerhouse area as high as 51 dBA. These noise levels would

also exceed Fresno County's exterior daytime and nighttime noise standards. Assuming the average exterior-to-interior noise level reduction of 20 dBA provided by wood frame buildings with the windows closed (Caltrans 2011), the interior noise level at these houses would be approximately 56 dBA, which would exceed Fresno County's daytime interior noise standard of 45 dBA $L_{8.3}$ and nighttime interior noise standard of 35 dBA $L_{8.3}$.

Among noise-sensitive receptors located in Madera County, the house on Dumna Island would be exposed to a noise level of 49 dBA and 50 dBA from the building of Access Road #3 and construction activity at the proposed powerhouse location, respectively. It is not anticipated that these noise-generating activities would occur at the same time because the access road would need to be completed before construction at the powerhouse site could begin. These noise levels would exceed Madera County's exterior nighttime noise standard of 45 dBA L_{eq}, which applies to the hours of 10:00 PM to 7:00 AM daily.

Some residences located in Hidden Lake Estates could be exposed to noise levels of 54 dBA during the construction portions of the haul road between the staging area to the left abutments of the dam and cofferdams. There would be a direct line of site between this residential area and portions of the haul road and the rate of attenuation would be lower given the "hard" acoustical surface of the intervening portion of Millerton Lake. This noise level would exceed Madera County's noise standard of 50 dBA L_{eq} for daytime hours and standard of 45 dBA L_{eq} for nighttime hours. Homes located in Hidden Lake Estates could also be exposed to noise levels of 48 dBA and 50 dBA from construction activity at the downstream coffer dam and the dam staging area, respectively. Noise levels generated from these activity areas would also exceed Madera County's nighttime noise standard of 45 dBA L_{eq}.

A house located approximately 200 feet north of Ralston Way (County Road 210) in Madera County would be adversely affected by noise associated with construction along nearby segments of the roadway, which would be improved to serve as a haul road providing access between Highway 41 and the Madera County side of the dam site as well as the proposed sites of the aggregate quarry and batch plant under Quarry, Batch Plant, and Haul Road Option A. The level of construction noise exposure could reach 72 dBA at the house, which would be in exceedance of Madera County's outdoor

noise standards (i.e., daytime L_{eq} of 50 dBA and nighttime L_{eq} of 45 dBA). Assuming the average exterior-to-interior noise level reduction of 20 dBA provided by wood frame buildings with the windows closed (Caltrans 2011), interior noise levels at the house could be as high as 52 dBA, which exceeds the interior noise standard of 45 dBA L_{dn} for residences established by Policy 7.A.1 of the Madera County General Plan.

Other noise-generating construction activities that could adversely affect noise-sensitive receptors include helicopter use, vegetation clearing that would occur in areas that would be inundated with water after project completion (this process is referred to as reservoir clearing), relocation of approximately 4-miles of inundated portions of the Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines, and construction of a new, approximately 5-mile transmission line from the powerhouse to the existing Kerckhoff-Sanger line near the intersection of Auberry and Millerton Roads.

A helicopter would be used for a total of approximately 19 hours during the construction of some new recreation facilities in more remote locations during daytime hours. The noise level generated from operation of a Kaman K-Max K-1200 helicopter is approximately 83 dBA SEL below the helicopter and at a hover distance of 492 feet above the ground (Kaman Aerospace Corporation 1993). If the helicopter were to hover as low as 50 feet from the ground it would result in approximately 100 dBA SEL at 50 feet from the construction site at ground level (i.e., someone standing 50 feet from the construction site would be exposed to this noise level). However, helicopters do not operate in one place for extended periods of time and therefore a more likely noise level of 72 dBA L_{eq} would occur at 50 feet from the construction site where a helicopter is hovering for 10 minutes. Because a helicopter would be used to access some recreational facilities in more remote locations during daylight hours it is not anticipated that helicopter noise would exceed applicable noise standards at any noise-sensitive receptors or result in sleep disturbance at any residential land uses.

Reservoir clearing would occur in areas of both counties in the inundation area along the San Joaquin River between the site of the new dam and the downstream end of Kerckhoff Lake. Reservoir clearing activity typically involves the clearing of vegetation and therefore would not occur in any single location for an extended period. The typical noise level associated with reservoir clearing activities is 83 dBA L_{eq} at distance of 50 feet

(EPA 1971). Through distance alone, this noise level would attenuate over land to the daytime noise standard of 50 dBA L_{eq}/L_{50} of both counties at a distance of approximately 900 feet (see the Physical Resources Appendix for detailed calculations). Noise-sensitive receptors located within 900 feet of areas that would be cleared include the houses located along the north end of Wellbarn Road in Fresno County.

Transmission line construction would produce noise levels of approximately 88 dBA L_{eq} at a distance of 50 feet, which would attenuate to Fresno County's daytime noise standard of 50 dBA L_{eq} at a distance of approximately 1,400 feet (see the Physical Resources Appendix for detailed calculations). No noise-sensitive receptors are located within this distance of the areas where the relocated portions of the Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines would be relocated. Some noise-sensitive receptors; however, are located within 1,400 feet of the proposed transmission line corridor connecting to the powerhouse and the existing Kerckhoff-Sanger line, including three houses on south side of Sky Harbour Drive near the intersection of Sky Harbour Road and multiple houses located in the residential area along Auberry Road.

In summary, various noise-sensitive receptors would be exposed to construction-related noise levels that exceed the daytime and/or nighttime noise standards established by the respective county jurisdictions. While both counties exempt construction from noise standards during specific times of the week, these noise-sensitive receptors may be exposed to construction noise levels that exceed applicable daytime and nighttime standards outside of these exempt periods. Fresno County exempts construction from its noise standards from 6:00 AM to 9:00 PM on weekdays and 7:00 AM to 5:00 PM on Saturdays and Sundays, but its daytime noise standards apply during other times of the week. Similarly, Madera County effectively exempts construction noise from its noise standards from 7:00 AM to 7:00 PM Monday through Friday and 9:00 AM to 5:00 PM on Saturdays but its daytime noise standards also apply during other times of the week. In addition, interior noise levels at the houses on the northeast side of Winchell Bay in Fresno County and the house on Ralston Way in Madera County could exceed applicable indoor noise standards of 45 dBA L_{eq}.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact NOI-2: Construction-Generated Ground Vibration

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative. Therefore, no ground vibration would be generated through construction.

There would be **no impact** under the No Action Alternative.

Action Alternatives Construction-related activities under the action alternatives would generate ground vibration due to the use of heavy-duty construction equipment. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increased distance. Construction activities generate varying degrees of ground vibration, depending on the specific construction equipment used and activities involved. Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. Blasting activities also generate relatively high levels of ground vibration. The effects of ground vibration may be imperceptible at the lowest levels, result in low rumbling sounds and detectable vibrations at moderate levels, can cause sleep disturbance or annoyance at high levels, and, at even higher levels, can result in damage to nearby structures.

The action alternatives could result in ground vibration during construction of the various proposed facilities, such as the dam structure, intake structure, and diversion tunnels. Based on equipment use information for the action alternatives, equipment that would generate the most ground vibration include the use of hydraulic drills (e.g., for tunnel construction) and large dozers. In addition to the use of heavy-duty construction equipment it is assumed that blasting could potentially be used during the tunnel construction or at the quarry site for aggregate processing. The levels of ground vibration associated with these types of construction equipment and activities are summarized in Table 18-10, below.

Table 18-10. Representative Ground Vibration and Noise Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)[1]	PPV at 15 feet (in/sec)[2]	Approximate L_v (VdB) at 25 feet
Blasting	1.130	2.431	109
Hydraulic Drill[1]	0.089	0.191	87
Large Dozer	0.089	0.191	87
Loaded Trucks	0.076	0.164	86

Source: FTA 2006

Notes:

[1] PPV = peak particle velocity; LV = the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4 FTA reference noise level is for a Caisson Drill which is representative of typical drilling activities at construction sites and therefore was used to represent a hydraulic drill.

[2] PPV at 25 feet are based on FTA 2006. To calculate PPV at 15 feet, the following equation (FTA 2006) was used:
PPV at 15 feet = PPV (at 25 feet) * ([25/15]^1.5)

Key:
in/sec = inches per second

The ground vibration levels listed in Table 18-10 were evaluated against applicable vibration thresholds as described in the Methods and Assumptions section above. This analysis focused on the human disturbance threshold of 0.1 inch/second PPV because it is more stringent than the Caltrans-recommended threshold of 0.2 inch/second PPV for evaluating the potential for structural damage. It is also more stringent than FTA's maximum acceptable vibration standard of 80 VdB because ground vibration levels need more distance to diminish to less than 0.1 inch/second PPV than to less than 80 VdB.

Based on FTA's recommended procedure for applying a propagation adjustment to reference ground vibration levels shown above, predicted worst-case ground vibration levels would exceed the threshold for human disturbance of 0.1 inch/second PPV for blasting at distances within 130 feet, for the use of heavy-duty equipment within 25 feet, and for vibration from trucks on haul roads within 21 feet.

With regards to structural damage, the Caltrans-recommended threshold of 0.2 inch/second PPV would be exceeded for blasting at distances within 80 feet, drilling within 15 feet, and heavy-duty equipment 15 feet. These distances would not be exceeded during construction of any action alternative.

Sensitive receptors are located throughout the primary study area (Figure 18-4). However, there are no sensitive receptors or

structures located within any distance described above for which structural damage or human disturbance could occur.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise

Primary Study Area

No Action Alternative No new construction-related vehicle trips and associated transportation noise would be introduced under the No Action Alternative. Therefore, sensitive receptors would not be exposed to construction-related traffic noise.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would result in increases in daily traffic volumes and associated traffic noise levels along area roadway segments during project construction. The Federal Highway Administration's (FHWA) Traffic Noise Model (FHWA 2006) was used to predict traffic noise levels along affected roadways for existing conditions, with and without trips associated with project construction under the action alternatives. Trip estimates were based on the number of daily trips related to the construction workers' commute, movement of equipment, and material delivery that would be added to area roadways during the peak of construction, as discussed in Chapter 24, "Transportation, Circulation, and Infrastructure." Because Alternative Plan 4 would generate more truck trips than the other action alternatives, for a conservative analysis, construction trips associated with Alternative Plan 4 were used in this analysis to represent all five action alternatives.

Table 18-11 displays the L_{dn} approximately 50 feet from the roadway edge (100 feet for SR 99 and SR 41) of each modeled road segment for existing conditions with and without the construction-related traffic. Note that most of the noise levels presented in Table 18-11 would be lower at the nearest sensitive receptors because the receptors are located further than the modeled distance. Table 18-11 also shows the net change in roadside noise levels due to construction-related vehicle trips by workers and trucks. The roadway noise levels presented in the table represent worst-case potential traffic noise exposures, which assume no natural or human-made

shielding (e.g., trees, intervening topography, or sound walls) between the roadway and nearby receptors. Detailed modeling parameters are provided in the Physical Resources Appendix.

Table 18-11. Summary of Traffic Noise Increases During Construction

Name	From	Quarry, Batch Plant, and Haul Road Option(s) Adding Construction Traffic[1]	Existing, dBA L_{dn} (short-term)[2]	Existing + Construction Trips, dBA L_{dn} (short-term)[2]	Increase, dBA L_{dn} (short-term)	County
SR 99	Jensen Avenue to SR 41	A, B, C	81.9	81.9	0.0	Fresno
SR 41	SR 99 to North Friant Road	A, B, C	78.4	78.4	0.1	Fresno
SR 41	North Friant Road to SR 145	A only	77.6	77.7	0.1	Madera
North Fork Road (County Road 200)	SR 41 to County Road 211	A only	60.8	62.6	1.8	Madera
County Road 211 (O'Neals Road)	North Fork Road (County Road 200) to County Road 210 (Hildreth Road)	A only	51.8	57.3	5.5	Madera
County Road 210	County Road 211 (O'Neals Road) to Aggregate Quarry Haul Road	A only	48.2	56.6	8.4	Madera
SR 145	West of SR 41	None	67.2	67.2	0.0	Madera
Millerton Road	North Fork Road to Brighton Crest Road	A, B, C	67.4	68.0	0.6	Fresno
Millerton Road	Brighton Crest Road to Sky Harbour Road	A, B, C	67.4	68.0	0.6	Fresno
Millerton Road	Sky Harbour Road to Table Mountain Road	None	66.7	66.7	0.0	Fresno
Millerton Road	Table Mountain Road to Auberry Road	None	64.4	64.4	0.0	Fresno
Sky Harbour Road	North of Millerton Road	A, B, C	55.1	59.8	4.7	Fresno
Friant Road	Lost Lake Road to North Fork Road	A, B, C	66.5	67.1	0.6	Fresno
Friant Road	Willow Avenue to Lost Lake Road	A, B, C	71.2	71.7	0.05	Fresno
Friant Road	Copper Avenue to Willow Avenue	A, B, C	69.1	69.6	0.5	Fresno
Friant Road	Rice Road to Copper Avenue	A, B, C	69.1	69.6	0.5	Fresno
Friant Road	SR 41 and Rice Road	A, B, C	66.5	67.1	0.6	Fresno

Table 18-11. Summary of Traffic Noise Increases During Construction (contd.)

Name	From	Quarry, Batch Plant, and Haul Road Option(s) Adding Construction Traffic[1]	Existing, dBA L_{dn} (short-term)[2]	Existing + Construction Trips, dBA L_{dn} (short-term)[2]	Increase, dBA L_{dn} (short-term)	County
Road 206	Road 145 to North Friant Road	None	62.1	62.1	0.0	Madera
Smalley Road	Powerhouse Road to San Joaquin River	A, B, C	48.5	49.4	0.9	Fresno
Powerhouse Road	Auberry Road to Smalley Road	A, B, C	52.1	52.5	0.4	Fresno
Powerhouse Road	Smalley Road to San Joaquin River	A, B, C	49.6	50.3	0.7	Fresno
Auberry Road	Powerhouse Road to SJ&E Road	A, B, C	67.8	67.8	0.0	Fresno
Auberry Road	SJ&E Road and Powerhouse Road	A, B, C	67.8	67.8	0.0	Fresno
Auberry Road	Morgan Canyon Road (SR 168) to SJ&E Road	A, B, C	67.8	67.8	0.0	Fresno
Auberry Road	Morgan Canyon Road (SR 168) to Wellbarn Road	A, B, C	64.0	64.1	0.1	Fresno
Auberry Road	Wellbarn Road to Millerton Road E.	A, B, C	63.8	64.0	0.2	Fresno
Auberry Road	Millerton Road E. to Millerton Road W.	A, B, C	64.5	64.7	0.2	Fresno
Auberry Road	Millerton Road W. to E. Copper Avenue	A, B, C	65.3	65.5	0.2	Fresno
Copper Avenue	Friant Road and Auberry Road	A, B, C	65.5	65.5	0.0	Fresno
Wellbarn Road	Auberry Road to Temperance Flat	A, B, C	47.4	51.5	4.1	Fresno

Source: Data modeled by Ascent Environmental in 2014.

Notes:

[1] The following four road segments would only experience construction traffic under quarry, batch plant, and haul road Option A: SR 41 from North Friant Road to County Road 200; N Fork Rd (County Rd 200) from SR 41 to County Rd 211; County Rd 211 (O'Neals Rd) from N Fork Rd to County Rd 210 (Hildreth Rd); and County Rd 210 from County Rd 211 (O'Neals Rd) to aggregate quarry haul road on the north side of the proposed dam. Therefore, there would be no increased traffic noise levels on these road segments under quarry, batch plant, and haul road Options B and C.

[2] Traffic noise levels were estimated using FHWA's Traffic Noise Model (FHWA 2006) based on trip information provided in Chapter 24, "Transportation, Circulation, and Infrastructure." Where construction traffic levels would vary among quarry, batch plant, and haul road Options A, B, and C, the highest trip levels from these three options were evaluated. Modeled traffic noise levels assume no natural or human-made shielding (e.g., vegetation, berms, walls, buildings). Refer to the Physical Resources Appendix for modeling input assumptions and output results.

Key:

CNEL = community noise equivalent level;

dBA = A-weighted decibel

SR = State Route

As shown in Table 18-11, on most of the modeled roadway segments the traffic noise increases would not be greater than 1.5 dBA L_{dn} during the construction period.

Those roadway segments that would experience traffic noise level increases great than 1.5 dBA L_{dn} are discussed further here. Traffic noise levels on the segment of Sky Harbour Road north of Millerton Road would increase from 55.1 dBA L_{dn} to 59.8 dBA L_{dn}, and traffic noise levels along the segment of Wellbarn Road from Auberry Road to Temperance Flat would increase from 47.4 dBA L_{dn} to 51.5 dBA L_{dn}. The existing traffic noise levels along these two roadway segments are less than 60 dBA L_{dn} and would not increase by more than 5 dBA.

Traffic noise levels along North Fork Road (Madera County Road 200) between SR 41 and County Road 211would experience an increase of 1.6 dBA L_{dn} from 61.4 to 63.0 dBA L_{dn} under Quarry, Batch Plant, and Haul Road Option A only. This noise level increase would not exceed applicable standards because the existing traffic noise level is less than 65 dBA L_{dn}.

The segment of County Road 211 between North Fork Road and Hildreth Road, and the segment of County Road 210 between County Road 211 and the aggregate quarry haul road in Madera County would experience traffic noise levels exceeding the 5 dBA-increase standard under Quarry, Batch Plant, and Haul Road Option A only.

In addition to increases in average daily traffic noise, intermittent SELs and increases in the frequency of occurrence of such levels is also of concern, particularly during the more noise-sensitive nighttime hours. Although the average daily noise descriptors (i.e., L_{dn} and CNEL) incorporate a nighttime weighting or “penalty” that is intended to reflect the expected increased sensitivity to noise at night, L_{dn} and CNEL standards do not fully protect residents from sleep disturbance. The SEL describes a receiver’s cumulative noise exposure from a single impulsive noise event (e.g., an automobile passing by or an air craft flying overhead), which is a rating of a discrete noise event that compresses the total sound energy of the event into a 1-second time period, measured in decibels (Caltrans 2011).

Fresno County, Madera County, Caltrans, the Governor’s Office of Research and Planning, and most cities and counties have not established noise level standards for the effects of single-event noise. However, following the court decision in *Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners of the City of Oakland, 2001* (*Berkeley* case) there has been increased attention to the evaluation of single-event noise levels and their effects on sleep. Because the

Berkeley case involved aircraft, and the action alternatives would involve construction-related haul truck trips, the situations are not entirely the same. Nonetheless, the SELs from truck passbys associated with construction under the action alternatives are evaluated here.

Many studies have been conducted regarding the effects of single-event noise on sleep disturbance, but because of the wide variation in the reaction of test subjects to SELs of various levels no definitive consensus has been reached with respect to a universal criterion to apply. Upon a review of studies about sleep disturbance and aircraft-generated SELs, the Federal Interagency Committee on Aviation Noise (FICAN) provided estimates of the percentage of people expected to be awakened when exposed to specific SELs inside a home (FICAN 1997). According to the FICAN's review, 10 percent of the population is estimated to be awakened when the SEL interior noise level is 81 dBA. An estimated 5 to 10 percent of the population is affected when the SEL interior noise level is between 65 and 81 dBA, and few sleep awakenings (less than 5 percent) are predicted if the interior SEL is less than 65 dBA. However, FICAN did not recommend a threshold of significance based on the percent of people awakened.

The threshold for sleep disturbance is not absolute because there is a high degree of variability from one person to another. Thus, the means of applying such research to land use decisions is not completely clear. As a result, no government agency has suggested what frequencies of awakenings are acceptable (Caltrans 2011). For these reasons, the Federal Interagency Committee on Noise , the Governor's Office of Research and Planning, and most cities and counties (including Fresno and Madera counties), continue to use L_{dn} or CNEL as the primary tool for the purpose of land use compatibility planning (Caltrans 2011). In fact, the L_{dn} and CNEL represents the cumulative exposure to all single events, that is, the exposure of all SELs taken together, weighed to add penalties for nighttime occurrences, and averaged over a 24-hour period. Thus, it can be argued that the L_{dn} standards established by Fresno County (shown in Chapter 18, "Noise and Vibration") and Madera County (i.e., General Plan Policy 7.A.2), already account for the individual impacts associated with the SELs. (Note that CNEL and L_{dn} are often used interchangeably, as there is only a subtle difference in noise level penalties during evening hours used to formulate the two metrics.)

Fresno and Madera counties have also established L_{max} standards, as shown in Table 18-5 and Table 18-6 for Fresno County and Table 18-7 for Madera County. The L_{max} metric is used to evaluate a maximum instantaneous sound level; however, the limitation of an instantaneous sound level is that it provides no information regarding the duration of a sound. Two different aircraft overflights or truck passbys, for instance, can produce vastly different total amounts of sound energy at a given receptor depending on how quickly the aircraft or trucks pass by. Thus, the relationship between L_{max} and SEL is not constant because some noise events last longer than others. The closer the noise event, the closer the L_{max} and SEL measurements will be to each other (Caltrans 2011).

Because the *Berkeley* case drew concerns due to interior SEL values in excess of 65 dBA, this analysis uses a threshold of 65 dBA SEL within residences. Exposure to 65 dBA SEL would result in a chance of sleep disturbance of less than 5 percent.

Reference SELs for heavy truck passbys were measured by Bollard Acoustical Consultants and reported in an EIR for a proposed commercial center (City of Ceres 2010). The results of the measurements indicated that heavy truck passby levels ranged from 77 to 85 dBA SEL, with a mean of 83 dBA SEL at a reference distance of 50 feet.

Assuming the average exterior-to-interior noise level reduction of 20 dBA provided by wood frame buildings with the windows closed (Caltrans 2011), the maximum SEL in the interior of rooms located closer than 50 feet from a passing truck would exceed 65 dBA SEL. Because some houses along the haul routes have inhabitable rooms located closer than 50 feet to the roadway, these rooms would experience SELs that exceed the threshold of 65 dBA and, therefore, the percentage of people expected to be awakened when inside the affected homes would exceed 5 percent. Roadways within 50 feet of nearby residences where this impact could potentially occur include North Friant Road between Lost Lake Road and North Fork Road, Millerton Road just east of Winchell Cove Road, Sky Harbour Road north of Millerton Road, Sky Harbour Drive east of Sky Harbour Road, the intersection of Auberry Road and Wellbarn Road, Auberry Road just west of Little Sandy Road, Auberry Road South of Blue Heron Lane, Auberry Road south of SJ and E Road, and Powerhouse Road north of Auberry Road. There are also some residences located within 50 feet of (Madera) County Road 210 between County Road 211 and the proposed site of the aggregate quarry haul road

north of the proposed dam site, which would experience construction-related truck trips under Quarry, Batch Plant, and Haul Road Option A only.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact NOI-4: Long-Term Operational Stationary- and Area-Source Noise

Primary Study Area

No Action Alternative No new operational noise sources would be introduced under the No Action Alternative. Therefore, no long-term operational stationary- or area-source noise would be generated.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would introduce new noise sources to the primary study area, including the new powerhouse, recreational watercraft operating in the new Temperance Flat RM 274 Reservoir, and potentially corona noise from the new transmission line connected to the powerhouse as well as the relocated portions of the existing Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines. Noise levels typically associated with these sources and the potential of exposing noise-sensitive receptors to excessive noise levels are discussed separately below.

Powerhouse Operations It is assumed that the noise level generated by the proposed 160 MW powerhouse would be similar to that of the existing Kerckhoff Powerhouse. The short-term noise measurement of the Kerckhoff Powerhouse, collected at Site ST5, as shown in Figure 18-1 and summarized in Table 18-1., indicates a steady noise level of approximately 74 dBA L_{eq} at a distance of 20 feet. Through distance alone this noise level would attenuate to less than 45 dBA L_{eq} at 600 feet, even without any additional attenuation provided by ground absorption and there are no residences or other noise-sensitive receptors located within this distance. (Detailed calculations are provided in the Physical Resources Appendix.) Thus, noise generated by the new powerhouse would not exceed Fresno County's respective daytime and nighttime noise standards of 50 dBA L_{50} and 45 dBA L_{50}, or Madera County's respective daytime and nighttime noise standards of 50 dBA L_{eq} and 45 dBA L_{eq}.

Recreational Boating Activity Upon completion of the action alternatives, a new reservoir would be created with new boat ramps. Thus, residences located near the new reservoir could be exposed to varying levels of boat noise. Operation of motorized watercraft would be limited to the daytime hours posted by the Park Rangers of the Millerton Lake State Recreation Area, which limit boating to particular daytime hours, depending on the time of year. Because recreational boating is largely considered an area source of noise, this evaluation compares noise generated by recreational boating to the standards established by Fresno County and Madera County for non-transportation noise sources.

As stated in the regulatory setting above, Section 654.06 of the Harbors and Navigation Code requires noise levels from recreational watercraft to be no greater than 86 dBA at a distance of 50 feet (California Department of Boating and Waterways 2012). In Fresno County the closest noise-sensitive receptors to the new reservoir would be houses along Sky Harbour Road and an existing house located south of the proposed new Wellbarn Road Boat Ramp. Noise levels from boating on the new reservoir would be generated no closer than 2,800 feet from the homes on Sky Harbour Road. Through distance alone boat noise levels would attenuate to approximately 41 dBA at these homes and additional attenuation would be provided by the intervening topography, including Pincushion Mountain. The existing house located closest to the proposed site of the Wellbarn Road Boat Ramp is located approximately 2,300 feet from the edge of the new reservoir (when at full capacity). At this distance boating noise levels would attenuate to approximately 43 dBA at this house. (Detailed calculations are provided in the Physical Resources Appendix.) At both this residence and the residences along Sky Harbour Road, levels of noise exposure from boating on the new reservoir would not exceed Fresno County's exterior daytime noise standards of 50 dBA L_{50} or 70 dBA L_{max}.

In Madera County the closest noise-sensitive receptors to the new reservoir would be some existing houses located in the Hildreth area approximately 4,100 feet from the edge of the new reservoir (when at full capacity). At this distance, boat noise would attenuate to approximately 36 dBA. A receptor that would be closer to the new reservoir is the house located north of the location where the aggregate plant would be operated. At a distance of approximately 1,400 feet from the edge of the new reservoir, the level of noise exposure at this house would be approximately 45 dBA. (Detailed calculations

are provided in the Physical Resources Appendix.) Thus, the levels of noise exposure from boating activity on Temperance Flat RM 274 Reservoir would not exceed Madera County's exterior daytime noise standards of 50 dBA L_{eq} or 70 dBA L_{max} at any of the noise-sensitive receptors located in Madera County.

Corona Noise from Transmission Lines Audible noise from transmission lines is primarily due to the point source corona effect—a crackling and hissing, hum-like sound with potential for small amounts of light—resulting from small variability in the conductor materials. Such noise is common and not harmful, and routinely occurs when air is ionized around a gap, a burr (raised area), a small irregularity, or some non-insulated component during the conductance of electricity through transmission lines. Corona is also produced when transmission lines break down over time and their fastener components loosen resulting in an air gap. Corona noise is most prominent during periods of rain, fog, or high humidity.

Corona noise is a source of electricity transmission inefficiencies (i.e., power is lost); and, therefore, transmission lines are designed to minimize coronal effect. Such design features include using homogenous insulators and implementing good high voltage design practices (i.e., maximizing the distance between conductors that have large voltage differentials, using conductors with large radii, and avoiding parts that have sharp points or sharp edges).

Under the action alternatives, a new, approximately 5-mile transmission line would be constructed from the powerhouse to the existing Kerckhoff-Sanger line near Auberry and Millerton Roads, and approximately 4-miles of the Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines would be relocated outside of the area that would be inundated by the new reservoir. Because the types of wear and tear to transmission lines that could result in atypically loud coronal noise also result in energy loss (e.g., damaged insulators or other transmission line materials, scratches to the conductor surface), transmission lines are typically inspected on a scheduled basis and repairs are made as needed. Also, coronal noise is typically most audible in high voltage lines (i.e., 345 kV and above) and during weather conditions with precipitation and high humidity (CPUC 2009). Because all transmission lines that would be added or relocated as part of the action alternatives would have a capacity of 115 kV, it is not anticipated that corona noise generated by these lines, if any, would expose any nearby

sensitive receptors to substantial increases in ambient noise levels or to levels that exceed any applicable standards.

Summary The levels of noise exposure at the nearest noise-sensitive receptors from operation of the new proposed powerhouse, boating activity on Temperance Flat RM 274 Reservoir, and any corona noise produced by the new and relocated transmission lines would not exceed the applicable noise standards of Fresno and Madera counties. Moreover, no noise-sensitive receptors would be exposed to substantial levels of noise from more than one of these sources, resulting in an additive affect, simply because the sources would not be located near each other.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact NOI-5: Long-Term Increases in Traffic Noise

Primary Study Area

No Action Alternative No new vehicle trips and associated transportation noise would be introduced under the No Action Alternative. Therefore, there would be no long-term increases in traffic noise.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives would result in long-term increase in daily traffic volumes and associated traffic noise level increases along area roadway segments due to increased recreation. FHWA's Traffic Noise Model (FHWA 2006) was used to predict traffic noise levels along affected roadways for existing conditions, with and without implementation of the action alternatives, based on the trip distribution estimates obtained from Chapter 24, "Transportation, Circulation, and Infrastructure." As explained in Chapter 24, it is estimated that during the eight weekend days in July an additional approximately 476 vehicle trips per day would be added to area roadways because of improved conditions at Millerton Lake and an additional 1,344 vehicle trips per day would be added to area roadways because of new recreational opportunities at the Temperance Flat RM 274 Reservoir. The traffic noise modeling is based on these worst-case days.

To be conservative, it was assumed that the increase in traffic associated with improved conditions at Millerton Lake (i.e., 476 trips per day) could potentially occur along routes that provide access between the city of Fresno, which is the largest nearby population center, and recreational areas around Millerton Lake. Regarding the 1,344 trips that would be added due to new recreational opportunities at the Temperance Flat RM 274 Reservoir, it was assumed that these trips could be added to any route between the city of Fresno and the Fresno County side of the new reservoir.

Table 18-12 displays the L_{dn} approximately 50 feet from the roadway edge (100 feet for SR 99 and SR 41) of each modeled road segment for existing conditions with and without the traffic associated with expanded operations. Note that most of the noise levels presented in Table 18-12 would be lower at the nearest sensitive receptors because the receptors are located further than the modeled distance. Table 18-12 also shows the net change in roadside noise levels due to operational trips. The roadway noise levels presented in the table represent worst-case potential traffic noise exposures, which assume no natural or human-made shielding (e.g., trees, intervening topography, or sound walls) between the roadway and nearby receptors. Detailed modeling parameters are provided in the Physical Resources Appendix.

Table 18-12. Summary of Traffic Noise Increases During Long-Term Operations

Name	From	Existing, dBa L_{dn} (long-term)[1]	County	Existing+ New Recreational Users, dBa L_{dn} (long-term)[1]	Increase, dba L_{dn} (long-term)[1]
SR 99	Jensen Avenue to SR 41	81.9	Fresno	81.9	0.0
SR 41	SR 99 to North Friant Road	78.4	Fresno	78.5	0.1
SR 145	West of SR 41	67.2	Madera	67.2	0.0
Millerton Road	North Fork Road to Brighton Crest Road	67.4	Fresno	68.0	0.7
Millerton Road	Brighton Crest Road to Sky Harbour Road	67.4	Fresno	68.0	0.7
Millerton Road	Sky Harbour Road to Table Mountain Road	66.7	Fresno	67.3	0.6
Millerton Road	Table Mountain Road to Auberry Road	64.4	Fresno	65.3	1.0

Table 18-12. Summary of Traffic Noise Increases During Long-Term Operations (contd.)

Name	From	Existing, dBa L_{dn} (long-term)[1]	County	Existing+ New Recreational Users, dBa L_{dn} (long-term)[1]	Increase, dba L_{dn} (long-term)[1]
Sky Harbour Road	North of Millerton Road	55.1	Fresno	57.0	1.9
Friant Road	Lost Lake Road to North Fork Road	66.5	Fresno	67.1	0.6
Friant Road	Willow Avenue to Lost Lake Road	71.2	Fresno	71.9	0.6
Friant Road	Copper Avenue to Willow Avenue	69.1	Fresno	69.7	0.6
Friant Road	Rice Road to Copper Avenue	69.1	Fresno	69.7	0.6
Friant Road	SR 41 and Rice Road	66.5	Fresno	67.1	0.6
Road 206	Road 145 to North Friant Road	62.1	Madera	63.6	1.5
North Fork Road (Road 200)	SR 41 to Aggregate Quarry	61.4	Fresno	61.4	0.0
Smalley Road	Powerhouse Road to San Joaquin River	48.5	Fresno	53.8	5.3
Powerhouse Road	Auberry Road to Smalley Road	52.1	Fresno	55.2	3.1
Powerhouse Road	Smalley Road to San Joaquin River	49.6	Fresno	49.6	0.0
Auberry Road	Powerhouse Road to SJ&E Road	67.8	Fresno	68.0	0.2
Auberry Road	SJ&E Road and Powerhouse Road	67.8	Fresno	68.0	0.2
Auberry Road	Morgan Canyon Road (SR 168) to SJ&E Road	67.8	Fresno	68.0	0.2
Auberry Road	Morgan Canyon Road (SR 168) to Wellbarn Road	64.0	Fresno	64.6	0.6
Auberry Road	Wellbarn Road to Millerton Road E.	63.8	Fresno	64.9	1.1
Auberry Road	Millerton Road E. to Millerton Road W.	64.5	Fresno	65.4	1.0
Auberry Road	Millerton Road W. to E. Copper Avenue	65.3	Fresno	66.1	0.8
Copper Avenue	Friant Road and Auberry Road	65.5	Fresno	66.3	0.8
Wellbarn Road	Auberry Road to Temperance Flat	47.4	Fresno	53.5	6.1

Note:

[1] Traffic noise levels were estimated using FHWA's Traffic Noise Model (FHWA 2006) based on trip information provided in Chapter 24, "Transportation, Circulation, and Infrastructure." Modeled traffic noise levels assume no natural or human-made shielding (e.g., vegetation, berms, walls, buildings). Refer to the Physical Resources Appendix for modeling input assumptions and output results.

Key:

CNEL = community noise equivalent level

dBA = A-weighted decibel

SR = State Route

As shown in Table 18-11, all but five of the modeled roadway segments would experience a traffic noise level increase of less than 1.5 dBA L_{dn}. The segment of Sky Harbour Road north of Millerton Road and the segment of Road 206 in Madera County between Road 145 and North Friant Road could experience respective increases of 1.9 dBA L_{dn} and 1.5 dBA L_{dn}; however, the resultant noise levels along these two segments would be less than 65 dBA L_{dn}. Thus, these segments would not exceed applicable standards.

The segment of Powerhouse Road between Auberry Road and Smalley Road would experience an increase of 3.1 dBA, as shown in Table 18-11. Because this increase is less than 5 dBA and the resultant noise level (of 55.2 dBA L_{dn}) would not exceed 60 dBA L_{dn}, the noise level increase along this segment would not exceed applicable standards.

Applicable standards would be exceeded, however, along the segment of Wellbarn Road that approaches the proposed boat ramp and the segment of Smalley Road that approaches the second new boat ramp. Houses located along Wellbarn Road, which is the only road that would provide access (from Auberry Road) to the proposed new boat ramp at Temperance Flat RM 274 Reservoir, as well as the Auberry School, could experience a substantial traffic noise increase . The modeling results shown in Table 18-12 indicate that the traffic noise level would increase by approximately 6.1 dBA L_{dn}. This would exceed Fresno County's incremental increase standard of 5 dBA L_{dn}.

Similarly, houses along the segment of Smalley Road west of Power House Road would experience a traffic noise increase of 5.3 dBA L_{dn}. This would also exceed Fresno County's incremental increase standard of 5 dBA L_{dn}.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 18-7.

No mitigation is required for Impact NOI-2 or NOI-4 within the primary study area because these impacts would be less than significant for all action alternatives. The following

mitigation is required for Impacts NOI-1 NOI-3, and NOI-5 in the primary study area for all action alternatives.

Mitigation Measure NOI-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites

Reclamation and its primary construction contractors will implement the measures listed below during construction:

- To the extent feasible, construction activities shall be limited to the less noise-sensitive daytime hours of 7:00 AM to 7:00 PM Monday through Friday and 9:00 AM to 5:00 PM on Saturdays. No construction work shall be performed on Sundays or Federal or State holidays.

- All construction equipment and staging areas shall be located at the farthest distance feasible from nearby noise-sensitive land uses that have a direct line of sight to the location of construction activity.

- All construction equipment shall be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturers' recommendations. Equipment engine shrouds shall be closed during equipment operation.

- All motorized construction equipment shall be shut down when not in use to prevent idling.

- Where feasible and necessary, a temporary barrier will be placed as close to the noise source or receptor as possible and will break the line of sight between the source and receptor.

- A disturbance coordinator will be designated and the person's telephone number conspicuously posted around the project sites and supplied to nearby residences. The disturbance coordinator will receive all public complaints and be responsible for determining the cause of the complaint and implementing any feasible measures to alleviate the problem.

- If feasible, to protect the houses on the northeast side of Winchell Bay, Reclamation shall install temporary noise curtains or some other type of temporary sound barrier along the south end of the waste area where

waste rock from the diversion tunnel and powerhouse area would be placed. The noise barrier layer shall consist of rugged, impervious, material with a surface weight of at least one pound per square foot. The sound barrier shall block the line of site between the houses located on the northeast side of Winchell Bay and the waste area.

- Reclamation shall require its contractors to implement any feasible site-specific noise control measures to protect the house located approximately 200 feet north of Ralston Way (County Road 210) from road improvement-related construction to nearby portions of the roadway, which would serve as Access Road #1. Measures may include the installation of a temporary noise curtain or other type of barrier between the house and construction activity along the roadway, rerouting the roadway so that no portions pass within 250 feet of the house, and/or coordinating with the occupants of the residence to ensure that nearby noise-generating construction activity is performed during the least noise-sensitive times of day (e.g., when occupants aren't home).

- If any construction activity results in interior noise levels at residential receptors that would exceed the interior noise standard of 45 dBA L_{dn} during non-exempt times of day, the Reclamation shall offer alternative overnight accommodation to the inhabitants of the affected residence.

Implementation of Mitigation Measure NOI-1 would reduce temporary project generated construction source noise levels and, when feasible, limit them to the less sensitive daytime hours, thus limiting exposure of noise-sensitive receptors to temporary construction noise (Impact NOI-1). However, some construction activities would need to occur during the non-exempt times of day, and possibly on Sundays to adhere to the construction schedule, which is governed, in part, by the rainy season. If performed during the more noise-sensitive evening or nighttime hours some construction activities could generate noise levels that exceed either Fresno County's nighttime noise standard of 45 dBA L_{50} or Madera County's nighttime noise standard of 45 dBA L_{eq}. For instance, as shown in Table 18-9, the construction of the aggregate quarry haul road north of the proposed dam site under Quarry, Batch Plant, and Haul Road Option A would generate noise levels as high as 72 dBA at the

house on Ralston Way; the construction of the haul road from the staging area to the left abutments of the dam and cofferdams would result in a noise level of 64 dBA at the five houses on the north end of Sky Harbour Road; construction activity at the downstream cofferdam and the dam site staging area could generate 48 dBA and 50 dBA, respectively, at some residences in Hidden Lake Estates; activity at the waste area and powerhouse would generate 76 dBA and 50 dBA, respectively, at the houses on the north side of Winchell Bay; activity at the powerhouse area would also result in 50 dBA at the house on Dumna Island; and reservoir clearing could produce 45 dBA at the house north of where the aggregate quarry would be located under Quarry, Batch Plant, and Haul Road Option A. While implementation of temporary sound barriers could help reduce the level of noise exposure from some construction activities to levels less than the nighttime standards, the feasibility of installing such barriers is not certain at this time. For these reasons, this impact would be **significant and unavoidable**.

Mitigation Measure NOI-3: Install Sound Barriers along County Road 211 and County Road 210, and Restrict Truck Hauling on Public Roads to the Less-Sensitive Daytime Hours

If Quarry, Batch Plant, And Haul Road Option A is implemented, Reclamation will implement the following measures to reduce exposure of existing noise-sensitive receptors along County Road 211 (between North Fork Road and County Road 210) and County Road 210 (between County Road 211 and the proposed aggregate quarry haul route north of the proposed dam site) to an incremental increase of less than 5 dBA L_{dn}.

Reclamation shall offer the owners of all the residences with addresses along these two roadway segments the installation of a sound barrier along the property line of their affected residential properties. The sound barriers must be constructed of solid material (e.g., wood, brick, adobe, an earthen berm, or combination thereof). All barriers shall blend into the overall landscape and have an aesthetically pleasing appearance that agrees with the color and rural character of the houses and the general area, and not become the dominant visual element of the community. Relocation of the driveway at each residence may be necessary to preclude having gaps in the sound barrier. Relocation of landscaping may also be necessary to achieve an aesthetically pleasing appearance. The owners of the affected properties may choose to refuse this offer; however, the offer

shall be made available to subsequent owners of the property if change of ownership occurs before project construction is complete. If an existing owner refuses these measures, a deed notice must be included with any future sale of the property to comply with California state real estate law, which requires that sellers of real property disclose "any fact materially affecting the value and desirability of the property" (California Civil Code, Section 1102.1[a]) and shall indicate that Reclamation agrees to install a sound barrier, as described above.

To ensure compliance with applicable noise standards, a site-specific noise study shall be conducted by Reclamation or one of its approved consultants to determine specific noise barrier design. Reclamation shall also be responsible for removal of these sound barriers at the end of project construction.

The construction of sound barriers along County Road 211 between North Fork Road and County Road 210 would achieve the minimum 0.5 dBA L_{dn} reduction to ensure that the resultant traffic noise increase would not exceed the applicable incremental increase standard of 5 dBA L_{dn}. The construction sound barriers along the segment of County Road 210 between County Road 211 and proposed aggregate quarry haul road north of the dam site would achieve the minimum 3.4 dBA L_{dn} reduction to ensure that the resultant traffic noise increase would not exceed the applicable standard of 5 dBA L_{dn}.

Additionally, to minimize the impact of nighttime SELs associated with truck passbys under Quarry, Batch Plant, and Haul Road Options A, B, and C, Reclamation and its primary construction contractors shall prohibit both (1) the arrival of haul trucks that travel along the roadway segments listed below (i.e., on routes that pass within in 50 feet of an inhabitable room of a residential dwelling) before 7:30 AM or after 9:00 PM and (2) the departure of trucks from construction sites before 7:00 AM or after 9:30 PM that would use the roadway segments listed below:

- North Friant Road between Lost Lake Road and North Fork Road,
- Millerton Road just east of Winchell Cove Road,
- Sky Harbour Road north of the turnoff to the proposed site of the surge chamber,

- Sky Harbour Drive east of Sky Harbour Road,
- Intersection of Auberry Road and Wellbarn Road,
- Auberry Road just west of Little Sandy Road,
- Auberry Road South of Blue Heron Lane,
- Auberry Road south of SJ and E Road,
- Powerhouse Road north of Auberry Road,
- County Road 210 between County Road 211 and proposed aggregate quarry haul road north of the proposed dam site (under Quarry, Batch Plant, and Haul Road Option A only), or
- Any other route that passes within 50 feet of an inhabitable room of a residential dwelling unit.

By including a half-hour increment to the period when construction is exempt from local noise standards, this measure ensures that haul trucks would not be traveling on local public roads during non-exempt times of day. This time-of-day restriction applies to any vehicle with three or more axles, including trucks hauling equipment, construction materials, earthen material, and/or workers. Reclamation shall require its primary contractor, all subcontractors, and all vendors to acknowledge and commit to adhering to this restriction in their contracts and purchase orders.

Implementation of the nighttime restriction for construction-related truck traffic, as required by Mitigation Measure NOI-3, would reduce exposure of residential dwelling units to interior single noise events that exceed 45 dBA SEL generated by the passbys of trucks associated with construction under the action alternatives during the more noise-sensitive nighttime hours of 10:00 PM to 7:00 PM, as established by Fresno County.

Implementation of sound barriers along County Road 211 between North Fork Road and County Road 210, and the segment of County Road 210 between County Road 211 and proposed aggregate quarry haul road north of the proposed dam site, also required by Mitigation Measure NOI-3 if Quarry, Batch Plant, and Haul Road Option A is implemented, would reduce construction-related traffic noise level increases to less than 5 dBA L_{dn}. However, because the affected residents

cannot be required to have a sound barrier installed, Impact NOI-3 would be **significant and unavoidable** under Quarry, Batch Plant, and Haul Road Option A. Under Quarry, Batch Plant, and Haul Road Options B and C, however, no sound barriers would be necessary to reduce traffic noise increases that exceed applicable traffic noise increase criteria. Therefore, Impact NOI-3 would be **less than significant** with implementation of Mitigation Measure NOI-3 under Quarry, Batch Plant, and Haul Road Options B and C.

Mitigation Measure NOI-5: Implement Measures to Reduce Exposure to Operational Traffic Noise along Wellbarn Road and Smalley Road

Reclamation will implement the following measures to reduce exposure of existing noise-sensitive receptors along Wellbarn Road, including Auberry School, and along Smalley Road to an incremental increase of less than 5 dBA L_{dn}.

Reclamation shall provide notification to potential recreation users when either the Wellbarn Road or Smalley Road boat ramps are at full capacity. Notification shall include posting signs on Auberry Road before the turnoff to Wellbarn Road, and on Powerhouse Road or Auberry Road before the turnoff to Smalley Road, notifying users that the respective Wellbarn Road or Smalley Road boat ramps, respectively, are at full capacity. These sign locations would help prevent any unnecessary trips on the Wellbarn Road and Smalley Road.

Reclamation shall offer the owners of all the residences with addresses on Wellbarn Road and the house located near its intersection with Ranch Road and the Auberry School the installation of a sound barrier along the property line of their affected residential properties. The sound barriers must be constructed of solid material (e.g., wood, brick, adobe, an earthen berm, or combination thereof). All barriers shall blend into the overall landscape and have an aesthetically pleasing appearance that agrees with the color and rural character of the houses and the general area, and not become the dominant visual element of the community. Relocation of the driveway at each residence may be necessary to preclude having gaps in the sound barrier. Relocation of landscaping may also be necessary to achieve an aesthetically pleasing appearance. The owners of the affected properties may choose to refuse this offer; however, the offer shall be made available to subsequent owners of the property. If an existing owner refuses these measures a deed notice must be included with any future sale of the property to comply with California state real estate law,

which requires that sellers of real property disclose “any fact materially affecting the value and desirability of the property” (California Civil Code, Section 1102.1[a]) and shall indicate that Reclamation agrees to install a sound barrier, as described above.

To ensure compliance with applicable noise standards, a site-specific noise study shall be conducted by Reclamation or one of its approved consultants to determine specific noise barrier design.

The construction of sound barriers along Wellbarn Road would achieve the minimum 1.1 dBA L_{dn} reduction to ensure that the resultant traffic noise increase would not exceed the applicable Fresno County incremental increase standard of 5 dBA L_{dn}. The construction sound barriers along Smalley Road would achieve the minimum 0.3 dBA L_{dn} reduction to ensure that the resultant traffic noise increase would not exceed the applicable Fresno County standard of 5 dBA L_{dn}.

Implementation of Mitigation Measure NOI-5 would reduce traffic on Wellbarn Road and Smalley Road, and give affected residents along Wellbarn Road and the Auberry School the opportunity to reduce increases in traffic noise. However, because users would not be restricted from accessing Wellbarn Road or Smalley Road when traffic would exceed 5 dBA L_{dn}, and the school and residents cannot be required to have a sound barrier installed, Impact NOI-5 would be **significant and unavoidable**.

Chapter 19
Paleontological Resources

This chapter describes the affected environment for paleontological resources, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

Primary Study Area

Regional Geology

As discussed in detail in Chapter 11, "Geology and Soils," the upper San Joaquin River and the primary study area lie in the central portion of the Sierra Nevada Province at its boundary with the eastern edge of the Central Valley Province. The Sierra Nevada Province encompasses the Sierra Nevada and comprises primarily intrusive rocks, including granite and granodiorite, with some metamorphosed granite and granite gneiss. The central Sierra Nevada has a complex history of uplift that resulted in tilting of the entire Sierra Nevada block to the west. The San Joaquin River and its smaller tributaries cut through the granitic rocks present in the upper San Joaquin River watershed and through intrusive formations and sedimentary and metamorphosed rocks. At the western border of the two provinces, alluvium and sedimentary rocks overtop the granitic Sierra Nevada block. Occasional remnants of lava flows and layered tuff from volcanic episodes in the Sierra Nevada are present in the project vicinity. Metamorphic rocks in the Friant Dam area dip steeply downstream to the west and strike northwesterly. The contact of these metamorphic rocks with the Sierra Nevada batholith lies just east of Friant Dam under Millerton Lake. Friant Dam is founded on metamorphic rocks consisting of quartz biotite schist intruded by aplite and pegmatite dikes and by inclusions of dioritic rocks. Erosion has resulted in thin colluvial cover (Reclamation 2002). Intrusive

Sierra Nevada batholith rocks underlie most of Millerton Lake and areas immediately upstream from Friant Dam.

Local Geology

The proposed facilities would be constructed in a variety of geologic formations (Bateman and Busacca 1982, Matthews and Burnett 1966), which are identified in Table 19-1. Table 19-1 also provides a brief description of each formation, its approximate age, and the paleontological sensitivity determination. Chapter 11, "Geology and Soils," shows the location of the proposed facilities in relation to the rock formations listed in Table 19-1. Table 19-2 presents an abbreviated geologic time scale for reference.

Paleontological Resource Inventory

A stratigraphic inventory was completed to develop a baseline paleontological resource inventory of the primary study area and surrounding area by rock unit and to assess the potential paleontological productivity of each rock unit. Geologic maps and reports covering the geology of the primary study area and the surrounding area were reviewed to determine the exposed rock units and to delineate their respective aerial distributions in the project area.

Published and unpublished geological and paleontological literature was reviewed to document the number and locations of previously recorded fossil sites from rock units exposed in the primary study area and vicinity, as well as the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the University of California Museum of Paleontology (UCMP) in Berkeley, California, on April 8, 2013.

Paleontological Resource Assessment Criteria

The potential paleontological importance of a project site can be assessed by identifying the paleontological importance of exposed rock units. Because the areal distribution of a rock unit can be delineated on a topographic map, this method is conducive to delineating parts of a project site that are of higher and lower sensitivity for paleontological resources and to delineating parts of a project site that may require mitigation to ensure that unique paleontological resources are not damaged or destroyed.

Table 19-1. Description of Geologic Formations in the Primary Study Area and Paleontological Sensitivity

Geologic Map of the Millerton Lake Quadrangle				
Map Abbreviation	**Formation Name**	**Description**	**Age**	**Paleontological Sensitivity**
Qal	Alluvium	Stream and gravel alluvium.	Holocene Epoch	Low
Qdf	Debris Flow	Deposits a few meters thick composed of angular trachyandesite blocks, from erosional undercutting of margins of Kennedy Table, and rounded metavolcanic cobbles in a sandy matrix.	Holocene Epoch	Low
Kgd	Biotite Granodiorite	The Millerton Ridge pluton is composed of leucogranodiorite and contains garnets (0.1 to 2 mm across) along the west edge.	Cretaceous Period	Low
Kbl	Tonalite of Blue Canyon–Blocky Hornblende Facies	Plutonic rocks characterized by undeformed blocky hornblende prisms as long as 1 cm and by biotite books as much as 5 mm across.	Cretaceous Period	Low
Kblb	Tonalite of Blue Canyon–Biotite-Rich Facies	Biotite-rich facies of the tonalite of Blue Canyon in the northeastern part of the primary study area may contain 5–12% poikilitic K-feldspar crystals 1–3 cm across. The portion of the biotite-rich facies in the south-central portion of the quadrangle that overlaps with the primary study area may contain subhedral biotite books and quartz crystals as large as 1 cm across.	Cretaceous Period	Low
KJgb	Gabbro	Primarily plagioclase-hornblende that exhibits a range of textures and locally contains minor olivine and/or augite.	Cretaceous or Jurassic Period	Low
Pzv	Metamorphosed Volcanic and Volcanogenic Rocks	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite that is often massive.	Paleozoic Era	Low
Pzs	Metasedimentary Rocks–Quartz-Biotite Schist	Metasedimentary rocks are strongly foliated and lineated with minor folds that are isoclinal and with axes that plunge steeply. These rocks include thin layers of quartzite.	Paleozoic Era	Low
Pzvh	Metamorphosed Volcanic and Volcanogenic Rocks	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite that is often massive. Composed primarily of quartz, hornblende, and plagioclase schist.	Paleozoic Era	Low
Pzva	Metamorphosed Volcanic and Volcanogenic Rocks	Metamorphosed volcanic and volcanogenic rocks characterized as generally strongly foliated and lineated with amphibolite that is often massive. Composed primarily of plagioclase, diopside, and hornblende amphibolite.	Paleozoic Era	Low
Pzu	Metasedimentary and Metavolcanic Rocks, Undifferentiated	Metasedimentary and metavolcanic rocks, undifferentiated.	Paleozoic Era	Low

Table 19-1. Description of Geologic Formations in the Primary Study Area and Paleontological Sensitivity (contd.)

Geologic Map of California, Fresno Sheet				
Map Abbreviation	**Formation Name**	**Description**	**Age**	**Paleontological Sensitivity**
Tc	Tertiary Nonmarine Sedimentary Rocks	Janda (1966, cited in Marchand and Allwardt 1981) recognized a series of tuffaceous silt, sand, and gravel beneath the trachyandesite of Kennedy Table just east of Friant Dam. Age estimates indicate that these deposits correlate with the older (Miocene-age) portion of the Mehrten Formation. The Mehrten Formation typically consists of sandstone, siltstone, and conglomerate that are interbedded with andesitic breccia from volcanic lava flows that occurred in the Sierra Nevada.	Miocene Epoch	High
Tv[b]	Tertiary Volcanic Pyroclastic Rocks	Olivine basalt and some hornblende andesite flows.	Tertiary Undivided	Low
gr[g]	Mesozoic Granitic Rocks	Granodiorite, including hornblende biotite granodiorite.	Mesozoic Era	Low
ms	Pre-Cretaceous Metasedimentary Rocks	Unnamed metamorphic rocks composed predominantly of schist, metachert, phyllite, quartzite, hornfels, tactite, slate, and marble.	Mesozoic Era	Low

Sources: Bateman and Busacca 1982, Matthews and Burnett 1966, Marchand and Allwardt 1981

Key:
cm = centimeter
mm = millimeter

Table 19-2. Abbreviated Geologic Time Scale

Era	Period	Epoch	Age (million years before present)
Cenozoic	Quaternary	Holocene	0.117 (=11,700)
		Pleistocene	2.6 to 0.11
	Tertiary	Pliocene	5.3 to 2.6
		Miocene	23 to 5.3
		Oligocene	33.9 to 23
		Eocene	55.8 to 33.9
		Paleocene	65.5 to 55.8
Mesozoic	Cretaceous	Upper	99.6 to 65.5
		Lower	145.5 to 99.6
	Jurassic	Upper	161.2 to 145.5
		Middle	175.6 to 161.2
		Lower	199.6 to 175.6
	Triassic	Upper	228.7 to 199.6
		Middle	245.9 to 228.7
		Lower	251 to 245.9
Paleozoic			541 to 251
Precambrian			4,000 to 542

Source: UCMP 2011
Note:
Numbers have been rounded.

A paleontologically important rock unit is one that has a high potential paleontological productivity rating and is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at a project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit in a project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site.

The tasks listed below were completed to establish the paleontological importance of each rock unit exposed in or near the primary study area:

- The potential paleontological productivity of each rock unit was assessed, based on the density of fossil remains previously documented in the rock unit.
- The potential for a rock unit exposed in the primary study area to contain a unique paleontological resource was considered.

Paleontological Resource Inventory Results

Stratigraphic Inventory Regional and local surficial geologic mapping and correlation of the various geologic units in the primary study area and vicinity have been provided at a scale of 1:65,000 by Bateman and Busacca (1982) and 1:250,000 by Matthews and Burnett (1966).

Paleontological Resource Inventory and Assessment by Rock Unit Based on a record search conducted at UCMP (UCMP 2013), there are no previously recorded fossil localities within or adjacent to the primary study area. The rock formations listed in Table 19-1 have been grouped together and are discussed in the assessment below.

Holocene Rock Formations Holocene-age deposits are less than 11,700 years old and contain only the remains of extant, modern taxa, which are not considered "unique" paleontological resources. To be considered a "unique" paleontological resource, a fossil specimen must be more than 11,700 years old. Therefore, the Quaternary Alluvium and Debris Flow deposits are considered to be of low paleontological sensitivity.

Tertiary Nonmarine Sedimentary Rocks (Mehrten Formation) Vertebrate mammal and plant fossils have been reported from the Mehrten Formation throughout the Sierra Nevada foothills and the eastern margin of the Central Valley. Fossils have been recovered from the Mehrten Formation from more than 50 locations in Alpine, Amador, Calaveras, El Dorado, Nevada, Placer, San Joaquin, Sierra, Stanislaus, Tuolumne, and Merced Counties (UCMP 2013, Sierra College Natural History Museum 2011). Because of the large number of vertebrate and plant fossils that have been recovered from the Mehrten Formation, it is considered to be of high paleontological sensitivity.

Tertiary Volcanic Pyroclastic Rocks Pyroclastic rocks are composed of volcanic materials that range in size from small ashes and tuffs to large blocks ejected from a volcano. Therefore, these deposits would not be expected to contain fossils and are considered to be of low paleontological sensitivity.

Mesozoic and Paleozoic Rock Formations Although vertebrate fossils have been recovered from Fresno and Madera counties in rock formations of Mesozoic age, these localities are on the western edge of the San Joaquin Valley, either

within or adjacent to the Coast Ranges. These types of rock formations are not present in the eastern portions of either county, which are located in the Sierra Nevada. The results of a search of the UCMP database indicate that there are no recorded vertebrate fossil localities in the Mesozoic and Paleozoic granitic rocks that make up the Sierra Nevada. These rocks were formed deep beneath the earth's surface under conditions of high temperature and pressure and therefore would not be expected to contain fossils. Thus, these formations are considered to be of low paleontological sensitivity.

Extended Study Area

The portion of the extended study area extending from Friant Dam to the Delta is now subject to changed instream flows associated with implementing the Settlement. Restoration Flows will modify environmental conditions in the river channel and bypasses. However, the flow of water in any streambed is a natural process that has been ongoing for millennia, and its action and interaction with paleontological resources is a natural process. Regardless of whether water flows would increase or decrease from operation of any water-related project, the flow of water in watercourses does not adversely affect paleontological resources other than perhaps resulting in their movement farther downstream. In addition, use of equipment to remove vegetation would not affect unique paleontological resources that may potentially be present because the zone of soil disturbance would be less than 8 inches (Reclamation 2009). Streambed deposits at and near the surface of watercourses are generally of Holocene age (i.e., less than 11,700 years old) and therefore would not contain unique paleontological resources.

The Delta is also a landform that has developed during the more recent Holocene age and therefore would not contain unique paleontological resources.

The potential to encounter paleontological resources in the CVP and SWP water service areas varies according to the age and character of geologic materials present. San Joaquin Valley is composed of recent flood overflow deposits, alluvial fan and older alluvial deposits, and limited marine sediments found along the margins of the valley. As described previously in the Primary Study Area section, these various formations maintain varying potential to contain paleontological resources. Other areas of southern California also exhibit geologic materials with a wide range of potential to contain paleontological

resources, with deposits ranging from low potential to high potential.

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on paleontological resources that could result from implementing any of the alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on paleontological resources. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on paleontological resources and associated mitigation measures are summarized in Table 19-3.

Methods and Assumptions

The Society of Vertebrate Paleontology (SVP) has established standard guidelines that outline acceptable professional practices regarding paleontological resources, and most practicing professional paleontologists in the nation follow these guidelines. In its standard guidelines for assessing and mitigating adverse impacts on paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past typically are considered to have low sensitivity. Areas that have not had any previous paleontological resource surveys or fossil finds are considered to be of undetermined sensitivity until surveys and mapping are performed to determine their sensitivity. After reconnaissance surveys, observation of exposed cuts, and possibly subsurface testing, a qualified paleontologist can determine whether the area should be categorized as having high or low sensitivity. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are generally categorized as being of potentially significant scientific value.

Table 19-3. Summary of Impacts and Mitigation Measures for Paleontological Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PAL-1: Potential for Damage to or Destruction of Unique Paleontological Resources	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	PAL-1: Implement a Recovery Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact
SU = significant and unavoidable
PS = potentially significant
LTS = less than significant

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]). Implementing any of the action alternatives would have a significant impact on paleontological resources if it would directly or indirectly destroy a unique paleontological resource or site. A "unique paleontological resource or site" is one that is considered significant under the professional paleontological standards described below.

An individual vertebrate fossil specimen may be considered unique or significant if it is identifiable and well preserved and if it meets one of the following criteria:

- It is a type specimen (i.e., the individual from which a species or subspecies has been described).
- It is a member of a rare species.
- It is a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable, and important information regarding life history of individuals can be drawn.
- It is a skeletal element different from, or a specimen more complete than, those now available for its species.
- It is a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The value or importance of different fossil groups varies depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which

they have already been identified and documented, and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates are generally common; the fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource. Identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare.

Topics Eliminated from Further Consideration

No topics related to paleontological resources that are included in the significance criteria listed above were eliminated from further consideration. Each of the topics associated with potential impacts in the primary study area is addressed below in the Direct and Indirect Impacts section.

As discussed previously in the Affected Environment section, both the streambed deposits in the San Joaquin River and the Delta are generally of Holocene age and therefore would not contain unique paleontological resources. Changes to water conveyance to the CVP and SWP water service areas would not exceed historic maximum deliveries and would not result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment. Therefore, none of the action alternatives would have an impact on any unique paleontological resources that may be present in the extended study area. The potential paleontological resources that may be present in the extended study area are therefore not discussed further in this analysis.

Direct and Indirect Effects

This section describes the environmental consequences of implementing any of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact PAL-1: Potential for Damage to or Destruction of Unique Paleontological Resources

Primary Study Area

No Action Alternative Because no project-related earthmoving activities would occur under the No Action Alternative, there would be no potential for damage to or destruction of unique paleontological resources.

There would be **no impact** under the No Action Alternative.

Action Alternatives Most of the rock formations located where project-related earthmoving activities would occur are not considered to be paleontologically sensitive, as described previously in the Affected Environment section. However, a portion of the construction activities that would be associated with the new transmission line south of Millerton Lake would occur in Tertiary nonmarine sedimentary rocks, which have been correlated with the Mehrten Formation (see Chapter 11, "Geology and Soils"). Because of the large number of vertebrate and plant fossils that have been recovered from the Mehrten Formation, it is considered to be of high paleontological sensitivity. Therefore, earthmoving activities in the Mehrten Formation have the potential to result in damage to or destruction of unique paleontological resources.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses the mitigation measure for the potentially significant impact described in the Direct and Indirect Impacts section, as presented in Table 19-3.

Mitigation is required for Impact PAL-1 in the primary study area for all action alternatives. This impact does not apply to the extended study area.

Mitigation Measure PAL-1: Implement a Recovery Plan
To minimize potential adverse impacts on previously unknown potentially unique, scientifically important paleontological resources in the Mehrten Formation as shown in Chapter 11, "Geology and Soils," Reclamation will implement the following measures:

- Before the start of any earthmoving activities associated with the transmission line south of Millerton Lake, Reclamation will retain a qualified paleontologist to train all construction personnel involved with earthmoving activities, including the site superintendent, regarding the possibility of encountering fossils, the appearance and types of fossils likely to be seen during construction, and proper notification procedures if fossils are encountered.

- If paleontological resources are discovered during earthmoving activities, the construction crew shall immediately cease work in the vicinity of the find and notify Reclamation. Reclamation will retain a qualified paleontologist to evaluate the resource and prepare a recovery plan in accordance with SVP guidelines (1995, 1996). The recovery plan may include, but would not be limited to, a field survey, construction monitoring, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings. Recommendations in the recovery plan that are determined by Reclamation to be necessary and feasible shall be implemented before construction activities can resume at the site where the paleontological resources were discovered.

Implementing Mitigation Measure PAL-1 would reduce the potentially significant impact of damage to or destruction of paleontological resources to a **less-than-significant** level.

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Chapter 20
Power and Energy

This chapter describes the environmental setting for power and energy, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the project alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274) and extended study area.

Affected Environment

Hydropower long has been an important element of power supply in California, both from in-state and out-of-state sources. Hydropower currently supplies between 14 and 19 percent of California's annual electrical energy generation, depending on hydrologic conditions (CEC 2014). About 7.5 percent of electrical generation supplying the United States on a capacity basis comes from hydropower (U.S. Energy Information Administration 2014). Because of its ability to rapidly increase and decrease power generation rates, hydropower is often used to provide load-following generation both during on- peak and off-peak periods. Hydropower is also able to smooth and firm renewable generation such as wind and solar generation.

The upper San Joaquin River watershed is extensively developed for hydroelectric generation. In this area, PG&E and SCE own and operate several hydropower generation facilities. Both the PG&E and SCE systems consist of a series of reservoirs that provide water through tunnels to downstream powerhouses. Hydropower is also generated by the Friant Power Authority (FPA) at the Friant Power Project through releases from Friant Dam to the Friant-Kern Canal, Madera Canal, and San Joaquin River. In total, the upper San Joaquin River Basin has 19 powerhouses with an installed capacity of almost 1,300 MWs, which represents approximately 9 percent of the hydropower generation capacity in California.

The section describes the affected environment for power and energy resources that may be impacted by the alternatives. These include hydropower facilities in the primary study area

between Kerckhoff Dam and Millerton Lake, the FPA and other hydropower facilities at Friant Dam, pumping facilities along the San Joaquin River from Friant Dam to the Delta, and major hydropower and pumping facilities in the CVP and SWP water service areas.

Primary Study Area

This section describes power and energy resources within the primary study area.

Temperance Flat Reservoir Area

The PG&E Kerckhoff Hydroelectric Project accounts for approximately 5 percent of PG&E´s hydroelectric generation capacity, and 15 percent of the generation capacity in the upper San Joaquin River Basin. The existing Kerckhoff Hydroelectric Project (FERC Project No. 96, originally licensed in 1922) with an installed capacity of 174 MW, is today rated at 162.7 MW and includes the following major facilities:

- Kerckhoff Dam and Lake
- Kerckhoff Powerhouse
- Kerckhoff No. 2 Powerhouse

Kerckhoff Dam and Lake Kerckhoff Dam impounds Kerckhoff Lake, which serves as the forebay for both the Kerckhoff and Kerckhoff No. 2 powerhouses. The dam is a concrete arch type, approximately 114 feet in height. The top of the dam is at elevation 997.33, the spillway crest is at elevation 974.172, and the normal maximum water surface is at elevation 987.83. The reservoir has a usable capacity of 4,252 acre-feet. Typically, the reservoir is only drawn 5 feet below the normal maximum water surface. The top 5 feet of the reservoir correspond to an operating capacity of about 750 acre-feet to allow for generation peaking during periods of high electrical demand.

Separate intakes and water conveyance systems are provided for the Kerckhoff and Kerckhoff No. 2 powerhouses. The Kerckhoff Powerhouse intake structure is constructed of concrete and is equipped with two steel slide gates. The intake for the Kerckhoff No. 2 Powerhouse is a concrete-lined box structure located upstream from the Kerckhoff Powerhouse intake.

Kerckhoff Powerhouse The Kerckhoff Powerhouse, sometimes referred to as the Kerckhoff No. 1 Powerhouse, was commissioned in 1920 and is located on the San Joaquin River about 1 mile upstream from Millerton Lake. The powerhouse discharges to the San Joaquin River above Millerton Lake, and generated an average of about 40 GWh/year from 1994 through 2010.

Kerckhoff powerhouse is a reinforced-concrete, tri-level building approximately 46 feet by 99 feet inside. It houses three vertical, Francis-type turbine units directly coupled to generators with a total capacity of 38 MW. The normal maximum gross head is 350 feet and the turbine speed is 360 revolutions per minute (rpm); each turbine has a butterfly-type shutoff valve. Generation voltage is 6,600 volts (v). Of the three units in Kerckhoff Powerhouse, Unit 2 is currently inoperable. In November 2012, PG&E submitted a non-capacity license amendment to FERC to retire-in-place Unit #2 in the Kerckhoff Powerhouse (PG&E 2012). This would reduce generation capacity to approximately 25 MW. The license was amended accordingly in an April 2013 FERC order (FERC 2013).

Water supply to the Kerckhoff Powerhouse is conveyed from Kerckhoff Lake through an unlined tunnel, approximately 16,943 feet long, to three penstocks, which range from 913 feet to 945 feet in length and allow for a normal maximum gross head of 350 feet. A surge chamber is located at the end of the tunnel, upstream from the penstock gate valve. Table 20-1 shows historical generation at Kerckhoff Powerhouse.

Table 20-1. Recent Hydroelectric Generation at Kerckhoff and Kerckhoff No. 2 Powerhouses

Item	Kerckhoff	Kerckhoff No. 2
Number & Type of Units	3 – Francis	1 – Francis
Maximum Capacity (MW)	38	155
Year Constructed	1920	1983
Reported Annual Generation (MWh)		
1994	10,348	275,752
1995	115,930	803,490
1996	52,273	696,653
1997	72,350	695,775
1998	75,657	735,830
1999	31,959	410,567
2000	37,632	482,279
2001	10,768	316,602
2002	19,639	368,396
2003	18,850	423,974
2004	15,833	362,974
2005	51,662	670,639
2006	55,192	640,116
2007	3,701	212,585
2008	12,270	312,023
2009	31,045	395,527
2010	39,111	551,886
Minimum Annual Generation[1]	3,701	212,585
Maximum Annual Generation[1]	115,930	803,490
Average Annual Generation[1]	38,484	491,475

Source: Annual FERC licensee reports; FERC 2014

Note:

[1] Years 1994-2010

Key:

MW = megawatt

MWh = megawatt-hour

Kerckhoff Powerhouse No. 2 The Kerckhoff No. 2 Powerhouse is a relatively modern facility, commissioned in 1983. It discharges directly to Millerton Lake and generated about 500 GWh/year, on average, from 1994 through 2010.

The Kerckhoff No. 2 Powerhouse is approximately 200 feet underground in a circular, rock chamber measuring 85 feet in diameter and 124 feet high. It houses a single, vertical Francis-type turbine/generator assembly. The powerhouse operates at a normal maximum gross head of 421 feet and has a normal operating capacity of 155 MW. Turbine speed is 180 rpm; the turbine has a butterfly-type shutoff valve.

Water is conveyed from the intake in Kerckhoff Lake to the Kerckhoff No. 2 Powerhouse through a tunnel and penstock. The tunnel is approximately 21,632 feet long and has both lined and unlined sections. A surge chamber is located at the end of the tunnel, near the intake for the penstock, and consists

of an unlined, tapered vertical shaft. A concrete- and steel-lined penstock, approximately 1,013 feet long, conveys water from the tunnel to the powerhouse. The penstock has a concrete-lined section that is 20 feet in diameter and 481 feet long, a concrete-lined section that is 18 feet in diameter and 338 feet long, and a steel-lined section that is 15 feet in diameter and 194 feet long. This steel-lined section enters the powerhouse chamber. The penstock has a flow capacity of 5,100 cfs. Table 20-1 shows historical generation at Kerckhoff No. 2 Powerhouse.

Millerton Lake Below RM 274

The Friant Power Project (FPP) is owned and operated by the FPA, which includes eight member districts of the Friant Division of the CVP: Southern San Joaquin Municipal Utility District, Delano-Earlimart ID, Lindsay-Strathmore ID, Lindmore ID, Terra Bella ID, Orange Cove ID, Madera ID, and Chowchilla WD. Three powerhouses, owned and operated by FPA, are located on the downstream side of Friant Dam.

A powerhouse on each canal outlet generates hydroelectricity as water is released for delivery. The Friant-Kern Powerhouse generates hydroelectricity as water is released through outlets in the left abutment to the Friant-Kern Canal; it has a normal maximum head of 105 feet. The Madera Powerhouse generates hydroelectricity as water is released through outlets in the right abutment to the Madera Canal; it has a normal maximum head of 126 feet. The River Outlet Powerhouse, located at the base of the dam adjacent to the spillway, generates hydroelectricity as water is released to the San Joaquin River through river outlets; it has a normal maximum head of 273 feet. The first full year of generation for the FPP powerhouses was 1986. The combined installed capacity of the three powerhouses is about 30 MW. This represents less than 3 percent of the generation capacity in the upper San Joaquin River Basin. Table 20-2 summarizes Friant Dam hydroelectric project features. Historical power generation and capacity of the FPP is summarized in Table 20-3. Electricity from the FPP is transmitted to the PG&E power grid over a 70-kV transmission line.

Table 20-2. Summary of Hydroelectric Project Features at Friant Dam

Item	Friant Power Project
No. of Storage Reservoirs	1[1]
Additional Regulating Reservoirs[2]	N/A
Total Volume of Storage (TAF)	520.5
No. of Powerhouses	3
Total Installed Capacity (MW)	30.6
Miles of Conveyance (tunnel, penstock, flume, etc.) [3]	N/A

Source: Reclamation and DWR 2005

Notes:

[1] Millerton Lake (Friant Dam) is the storage reservoir that provides head and flow to the Friant Power Project, but the reservoir is not owned by the Friant Power Authority.

[2] Diversion dam reservoirs not included in count of additional regulating reservoirs.

[3] Conveyance length is approximate, as measured in GIS.

Key:
GIS = geographic information system
MW = megawatt
N/A = not applicable
TAF = thousand acre-feet

Table 20-3. Historical Hydroelectric Generation at Friant Power Project

Item	Friant Power Authority		
	Friant-Kern Canal	Madera Canal	River Outlet
Number & Type of Units	1 – Kaplan	1 – Kaplan	1 – Francis
Maximum Capacity (MW)	16	8.3	2
Year Constructed	1986	1985	1985
Reported Annual Generation (MWh)[1]			
1986	57,379	30,853	11,191
1987	13,394	6,288	7,554
1988	19,202	5,934	9,340
1989	22,238	7,382	10,940
1990	15,442	6,354	12,492
1991	28,805	9,990	13,313
1992	23,032	8,160	13,010
1993	74,090	29,008	12,832
1994	25,145	8,916	14,632
1995	89,244	35,843	14,901
1996	80,371	30,464	14,331
1997	63,653	29,570	10,945
1998	59,539	34,679	17,577
1999	70,128	23,723	14,565
2000	71,520	23,526	13,249
2001	35,541	13,627	11,261
2002	43,262	13,686	13,250
2003	58,694	18,203	14,257
Minimum Annual Generation[2]	13,394	5,934	7,554
Maximum Annual Generation[2]	89,244	35,843	17,577
Average Annual Generation[2]	47,260	18,678	12,758

Notes:
[1] First full year of generation for the Friant Power Project was 1986.
[2] Years 1986-2003
Key:
MW = megawatt
MWh = megawatt-hour

A fourth powerhouse, owned and operated by the Orange Cove ID, generates hydroelectricity on releases to the San Joaquin Fish Hatchery. The installed capacity of this facility, known as Fishwater Release Hydroelectric Project, is 0.51 MW.

Extended Study Area

The discussion of power and energy existing conditions and the potential impacts of the action alternatives on power and energy encompasses the primary study area, as well as CVP/SWP water service areas and associated facilities. Implementation of the action alternatives is not anticipated to cause impacts to power and energy outside of these areas; therefore, the San Joaquin River downstream from Friant Dam

and the Delta were eliminated from detailed environmental analysis.

Facilities Within Friant Division of the Central Valley Project Water Service Area

Within the Friant Division of the CVP, the Madera-Chowchilla Water and Power Authority owns and operates four powerhouses along the Madera Canal. These powerhouses have a combined capacity of almost 4 MW.

The Friant Division of the CVP was designed and is operated to support conjunctive water management in an area that was subject to groundwater overdraft. Chapter 13, "Hydrology – Groundwater," discusses the current state of groundwater use and overdraft in the region. Under conditions with reduced surface water deliveries, groundwater pumping increases. Additionally, pumping energy required for groundwater pumping increases with increased overdraft of the groundwater basin.

Central Valley Project Facilities Outside of Friant Division

This section describes power generation and pumping facilities owned and operated by Reclamation as part of the CVP outside of the Friant Division of the CVP.

Central Valley Project Power Generation Facilities Table 20-4 shows the 11 CVP hydroelectric power plants, which have a maximum operation capability of 2,079 MW when all reservoirs are at their fullest. Table 20-4 also shows historical annual power generation for calendar year 2007.

Table 20-4. Central Valley Project Powerplants, Capacities, and Historical Annual Generation

CVP Powerplants	Capacities (megawatt)	Net Annual Generation Calendar Year 2007 (megawatt-hour)
Shasta Powerplant	710	1,914,175
Trinity Powerplant	140	364,532
Judge Francis Carr Powerplant	171	291,940
Spring Creek Powerplant	180	271,582
Keswick Powerplant	117	419,597
Lewiston Powerplant	0.35	N/A
Folsom Powerplant	215	371,369
Nimbus Powerplant	17	41,262
New Melones Powerplant	383	469,679
O'Neill Pumping-Generating Plant	14.4	5,404
William R. Gianelli Pumping-Generating Plant (Federal share)	202	126,409

Source: Reclamation 2007
Key:
CVP = Central Valley Project
N/A = Records not available

Shasta Lake and Vicinity The Shasta Division of the CVP contains Shasta Dam, Lake, and Powerplant, and Keswick Dam, Reservoir, and Powerplant; it captures water of the Sacramento River Basin. Shasta Powerplant is located just below Shasta Dam as part of the Shasta Division. Water from the dam is released through five 15-foot penstocks leading to the five main generating units and two station service units. Shasta Powerplant is a peaking plant and generally runs when demand for electricity is high. Its power is dedicated first to meeting the requirements of CVP facilities. The remaining energy is marketed to various preference power customers in Northern California. The 2006 net annual generation of Shasta Powerplant was 2,648,325 megawatt-hours (MWh).

Upper Sacramento River CVP powerplants located downstream from Shasta Reservoir but upstream from Red Bluff Diversion Dam (RBDD) are the Trinity, Lewiston, Judge Francis Carr, and Spring Creek powerplants of the Trinity River Division and Keswick Powerplant of the Shasta Division. The Trinity River Division of the CVP consists of Trinity Dam and Clair Engle Lake, Trinity Powerplant, Lewiston Dam and Lake, Lewiston Powerplant, Clear Creek Tunnel, Judge Francis Carr Powerplant, Whiskeytown Dam

and Lake, Spring Creek Tunnel and Powerplant, Spring Creek Debris Dam and Reservoir, and related pumping and distribution facilities. The Trinity River Division captures water from the Trinity River Basin for diversion to the Sacramento River.

Trinity Dam stores water from the Trinity River in Clair Engle Lake. Water is released through Trinity Powerplant. Downstream, Lewiston Dam diverts water from the Trinity River, through the Lewiston Powerplant, into Clear Creek Tunnel for the 11-mile trip through the Trinity Mountains. Water enters Whiskeytown Lake through Judge Francis Carr Powerplant. Some of the water flows through the Spring Creek Power Conduit and Powerplant into Keswick Reservoir in the Shasta Division. From there, the water passes through Keswick Powerplant, then flows south in the Sacramento River. The following are hydropower facilities of the Trinity Division of the CVP:

- Trinity Powerplant is a peaking plant that operates mostly during times of peak electricity demand. Trinity County has first preference for the CVP power benefit from Trinity Powerplant.

- Lewiston Powerplant is operated in conjunction with the spillway gates to maintain minimum flow in the Trinity River downstream from the dam. The turbine is normally set at maximum output, with the spillway gates adjusted to regulate river flow. The Lewiston Powerplant provides power to an adjacent fish hatchery.

- Judge Francis Carr Powerplant is a peaking plant with two generators with a total capacity of 171,000 kilowatts (kW). Trinity County has first preference for the CVP power benefit from the Judge Francis Carr Powerplant.

- Spring Creek Powerplant is at the foot of the Spring Creek Debris Dam. Water for power is received through Spring Creek Tunnel, which diverts water from Whiskeytown Lake on Clear Creek. Water from the plant is discharged to Keswick Reservoir. Spring Creek Powerplant is a peaking plant. Its operation is tied to flow regimes aimed at minimizing metal concentrations in the Spring Creek arm of Keswick Reservoir. Trinity County has first preference for the CVP power benefit from Spring Creek Powerplant.

- The Shasta Division of the CVP's Keswick Powerplant, located at Keswick Dam, has three generating units with a total capacity of 117 MW. Keswick Dam acts as Shasta Dam's afterbay, stabilizing the water flow released through Shasta Powerplant to meet on-peak demands and provide ancillary services. Keswick Powerplant is a run-of-the-river plant. This means that the plant runs throughout the day at a constant rate, providing a uniform release to the Sacramento River. Keswick Reservoir also captures water diverted from the Trinity River through the Trinity River Division of the CVP.

Lower Sacramento River and Delta The two CVP powerplants located between RBDD and the Delta are the Folsom and Nimbus powerplants. Both powerplants belong to the Folsom Unit on the American River. The Folsom Unit of the CVP consists of Folsom Dam, Folsom Reservoir, Folsom Powerplant, Nimbus Dam, Lake Natoma, Nimbus Powerplant, and Nimbus Fish Hatchery.

Folsom Powerplant is a peaking powerplant located at the foot of Folsom Dam on the north side of the American River. Water from the dam is released through three 15-foot-diameter penstocks to three generating units. Folsom Dam was constructed by the USACE and, on completion, was transferred to Reclamation for coordinated operation as an integral part of the CVP. Folsom Powerplant provides a large degree of local voltage control and is increasingly relied on to support local loads during system disturbances.

Nimbus Dam forms Lake Natoma to regulate releases for power made through Folsom Powerplant. It allows dam operators to coordinate power generation and flows in the lower American River channel during normal reservoir operations. Lake Natoma has a surface area of 500 acres and its elevation fluctuates between 4 and 7 feet daily. Nimbus Powerplant is a run-of-the-river plant and provides station service backup for Folsom Powerplant.

Central Valley Project South-of-Delta Facilities The CVP powerplants located in the CVP SOD water service area include New Melones Powerplant of the New Melones Unit of the East Side Division of the CVP, and the William R. Gianelli and O'Neill Pumping-Generating plants of the San Luis Unit of the West San Joaquin Division of the CVP. The latter two

plants, with dual functions of generating electricity and pumping water, are jointly owned by Reclamation and DWR.

New Melones Dam was completed in 1979, and inundated the original Melones Dam and created New Melones Reservoir on the Stanislaus River. New Melones Powerplant, located on the north bank immediately downstream from the dam, is a peaking plant. The powerplant contains two generators. New Melones Reservoir on the Stanislaus River currently operates under the New Melones Reservoir Interim Operating Agreement.

The San Luis Unit, part of both the CVP and SWP, was authorized in 1960. Reclamation and the State constructed and operate this unit jointly; 45 percent of the total cost was contributed by the Federal government and the remaining 55 percent by the State. The joint-use facilities are the O'Neill Dam and Forebay, B.F. Sisk (San Luis) Dam, San Luis Reservoir, William R. Gianelli Pumping-Generating Plant, Dos Amigos Pumping Plant, Los Banos and Little Panoche reservoirs, and San Luis Canal from O'Neill Forebay to Kettleman City, together with the necessary switchyard facilities. The Federal-only portion of the San Luis Unit includes the O'Neill Pumping-Generating Plant and Intake Canal, Coalinga Canal, Pleasant Valley Pumping Plant, and San Luis Drain (the drain was never completed).

San Luis Reservoir serves as the major storage reservoir, and O'Neill Forebay acts as an equalizing basin for the upper stage dual-purpose pumping-generating plant. O’Neill Pumping-Generating Plant takes water from the DMC and discharges it into the O'Neill Forebay, where the California Aqueduct (SWP feature) flows directly. The William R. Gianelli Pumping-Generating Plant lifts water from the O'Neill Forebay and discharges it into San Luis Reservoir. During releases from the reservoir, these plants generate electric power by reversing flow through the turbines. Water for irrigation is released into the San Luis Canal and flows by gravity to Dos Amigos Pumping Plant where it is lifted more than 100 feet to permit gravity flow to its terminus at Kettleman City. The SWP canal system continues to southern coastal areas.

The O'Neill Pumping-Generating Plant consists of an intake channel, leading off the DMC, and six pumping-generating units. Normally, these units operate as pumps to lift water from 45 to 53 feet into the O'Neill Forebay; each unit can discharge 700 cfs and has a rating of 6,000 horsepower (hp). Water is

occasionally released from the forebay to the DMC, and these units then operate as generators; each unit has a generating capacity of about 4,200 kW.

William R. Gianelli Pumping-Generating Plant, the joint Federal-State facility located at San Luis Dam, lifts water by pump turbines from the O'Neill Forebay into San Luis Reservoir. During the irrigation season, water is released from San Luis Reservoir back through the pump-turbines to the forebay and energy is reclaimed. Each of the eight pumping-generating units has a capacity of 63,000 hp as a motor and 53,000 kW as a generator. As a pumping plant to fill San Luis Reservoir, each unit lifts 1,375 cfs at a design dynamic head of 290 feet. As a generating plant, each unit passes 2,120 cfs at a design dynamic head of 197 feet.

Central Valley Project Pumping Plants CVP pumping plants to move water from the Delta to CVP water service areas in the Central Valley include the Jones Pumping Plant, O'Neill and William R. Gianelli pumping-generating plants (previously described), Dos Amigos Pumping Plant, and SWP's Banks Pumping Plant. Table 20-5 shows the calendar year 2007 energy consumption of each of the plants. Reclamation constructed and operated the Jones Pumping Plant. The Banks Pumping Plant is an SWP facility (constructed and operated by DWR, as discussed later in this chapter); however, Reclamation has access to its pumping capacity through a JPOD. The remaining plants, described previously, are joint-use facilities between the two agencies under the San Luis Unit.

Table 20-5. Central Valley Project Pumping Plants and Historical Consumption

CVP Pumping Plants	Energy Used in Calendar Year 2007 (megawatt-hour)
C.W. "Bill" Jones Pumping Plant	593,490
O'Neill Pumping-Generating Plant	75,377
William R. Gianelli Pumping-Generating Plant	210,019
Dos Amigos Pumping Plant	145,502
Harvey O. Banks Pumping Plant – Federal Share	39,647
Total	1,064,035

Source: Reclamation 2007
Key:
CVP = Central Valley Project

The Jones Pumping Plant, formerly Tracy Pumping Plant, is a component of the Delta Division of the CVP. Construction of the plant started in 1947 and was completed in 1951 with an inlet channel, pumping plant, and discharge pipes. Delta water is lifted 197 feet up and carried about 1 mile into the DMC. Each of the six pumps at the Jones Pumping Plant is powered by a 22,500 hp motor and is capable of pumping 767 cfs. Power to run the pumps is supplied by the CVP powerplants. The intake canal includes the Jones Pumping Plant fish screen, which was built to intercept downstream migrant fish to be returned to the main channel to resume their journey to the ocean.

The DMC/California Aqueduct Intertie, a shared federal-state water system improvement, connects the DMC and the California Aqueduct via two 108-inch-diameter pipes and pumping capacity of 467 cubic feet per second (900 cfs gravity flow from California Aqueduct to DMC). The DMC/California Aqueduct Intertie addresses DMC conveyance conditions that had restricted use of the Jones Pumping Plant to less than its design capacity, potentially restoring as much as 35 TAF of average annual deliveries to the CVP.

Dos Amigos Pumping Plant is a joint CVP/SWP facility, located 17 miles south of the O'Neill Forebay on the San Luis Canal. It lifts water 113 feet to permit gravity flow to the terminus of the San Luis Canal at Kettleman City. The plant contains six pumping units, each capable of delivering 2,200 cfs at 125 feet of head.

State Water Project Facilities

The SWP has 8 hydroelectric powerplants and 17 pumping plants. Table 20-6 summarizes powerplant capacity and historical annual generation in calendar year 2009 for each plant. Table 20-7 shows the historical annual power consumption in calendar year 2009 for each pumping plant.

Table 20-6. State Water Project Powerplants, Capacities, and Historical Power Generation

State Water Project Powerplants	Capacity (megawatt)	Energy Generated in Calendar Year 2009 (megawatt-hour)
Hyatt-Thermalito Powerplant Complex	762	1,449,966
William R. Gianelli Pumping-Generating Plant (SWP share)	222	55,835
Alamo Powerplant	17	55,356
Mojave Siphon Powerplant	33	30,518
Devil Canyon Powerplant	276	553,706
Warne Powerplant	74	279,900

Source: DWR 2013

Table 20-7. State Water Project Historical Power Consumption

State Water Project Pumping Plants and Powerplants	Energy Used in Calendar Year 2009 (megawatt-hour)
Hyatt-Thermalito Pumping-Generating Plant (pumpback and station service)	1,488
North Bay Interim Pumping Plant	-
Cordelia Pumping Plant	10,365
Barker Slough Pumping Plant	8,543
South Bay Pumping Plant	100,947
Del Valle Pumping Plant	559
Banks Pumping Plant	476,985
Gianelli Pumping-Generating Plant (SWP share)	174,028
Dos Amigos Pumping Plant (SWP share)	191,980
Buena Vista Pumping Plant	297,423
Teerink Pumping Plant	321,958
Chrisman Pumping Plant	703,386
Edmonston Pumping Plant	2,577,557
Alamo Power Plant (station service)	306
Pearblossom Pumping Plant	320,676
Pine Flat Power Plant	1,389
Mojave Siphon Powerplant (station service)	468
Devil Canyon Powerplant (station service)	919
Oso Pumping Plant	157,762
Warne Power Plant (station service)	880
Las Perillas Pumping Plant	8,349
Badger Hill Pumping Plant	20,628
Devil’s Den Pumping Plant	13,689
Bluestone Pumping Plant	12,695

Table 20-7. State Water Project Historical Power Consumption (contd.)

State Water Project Pumping Plants and Powerplants	Energy Used in Calendar Year 2009 (megawatt-hour)
Polonio Pass Pumping Plant	13,758
Greenspot Pumping Plant	13,075
Crafton Hills Pumping Plant	13,747
Cherry Valley Pumping Plant	363

Source: DWR 2013

State Water Project Power Generation Facilities Among the eight hydroelectric powerplants, three powerplants are located in the Lake Oroville vicinity and the remaining in the SOD area.

Lake Oroville, the SWP's largest reservoir, stores winter and spring runoff from the Feather River watershed, and releases water for SWP needs. These releases generate power at three powerplants: Hyatt Powerplant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plants (Hyatt-Thermalito Powerplant Complex). DWR schedules hourly releases through the Hyatt-Thermalito Powerplant Complex to maximize the amount of energy produced when power values are highest. Because the downstream water supply does not depend on hourly releases, water released for power in excess of local and downstream requirements is conserved by pumpback operation during off-peak times into Lake Oroville. Energy prices primarily dictate hourly operations for the power generation facilities.

The remaining five SWP powerplants are the jointly owned William R. Gianelli Pumping-Generating Plant (previously described), Alamo Powerplant, Devil Canyon Powerplant, Warne Powerplant, and Mojave Siphon Powerplant. They generate about one-sixth of the total energy used by the SWP. Alamo Powerplant uses the 133-foot head between Tehachapi Afterbay and Pool 43 of the California Aqueduct to generate electricity. Mojave Siphon Powerplant generates electricity from water flowing downhill after its 540-foot lift by Pearblossom Pumping Plant. Devil Canyon Powerplant generates electricity with water from Silverwood Lake with more than 1,300 feet of head, the largest head in the SWP system. Warne Powerplant uses the 725-foot drop from the

Peace Valley Pipeline to generate electricity with its Pelton wheel turbines.

State Water Project Pumping Facilities Among the 17 SWP pumping plants, plants that have historically consumed most of the energy are William R. Gianelli Pumping-Generating Plant (SWP share), Banks Pumping Plant, Dos Amigos Pumping Plant (SWP share), Chrisman Pumping Plant, and Edmonston Pumping Plant.

The Banks Pumping Plant is located 2.5 miles southwest of the Clifton Court Forebay on the California Aqueduct. The plant is the first pumping plant for the California Aqueduct and the South Bay Aqueduct. It provides the necessary head for water in the California Aqueduct to flow for approximately 80 miles south past the O'Neill Forebay and San Luis Reservoir to the Dos Amigos Pumping Plant (another jointly owned facility, as previously described). The Banks Pumping Plant initially flows into Bethany Reservoir, where the South Bay Aqueduct truly begins. The design head is 236 to 252 feet and installed capacity is 10,670 cfs with 333,000 hp.

Along the California Aqueduct, Pearblossom, Chrisman, and Edmonston pumping plants have historically consumed the highest amounts of energy. Pearblossom Pumping Plant lifts water about 540 feet and discharges the water at elevation 3,479, the highest point along the entire California Aqueduct. Chrisman and Edmonston pumping plants provide 524 and 1,970 feet of lift, respectively, to convey California Aqueduct water across the Tehachapi Mountains.

Environmental Consequences and Mitigation Measures

This section discusses environmental consequences on hydropower generation, energy use, and existing hydropower facilities associated with implementing the alternatives. It also describes potential mitigation measures associated with impacts that are significant or potentially significant. Potential direct and indirect impacts to hydropower generation, energy use, and existing hydropower facilities and associated mitigation measures are summarized in Table 20-8.

Table 20-8. Summary of Impacts and Mitigation Measures for Power and Energy

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services	Primary Study Area	No Action Alternative	PS	None Available	PSU
		Alternative Plan 1	S		SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
PWR-2: Change in Energy Generation at Friant Dam Powerhouses	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
PWR-3: Change in Energy Generation and Use Within the Friant Division of the CVP Water Service Area	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	PS	None Required	PSU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Table 20-8. Summary of Impacts and Mitigation Measures for Power and Energy (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-4: Decrease in CVP System Energy Generation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
PWR-5: Decrease in SWP System Energy Generation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
PWR-6: Increase in CVP System Pumping Energy Use	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 20-8. Summary of Impacts and Mitigation Measures for Power and Energy (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
PWR-7: Increase in SWP System Pumping Energy Use	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Key:
LTS = less than significant
NI = no impact
PS = potentially significant
PSU = potentially significant and unavoidable
S = significant
SU = significant and unavoidable

Methods and Assumptions

This impact assessment is based on quantitative data regarding changes to hydropower resources that could occur under the Investigation alternatives in geographic locales within the study area. All action alternatives are compared to a baseline to allow evaluation of potential impacts. For existing conditions, a 2005 level of development CalSim II simulation without Temperance Flat RM 274 Reservoir is used. Similarly, for future conditions, a 2030 level of development CalSim II simulation, the No Action Alternative, is used as a baseline. Each action alternative was simulated using the same levels of development so that any changes from the baseline hydropower generation or consumption can be attributed to the alternative. Detailed tables of monthly energy generation and energy consumption associated with each action alternative are included in the Modeling Appendix.

Four different hydropower models were used for the hydropower accomplishments evaluation in this analysis, including the following:

1. **Local Hydropower Generation** – Simulates existing local hydropower energy generation from the Kerckhoff Power Project and FPP and proposed local hydropower generation at Temperance Flat RM 274 Reservoir based on daily operation simulation.

2. **PLEXOS®** – Simulates hourly hydropower generation and capacity at Temperance Flat RM 274 Reservoir powerhouse and Kerckhoff Hydroelectric Project dispatch in an optimized manner to maximize the value of energy and ancillary services on an hourly basis. Ancillary services are provided by generating resources with specific attributes to quickly ramp up or down generation production. Ancillary services respond to fluctuations in variable energy resources generation to meet load in a reliable manner.

3. **LongTermGen** – Simulates CVP system power generation and power consumption at pumping facilities based on monthly mean operation information from CalSim II.

4. **SWP_Power** – Simulates SWP system power generation and power consumption at pumping

facilities based on monthly mean operation information from CalSim II.

The four hydropower models are described in the following sections.

Local Hydropower Generation Model

Developing any action alternative could affect operations of existing hydropower facilities and provide opportunities for new hydroelectric power production. Existing hydropower facilities estimates were made using modeling approaches that applied output from CalSim II. CalSim II output is post-processed to derive daily water operations, as described in the Modeling Appendix. Daily water operations were used to calculate daily generation in the Local Hydropower Generation Model for existing and proposed hydroelectric powerhouses.

The water-power equation is defined by the following formula:

$$kW = \frac{Q \times H \times e}{11.81} \qquad (1)$$

Where:

kW	=	power (kilowatt)
H	=	net head (feet)
Q	=	flow rate through turbine (cubic feet per second)
e	=	efficiency of the turbine (%)
11.81	=	unit conversion factor

To convert the power output kW to energy kilowatt-hour (kWh), the water power generation equation must be integrated over time.

The approach for estimating hydropower energy generation was as follows:

1. Water-level elevations of the forebay and tailwater or afterbay for each powerhouse are estimated based on reservoir storage output from the water operations model and bathymetric data.

2. Water elevations are then used to compute gross head and net head. Net head takes into account head loss in tunnels, penstocks, etc. Head loss in long conveyance tunnels is calculated based on a design flow.

3. Generation release is then calculated using net head and unit capacity. If the net head is outside the head range of the unit(s), the generation release is zero.

4. The number of hours that generation release can be sustained is then calculated, based on the daily flow from the water operations model.

5. Using the net head, the available water release for generation, and assumed efficiencies, the total power capacity (MW) is calculated.

6. Generation (MWh) is then calculated using the total number of hours the generation releases can be sustained and the total power capacity.

The water operations and models are further described in the Modeling Appendix.

PLEXOS® Model

Using the Local Hydropower Generation Model as input, the PLEXOS® model was used for those projects with dispatchable capacity to optimize the value of the hydropower attributes, as described in the Modeling Appendix. PLEXOS®, a transmission-constrained power market simulation model, distributes that portion of dispatchable energy for which the energy market represents the highest value over the most valuable hours within a day or week using an hourly time step. If ancillary services represent a higher value product, then PLEXOS® allocates a portion of dispatchable energy to the regulation-up market within a day or week using an hourly time step by optimizing among all market opportunities. This optimization assumes that ancillary services bid into the market are only called upon 50 percent of the time.

LongTermGen and SWP_Power Models

Regional energy estimates were made using the Benchmark Study Team (BST) power modeling tools LTGen, Version 1.18, and SWP_Power, BST April 2010 Version, for CVP and SWP facilities, respectively. LongTermGen (LTGen) and SWP_Power use operations data from CalSim II simulations to predict energy generation and consumption throughout the CVP and SWP. Methods applied to evaluate power generation are discussed below.

For each alternative, outputs from CalSim II simulation were input to LTGen and SWP_Power, to simulate power generation

and consumption throughout the CVP and SWP systems, respectively. These CalSim II outputs included reservoir releases, conveyance flow rates, and end-of-month reservoir storage data. Both LTGen and SWP_Power are monthly models. Their simulation periods are from October 31, 1921, to September 30, 2003.

In LTGen and SWP_Power, energy generation is a function of turbine configuration, reservoir release, net head, and duration of generation. Net head is the actual head available for power generation; it is reservoir water surface elevation (a function of storage) minus tailrace elevation (a function of release).

Similarly, the calculation of energy required for pumping in both models is a function of pump configuration, pumping rate, pumping head (i.e., net head with hydraulic losses), and duration of pumping. Detailed descriptions of LTGen and SWP_Power are included in the Modeling Appendix.

Criteria for Determining Significance of Effects

Thresholds of significance for impacts to power and energy are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. An alternative would be considered to have a potentially significant impact on regional hydropower production if the change in the average annual energy generation or consumption (over the 82-year period of simulation) by the CVP/SWP is greater than 5 percent, as shown in Table 20-9.

A threshold of 5 percent was selected as the threshold of significance for hydroelectric generation for several reasons, including seasonal and annual hydrologic variability, short-term operations decisions that may affect the water level in storage, and regional power market demands and prices that may dictate hydropower facilities operations. These factors could contribute to potentially substantial variations in hydropower generation on a monthly or annual basis. As a result, generation variations of less than 5 percent would not be considered significant. Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

Table 20-9. Impact Indicators and Significance Criteria for Energy Generation and Usage

Impact Indicator	Significance Criterion
Friant Powerplants Energy Generation	Decrease in average annual Friant Powerplants hydropower generation of more than 5 percent.
Combined Kerckhoff Project and Temperance Flat RM 274 Reservoir Energy Generation	Decrease in average annual hydropower generation or value for the Kerckhoff Project and Temperance Flat RM 274 Reservoir powerhouses of more than 5 percent.
CVP System Energy Generation	Decrease in average annual CVP system hydropower generation of more than 5 percent.
SWP System Energy Generation	Decrease in average annual SWP system hydropower generation of more than 5 percent.
CVP System Pumping Energy Use	Increase in average annual CVP system pumping energy use of more than 5 percent.
SWP System Pumping Energy Use	Increase in average annual SWP system pumping energy use of more than 5 percent.

Key:
CVP = Central Valley Project
RM = river mile
SWP = State Water Project

Energy Generation at Friant Dam Powerhouses

Changes in operations at Friant Dam powerhouses due to the action alternatives could directly affect hydropower generation caused by changes in head and flow available for hydropower generation. A significant increase in energy generation would be beneficial to FPA and Orange Cove ID customers. A significant reduction in energy generation at Friant Dam powerhouses could require the purchase of energy to meet affected FPA and Orange Cove ID customer energy demands, or a reduction in power revenue.

Kerckhoff Hydroelectric Project Energy Generation

The action alternatives could directly affect hydropower generation at Kerckhoff Hydroelectric Project facilities by inundating the Kerckhoff Hydroelectric Project powerhouses. A total loss in energy generation at Kerckhoff Hydroelectric Project powerhouses could require the purchase of energy and/or development of new hydropower power facilities to mitigate for the loss in energy or a reduction in power revenue.

CVP System Energy Generation

Changes in CVP operations due to the action alternatives could result in reoperation of other CVP hydropower generation

facilities, and could result in a systemwide decrease in CVP hydropower generation. A significant reduction in CVP energy generation might result in less generation available to preference power customers.

SWP System Energy Generation

Changes in SWP operations due to the action alternatives could result in reoperation of SWP generation facilities, and could result in a systemwide decrease in SWP hydropower generation. A significant reduction in SWP energy generation could require the purchase of energy to meet SWP pumping energy demands, or a reduction in power revenue.

CVP Pumping Energy Use

Changes in CVP operations due to the action alternatives could result in changes in operations of the CVP pumping plants. A significant increase in CVP system pumping energy use could require the purchase of energy to meet CVP pumping energy demands, or a reduction in power revenue.

SWP Pumping Energy Use

Changes in SWP operations due to the action alternatives could result in changes in operations of the SWP pumping plants. A significant increase in SWP system pumping energy use could require the purchase of energy to meet SWP pumping energy demands, or a reduction in power revenue.

Topics Eliminated from Further Discussion

No topics were dismissed from further discussion. Impacts to energy generation and consumption are presented according to the facilities that would be affected; therefore, the impacts presented in the following section are specific to either the primary study area (Impact PWR-1 and Impact PWR-2) or the extended study area (Impact PWR-3 through Impact PWR-6).

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact PWR-1 – Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services

Primary Study Area

No Action Alternative Changes in demands between existing and future levels of development would cause changes in magnitude and timing of Kerckhoff Hydroelectric Project tailwater (Millerton Lake) elevations. These changes would affect the magnitude and timing of energy generation and ancillary services under the No Action Alternative compared to Existing Conditions (Table 20-10 and Table 20-11).

This impact would be **potentially significant** under the No Action Alternative.

Table 20-10. Simulated Average Annual Energy Generation and Ancillary Services at Kerckhoff Hydroelectric Project – Existing Conditions and No Action Alternative

Alternative	Kerckhoff Project (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Energy Generation			
Existing Conditions	613.7	0.0	0%
No Action Alternative	616.2	2.5	0%
Ancillary Services			
Existing Conditions	302.2	0.0	0%
No Action Alternative	261.7	-40.5	-13%

Key:
GWh = gigawatt-hour
RM = river mile

Table 20-11. Simulated Average Annual Energy Generation and Ancillary Services Value at Kerckhoff Hydroelectric Project – Existing Conditions and No Action Alternative

Alternative	Kerckhoff Project ($M)	Change from Existing Condition ($M)	Change from Existing Condition (%)
Energy Generation			
Existing Conditions	41.3	0.0	0%
No Action Alternative	41.2	-0.1	0%
Ancillary Services			
Existing Conditions	6.0	0.0	0%
No Action Alternative	5.3	-0.7	-13%

Key:
GWh = gigawatt-hour
M = million
RM = river mile

Alternative Plans 1 – 3 Alternative Plans 1, 2, and 3 would inundate the Kerckhoff Hydroelectric Project powerhouses, and eliminate energy generation at these facilities. The ability of all action alternatives to replace the value of the Kerckhoff Hydroelectric Project powerhouses would vary depending on how carryover storage in Temperance Flat RM 274 Reservoir would be managed. Simulated annual average energy generation and ancillary services at the Kerckhoff Hydroelectric Project and Temperance Flat RM 274 Reservoir is shown in Table 20-12 through Table 20-19 for all action alternatives.

Under Alternative Plans 1, 2, and 3, onsite hydropower energy generation at Temperance Flat RM 274 Reservoir would replace 88 percent and 84 percent of Kerckhoff Hydroelectric Project generation compared to Existing Conditions and the No Action Alternative, respectively. Energy generation is lost because Temperance Flat RM 274 Reservoir has on average less head than the Kerckhoff Hydroelectric Project. Ancillary services would increase 18 percent and 4 percent compared to Existing Conditions and the No Action Alternative, respectively. Ancillary services would increase because the proposed reservoir has more storage capacity and operational flexibility than Kerckhoff Hydroelectric Project. Ancillary services value, however, would decrease because the Temperance Flat RM 274 Reservoir would only increase these services in wet years when value tends to be less.

Energy generation impacts would be **significant** under Alternative Plans 1, 2, and 3. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level. Although not considered mitigation for this impact, PG&E's net lost power generation value after development of new on-site hydropower facilities would be compensated, as described in Chapter 2, "Alternatives."

Alternative Plan 4 Alternative Plan 4 would inundate the Kerckhoff Hydroelectric Project powerhouses and eliminate energy generation at these facilities. Under Alternative Plan 4, onsite hydropower energy generation at Temperance Flat RM 274 Reservoir would replace 91 percent of Kerckhoff Hydroelectric Project generation compared to Existing Conditions and the No Action Alternative. Ancillary services would increase 31 percent and 43 percent compared to Existing Conditions and the No Action Alternative, respectively. Alternative Plan 4 has higher carryover storage in Temperance Flat RM 274 Reservoir than other action alternative and can replace more lost energy and ancillary services value, although not to the level of the Kerckhoff Hydroelectric Project.

Energy generation impacts would be **significant** under Alternative Plan 4. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level. Although not considered mitigation for this impact, PG&E's net lost power generation value after development of new on-site hydropower facilities would be compensated, as described in Chapter 2, "Alternatives."

Alternative Plan 5 Alternative Plan 5 would inundate the Kerckhoff Hydroelectric Project powerhouses and eliminate energy generation at these facilities. Alternative Plan 5 would replace the least amount of energy and ancillary services, relative to the other action alternatives, because of the wider range of head caused by varying reservoir levels in both Millerton Lake and Temperance Flat RM 274 Reservoir.

Energy generation impacts would be **significant** under Alternative Plan 5. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because

no feasible mitigation is available to reduce the impact to a less-than-significant level. Although not considered mitigation for this impact, PG&E's net lost power generation value after development of new on-site hydropower facilities would be compensated, as described in Chapter 2, "Alternatives."

Table 20-12. Simulated Average Annual Energy Generation at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Existing Conditions

Alternative	Kerckhoff Project Simulated Average Annual Generation (GWh)	Temperance Flat Simulated Average Annual Generation (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Conditions	613.7	0	0.0	0
Alternative Plan 1	0	539.6	-74.1	-12
Alternative Plan 2	0	539.6	-74.1	-12
Alternative Plan 3	0	539.6	-74.1	-12
Alternative Plan 4	0	559.4	-54.3	-9
Alternative Plan 5	0	496.1	-117.7	-19

Key:
GWh = gigawatt-hour
RM = river mile

Table 20-13. Simulated Average Annual Energy Generation Value at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Existing Conditions

Alternative	Kerckhoff Project Simulated Average Annual Generation Value ($M)	Temperance Flat Simulated Average Annual Generation Value ($M)	Change from Existing Condition ($M)	Change from Existing Condition (%)
Existing Conditions	41.3	0	0.0	0
Alternative Plan 1	0	36.2	-5.1	-12
Alternative Plan 2	0	36.2	-5.1	-12
Alternative Plan 3	0	36.2	-5.1	-12
Alternative Plan 4	0	37.7	-3.7	-9
Alternative Plan 5	0	32.6	-8.7	-21

Key:
GWh = gigawatt-hour
M = million
RM = river mile

Table 20-14. Simulated Average Annual Ancillary Services at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Existing Conditions

Alternative	Kerckhoff Project Simulated Average Annual Ancillary Services (GWh)	Temperance Flat Simulated Average Annual Ancillary Services (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Conditions	302.2	0	0.0	0
Alternative Plan 1	0	356.0	53.8	18
Alternative Plan 2	0	356.0	53.8	18
Alternative Plan 3	0	356.0	53.8	18
Alternative Plan 4	0	396.0	93.8	31
Alternative Plan 5	0	332.9	30.7	10

Key:
GWh = gigawatt-hour
RM = river mile

Table 20-15. Simulated Average Annual Ancillary Services Value at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Existing Conditions

Alternative	Kerckhoff Project Simulated Average Annual Ancillary Services Value ($M)	Temperance Flat Simulated Average Annual Ancillary Services Value ($M)	Change from Existing Condition ($M)	Change from Existing Condition (%)
Existing Conditions	6.0	0	0.0	0
Alternative Plan 1	0	6.0	-0.1	-1
Alternative Plan 2	0	6.0	-0.1	-1
Alternative Plan 3	0	6.0	-0.1	-1
Alternative Plan 4	0	6.6	0.6	10
Alternative Plan 5	0	5.4	-0.6	-10

Key:
GWh = gigawatt-hour
M = million
RM = river mile

Table 20-16. Simulated Average Annual Energy Generation at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Future Conditions

Alternative	Kerckhoff Project Simulated Average Annual Generation (GWh)	Temperance Flat Simulated Average Annual Generation (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	616.2	0	0.0	0
Alternative Plan 1	0	516.1	-100.1	-16
Alternative Plan 2	0	516.1	-100.1	-16
Alternative Plan 3	0	516.1	-100.1	-16
Alternative Plan 4	0	561.9	-54.3	-9
Alternative Plan 5	0	452.4	-163.8	-27

Key:
GWh = gigawatt-hour
RM = river mile

Table 20-17. Simulated Average Annual Energy Generation Value at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Future Conditions

Alternative	Kerckhoff Project Simulated Average Annual Generation Value ($M)	Temperance Flat Simulated Average Annual Generation Value ($M)	Change from No Action Alternative ($M)	Change from No Action Alternative (%)
No Action Alternative	41.2	0	0.0	0
Alternative Plan 1	0	34.4	-6.8	-16
Alternative Plan 2	0	34.4	-6.8	-16
Alternative Plan 3	0	34.4	-6.8	-16
Alternative Plan 4	0	37.7	-3.5	-8
Alternative Plan 5	0	29.5	-11.8	-29

Key:
GWh = gigawatt-hour
M = million
RM = river mile

Table 20-18. Simulated Average Annual Ancillary Services at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Future Conditions

Alternative	Kerckhoff Project Simulated Average Annual Ancillary Services (GWh)	Temperance Flat Simulated Average Annual Ancillary Services (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	261.7	0	0.0	0
Alternative Plan 1	0	273.1	11.4	4
Alternative Plan 2	0	273.1	11.4	4
Alternative Plan 3	0	273.1	11.4	4
Alternative Plan 4	0	373.2	111.5	43
Alternative Plan 5	0	253.1	-8.6	-3

Key:
GWh = gigawatt-hour
RM = river mile

Table 20-19. Simulated Average Annual Ancillary Services Value at Temperance Flat RM 274 Reservoir Powerhouse and Kerckhoff Hydroelectric Project – Future Conditions

Alternative	Kerckhoff Project Simulated Average Annual Ancillary Services Value ($M)	Temperance Flat Simulated Average Annual Ancillary Services Value ($M)	Change from No Action Alternative ($M)	Change from No Action Alternative (%)
No Action Alternative	5.3	0	0.0	0
Alternative Plan 1	0	4.7	-0.6	-12
Alternative Plan 2	0	4.7	-0.6	-12
Alternative Plan 3	0	4.7	-0.6	-12
Alternative Plan 4	0	6.3	1.1	20
Alternative Plan 5	0	4.2	-1.1	-20

Key:
GWh = gigawatt-hour
M = million
RM = river mile

Impact PWR-2 – Change in Energy Generation at Friant Dam Powerhouses

Primary Study Area

No Action Alternative Changes in demands between existing and future levels of development would cause changes in magnitude and timing of Millerton Lake elevations and Friant Dam diversions and releases. These changes would impact the magnitude and timing of energy generation under the No Action Alternative compared to Existing Conditions (Table 20-20).

This impact would be **less than significant** under the No Action Alternative.

Table 20-20. Simulated Average Annual Energy Generation at Friant Dam Powerhouses – Existing Conditions and No Action Alternative

Alternative	Simulated Average Annual Generation (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Conditions	64.9	0.0	0
No Action Alternative	63.2	-1.7	-3

Key:
GWh = gigawatt-hour
RM = river mile

Action Alternatives All action alternatives would increase Friant Dam powerhouses' average annual generation by up to 16 GWh (25 percent) compared to the No Action Alternative (up to 27 percent compared to Existing Conditions) (Table 20-21 and Table 20-22). Energy generation increases would be caused by higher heads and diversion volumes at Friant Dam.

This impact would be **beneficial** under all action alternatives. Mitigation is not required and thus not proposed.

Table 20-21. Simulated Average Annual Energy Generation at Friant Dam Powerhouses – Existing Conditions

Alternative	Simulated Average Annual Generation (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Conditions	64.9	0	0
Alternative Plan 1	82.3	17.4	27
Alternative Plan 2	82.3	17.4	27
Alternative Plan 3	81.1	16.2	25
Alternative Plan 4	80.1	15.2	23
Alternative Plan 5	80.5	15.6	24

Key:
GWh = gigawatt-hour

Table 20-22. Simulated Average Annual Energy Generation at Friant Dam Powerhouses– Future Conditions

Alternative	Simulated Average Annual Generation (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	63.2	0	0
Alternative Plan 1	78.9	15.7	25
Alternative Plan 2	78.8	15.6	25
Alternative Plan 3	78.8	15.6	25
Alternative Plan 4	78.9	15.7	25
Alternative Plan 5	77.2	14.0	22

Key:
GWh = gigawatt-hour

Impact PWR-3 – Change in Energy Generation and Use Within the Friant Division of the CVP Water Service Area

Extended Study Area

No Action Alternative Changes in energy generation at powerhouses along the Madera Canal would be within typical historical ranges. However, the current state of overdraft and declining groundwater levels in portions of the extended study area would continue. Impacts related to changes in groundwater levels are described in Chapter 13, “Hydrology – Groundwater.”

This impact would be **potentially significant** under the No Action Alternative.

Action Alternatives Implementing the action alternatives would likely increase diversions from Millerton Lake to the Madera Canal, and would likely improve energy generation at powerhouses along the Madera Canal. Additionally, increased diversions from Millerton Lake to the Friant-Kern and Madera canals would likely improve groundwater conditions and decrease groundwater pumping energy use.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact PWR-4 – Decrease in CVP System Energy Generation

Simulated average annual CVP system generation for the alternatives under the existing and future conditions is shown in Table 20-23 and Table 20-24, respectively.

Table 20-23. Simulated Average Annual Energy Generation in CVP System – Existing Conditions

Alternative	Simulated Average Annual Generation (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Condition	4,925	0	0
Alternative Plan 1	4,922	-3	0
Alternative Plan 2	4,924	-1	0
Alternative Plan 3	4,922	-3	0
Alternative Plan 4	4,923	-2	0
Alternative Plan 5	4,926	1	0

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 20-24. Simulated Average Annual Energy Generation in CVP System – Future Conditions

Alternative	Simulated Average Annual Generation (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	4,912	0	0
Alternative Plan 1	4,914	2	0
Alternative Plan 2	4,914	2	0
Alternative Plan 3	4,914	2	0
Alternative Plan 4	4,914	2	0
Alternative Plan 5	4,914	2	0

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Extended Study Area

No Action Alternative Simulated average annual CVP system energy generation for the No Action Alternative is shown in Table 20-24. Under the No Action Alternative, simulated average annual energy generation decreased by 13 GWh (0 percent) as compared with existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Simulated average annual CVP system generation under the action alternatives is shown in Table 20-23 and Table 20-24 for the existing and future conditions, respectively. Under the action alternatives, changes in simulated average annual energy generation compared with

existing conditions and the No Action Alternative would be less than 1 percent.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact PWR-5 – Decrease in SWP System Energy Generation

Simulated average annual SWP system generation for the alternatives under the existing and future conditions is shown in Table 20-25 and Table 20-26, respectively.

Table 20-25. Simulated Average Annual Energy Generation in SWP System – Existing Conditions

Condition/ Alternative	Simulated Average Annual Generation (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Condition	4,435	0	0
Alternative Plan 1	4,488	53	1
Alternative Plan 2	4,467	32	1
Alternative Plan 3	4,468	33	1
Alternative Plan 4	4,463	29	1
Alternative Plan 5	4,423	-11	0

Key:
GWh = gigawatt-hour
SWP = State Water Project

Table 20-26. Simulated Average Annual Energy Generation in SWP System – Future Conditions

Condition/ Alternative	Simulated Average Annual Generation (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	4,516	0	0
Alternative Plan 1	4,566	50	1
Alternative Plan 2	4,543	28	1
Alternative Plan 3	4,546	31	1
Alternative Plan 4	4,541	26	1
Alternative Plan 5	4,507	-8	0

Key:
GWh = gigawatt-hour
SWP = State Water Project

Extended Study Area

No Action Alternative Under the No Action Alternative, simulated average annual energy generation increased by 81 GWh (2 percent) as compared with existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, simulated average annual energy generation changes compared with existing conditions and the No Action Alternative would be less than 2 percent.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact PWR-6 – Increase in CVP System Pumping Energy Use

Simulated average annual CVP pumping energy use for the alternatives under the existing and future conditions are shown in Table 20-27 and Table 20-28, respectively.

Table 20-27. Simulated Average Annual Energy Use in CVP System – Existing Conditions

Condition/ Alternative	Simulated Average Annual Energy Use (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Condition	1,179	0	0
Alternative Plan 1	1,186	7	1
Alternative Plan 2	1,186	7	1
Alternative Plan 3	1,183	4	0
Alternative Plan 4	1,183	4	0
Alternative Plan 5	1,179	0	0

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 20-28. Simulated Average Annual Energy Use in CVP System – Future Conditions

Condition/ Alternative	Simulated Average Annual Energy Use (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	1,169	0	0
Alternative Plan 1	1,176	6	1
Alternative Plan 2	1,175	5	0
Alternative Plan 3	1,178	9	1
Alternative Plan 4	1,180	11	1
Alternative Plan 5	1,185	16	0

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Extended Study Area

No Action Alternative Under the No Action Alternative, simulated average annual pumping energy use decreased by 10 GWh (1 percent) as compared with existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, changes in simulated average annual pumping energy compared with existing conditions and the No Action Alternative would be less than 2 percent.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Impact PWR-7 – Increase in SWP System Pumping Energy Use

Extended Study Area Simulated average annual SWP pumping energy use for the alternatives under the existing and future conditions are shown in Table 20-29 and Table 20-30, respectively.

Table 20-29. Simulated Average Annual Energy Use in SWP System – Existing Conditions

Condition/ Alternative	Simulated Average Annual Energy Use (GWh)	Change from Existing Condition (GWh)	Change from Existing Condition (%)
Existing Condition	7,623	0	0
Alternative Plan 1	7,796	173	2
Alternative Plan 2	7,726	103	1
Alternative Plan 3	7,733	110	1
Alternative Plan 4	7,717	94	1
Alternative Plan 5	7,579	-44	0

Key:
GWh = gigawatt-hour
SWP = State Water Project

Table 20-30. Simulated Average Annual Energy Use in SWP System – Future Conditions

Condition/ Alternative	Simulated Average Annual Energy Use (GWh)	Change from No Action Alternative (GWh)	Change from No Action Alternative (%)
No Action Alternative	7,933	0	0
Alternative Plan 1	8,091	158	2
Alternative Plan 2	8,017	84	1
Alternative Plan 3	8,020	87	1
Alternative Plan 4	8,010	77	1
Alternative Plan 5	7,900	-33	0

Key:
GWh = gigawatt-hour
SWP = State Water Project

No Action Alternative Under the No Action Alternative, there would be an increase in simulated average annual pumping energy use of 310 GWh (4 percent) as compared with existing conditions.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under the action alternatives, changes in simulated average annual pumping energy compared with existing conditions and the No Action Alternative would be less than 3 percent.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Effects section, as summarized in Table 20-8. No mitigation is required for Impact PWR-2 in the primary study area, and Impacts PWR-3, PWR-4, PWR-5, PWR-6 or PWR-7 in the extended study area, as these impacts would be less than significant, less than significant and beneficial, or beneficial for all action alternatives.

Impact PWR-1 within the primary study area would be significant under all action alternatives. Energy generation and ancillary services at Temperance Flat RM 274 Reservoir powerhouse would offset some, but not all, of the reduction in energy generation caused by taking the Kerckhoff Hydroelectric Project powerhouses offline. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Therefore, Impact PWR-1 (within the primary study area) would be **significant and unavoidable**. Although not considered mitigation for this impact, PG&E's net lost power generation value after development of new on-site hydropower facilities would be compensated, as described in Chapter 2, "Alternatives."

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Chapter 21
Public Health and Hazards

This chapter describes the affected environment for public health and hazards, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The affected environment for public health focuses on hazards associated with activities from or influenced by humans, West Nile virus (WNV), valley fever, naturally occurring asbestos, school safety, wildland fire, and aircraft safety. In addition, this section addresses the potential sources of electromagnetic fields (EMF) in the primary study area, as well as the science behind EMF exposure and human or animal health hazards.

Primary Study Area

Hazards Associated with Human Activities

The term “hazardous material” is defined as any material that, because of quantity, concentration, or physical or chemical characteristics, poses a significant existing or potential hazard to human health and safety or a potential hazard to the environment. Hazardous materials and waste may exist in the primary study area as a result of past or ongoing waste generation and management. Contaminated sites generally are the result of unregulated spills of hazardous materials, such as gasoline or pesticides, which result in unacceptable levels of toxic substances in soil or water that may pose risks to human health and safety. Contamination also may result from ongoing land uses that generate substantial amounts of hazardous wastes, such as mines and landfills. In addition, utility poles, transformers, and associated electric power transmission facilities typically contain hazardous materials.

A records search of the applicable hazardous material databases was conducted to identify known hazardous materials sites in the vicinity of the primary study area. The search reviewed over 100 databases such as the National Priorities List, Comprehensive Environmental Response, Compensation, and Liability Information System, Resource Conservation and Recovery Act (RCRA), Geotracker (leaking underground storage tank database maintained by the State Water Board), EnviroStor (hazardous materials database maintained by California Department of Toxic Substances Control), and the interactive database of abandoned mines managed by the California Department of Conservation Abandoned Mines Unit. The database search included those that are part of the Cortese list. Table 21-1 provides a summary of the database results within the primary study area.

Based on their proximity to the proposed inundation area, the first three sites listed in Table 21-1 have a potential to be affected by project-related activities. Inundation of underground storage tanks could result in contamination of water in Millerton Lake and downstream in the San Joaquin River.

Implementing any of the action alternatives would require the demolition of several buildings and structures. Structures constructed before 1981 may contain asbestos, and structures painted before 1978 may contain lead paint. PCBs were used as an additive in cooling oils for electrical components, and typical sources of PCBs can include electrical transformers. Based on the age of the structures subject to removal and presence of existing utility infrastructure, asbestos, lead, mercury, and PCBs could be present in specific locations within the primary study area.

Table 21-1. Hazardous Materials Database Sites in the Primary Study Area

Facility Name and Address	Reported Condition
Topham Ranch 36265 Smalley Road Auberry, California 93602	Six permitted underground storage tanks with leaded, unleaded, and aviation-grade gasoline; no reported violations. Tanks are located approximately 600 feet uphill from proposed inundation area.
Delbert and Carole Pitts 35515 Smalley Road Auberry, California 93602	One permitted underground storage tank with leaded gasoline; no reported violations. Tank is located approximately 300 feet uphill from proposed inundation area.
Millerton Lake State Recreation Area 5290 Millerton Road Friant, California 93625	Two permitted underground storage tanks containing gasoline; no reported violations. Tanks are located within 50 feet of proposed inundation area near Friant Dam.
Southern Pacific Transportation Company 17930 Friant Road Friant, California 93626	Fresno County Health Department observed tank truck disposing unknown materials to septic tank in 1987; cleanup status is inactive. Site is located immediately adjacent to the San Joaquin River 100-year floodplain, approximately ¾ mile downstream from Friant Dam.
San Joaquin Fish Hatchery 17372 Brooktrout Friant, California 93626	One permitted above-ground storage tank; permitted removal and closure of one underground storage tank. Small quantity hazardous waste generator. No reported violations. Site is located immediately adjacent to the San Joaquin River 100-year floodplain, approximately ¾ mile downstream from Friant Dam.
Table Mountain Rancheria 23736 Sky Harbor Road Friant, California 93626	Storage, handling, and recovery of inorganic solid wastes and aqueous solutions. No reported violations. Site is located approximately ¼ mile west of the proposed transmission line.
Capricorn III Automotives 21706 Eastmere Lane Friant, California 93626	Gasoline station; no reported violations. Site is located approximately ¼ mile west of the proposed transmission line.
Eagle Springs Golf & Country Club 21722 Fairway Oaks Friant, California 93626	Auto repair/hazardous waste generator. No reported violations. Site is approximately ½ mile southwest of the proposed transmission line.
Table Mountain Rancheria 8206 Table Mountain Friant, California 93625	Wastewater treatment plant; hazmat disclosures are below reporting quantity, permitted organic materials, NPDES permit, air emissions permit. No reported violations. Site is approximately ¼ mile north of proposed transmission line.
Millerton General Store 20023 Auberry Road Clovis, California 93619	Permitted closure and removal of two underground storage tanks. No reported violations. Site is approximately ½ mile southwest of proposed transmission line.
Charles L. Sheppard 25112 Auberry Road Clovis, California 93612	One permitted underground storage tank with unleaded fuel. No reported violations. Site is approximately ½ mile southwest of proposed transmission line.
Fronk's Well Drilling 24941 Auberry Road Clovis, California 93612	Two permitted underground diesel fuel tanks and one waste oil tank; small quantity hazardous waste generator. No reported violations. Site is approximately ½ mile southwest of proposed transmission line.

Table 21-1. Hazardous Materials Database Sites in the Primary Study Area (contd.)

Facility Name and Address	Reported Condition
Don Fernando's at Marshall Station 25527 Auberry Clovis, California 93619	Permitted closure and removal of three underground storage tanks. No reported violations. Site is approximately ¼ mile south of proposed transmission line.
Hurley Forest Fire Station 25267 Auberry Clovis, California 93612	Permitted closure and removal of one underground storage tank; large quantity hazardous waste generator. No reported violations. Site is approximately ¼ mile south of proposed transmission line.

No abandoned mines recorded by the California Department of Conservation were identified in the primary study area. However, within the Millerton Lake watershed, 57 historical gold mines, one active gold mine, and two historical sand and gravel mines were identified. A survey conducted in 2003 by BLM in support of the Investigation identified three abandoned mine sites within the Temperance Flat RM 274 Reservoir Area, including the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. These mines include multiple adits and millsites. Contaminants associated with mining and related activities may include mercury and gold, which are recovered as byproducts from some gravel mining operations, especially in areas affected by historical gold mining, and naturally-occurring contaminants, such as metallic sulfides and/or sulfosalts typically associated with gold deposits (see Chapter 15, "Hydrology – Surface Water Quality," for further discussion). Other potential hazards associated with abandoned mines include undetonated explosives, decomposed support timbers, unstable ground and rocks, obscure vertical workings, and water-filled excavations (Springer 2005). These hazards pose potential risks to casual entrants.

West Nile Virus

All mosquito species are potential vectors of organisms that can cause disease to pets, domestic animals, wildlife, and humans. WNV has become an endemic disease in California and like other encephalitic viruses, can cause serious illness. People who are infected may have a variety of symptoms that can include fever, head and body aches, nausea, vomiting, swollen lymph glands, and skin rash. Only about 1 in 150 infected people will develop a serious illness that may require hospitalization. Elderly people are at highest risk of developing the severe form of WNV and are at an increased risk of long-lasting physical and mental disorders. The severe form of the disease can be fatal (CDC 2012a, DPH and MVC 2012).

Mosquito species are broadly separated into two groups according to where they lay eggs, floodwater mosquitoes and standing water mosquitoes. Adult female floodwater mosquitoes lay eggs on mud or previously submerged vegetation. The eggs may remain dormant for days, months, or even years until they are flooded, at which time larvae hatch. Standing water mosquitoes lay eggs on the water surface. The eggs float on the surface for a few hours to a few days until the larvae hatch into the water. Floodwater mosquito larval development (breeding) sites include irrigated pastures, rice

fields, seasonally flooded duck clubs and other managed wetlands, tidal wetlands, riparian corridors, and snowmelt pools. These intermittent or seasonally flooded habitats can be among the most productive sources of mosquitoes because they are often free of natural predators. Standing water mosquito breeding sites include artificial containers, treeholes, catch basins, open ditches, retention/detention ponds, natural or constructed ponds and wetlands, stormwater management devices, and along the edges of flowing streams. Sources are found everywhere from highly urban areas to natural wetlands and often produce multiple generations of mosquitoes each season (DPH and MVC 2012).

Severe WNV symptoms consist of West Nile encephalitis (inflammation of the brain), West Nile meningitis (inflammation of the membrane around the brain and spinal cord), and West Nile acute flaccid paralysis (inflammation of the spinal cord). Of the total WNV cases reported to the Centers for Disease Control and Prevention (CDC), 2,734 consisted of the severe West Nile neuroinvasive diseases listed above (CDC 2012b). It is important to note that these statistical data include only those cases reported to the CDC. Because most people infected do not experience symptoms and those who do experience symptoms may not seek medical attention, the epidemiological information discussed above does not include all cases of WNV infection.

Both Madera and Fresno counties have reported cases of WNV (DPH 2012a). Mosquito habitat for all the species' lifecycles is located in this geographic region within several miles of wetted portions of the San Joaquin River, bypasses, and tributaries. These habitats are also occupied by predatory fish and other insects that feed on mosquitos.

Valley Fever

Valley fever (*Coccidioidomycosis*) is an infection, usually targeting the lungs, which results from inhalation of the fungus *Coccidioides immitis*. These spores live in soil and generally are limited to areas of the southwestern United States, Mexico, and parts of Central and South America. It can be only contracted from inhalation of spores; it cannot be passed from person to person. In California, it is primarily found in the southern San Joaquin Valley. Spores can enter the air when ground-moving activities, including natural disasters such as earthquakes or excavation activities, disturb spore-bearing soil. Approximately 60 percent of exposed people experience symptoms. Infection can cause flu-like symptoms, and if it is

disseminated to organs other than the lungs, it can lead to severe pneumonia, meningitis, and death.

Fresno and Madera counties are considered "highly endemic" because they have an incidence rate of more than 20 cases per 100,000 population per year. It is reported that average incidence rates were 475 cases per 100,000 people in Fresno County, and 24 cases per 100,000 people in Madera County (DPH 2012b). Although Fresno and Madera counties are considered highly endemic, the incidence of valley fever in Fresno County varies significantly by location, with the majority of cases concentrated in the southwest and central portions of the county (MacLean 2011). The primary study area includes portions of the eastern extent of Fresno County, near the mountain region, which is considered a less endemic area. Nevertheless, the spores that cause valley fever may be present in the primary study area and could be disturbed and become airborne during earth-moving activities. A site-specific evaluation would be needed to confirm the soil types and presence of spores.

Naturally Occurring Asbestos

Asbestos is a term applied to several types of naturally occurring fibrous materials found in rock formations throughout California (i.e., naturally occurring asbestos, or "NOA"). Exposure and disturbance of rock and soil that contains asbestos can result in the release of fibers to the air and consequent exposure to the public. All types of asbestos are now considered hazardous and pose public health risks. Asbestos is commonly found in ultramafic rock, including serpentinite. Two forms of asbestos are associated with serpentinite: chrysotile asbestos and tremolite/actinolite asbestos. As discussed in detail in Chapter 11, "Geology and Soils," the primary study area is composed of volcanic basalt, the older portion of the Mehrten Formation, and older granitic and rocks of the Sierra Nevada Batholith. These types of rocks do not contain NOA. Furthermore, the California Geological Survey has prepared a publication entitled *General Location Guide for Ultramafic Rocks in California — Areas More Likely to Contain Naturally Occurring Asbestos* (Churchill and Hill 2000). A review of this publication indicates that the primary study area is not located in an area that is likely to contain NOA.

School Safety

School-aged children are considered to be particularly sensitive to adverse impacts resulting from exposure to hazardous

materials, substances, or waste. Public Resources Code Section 21151.4 requires that project proponents evaluate projects that are proposed within one-quarter mile of a school to determine whether release of hazardous air emissions or hazardous substances resulting from project implementation would pose a human health or safety hazard. The following schools are located in the vicinity of the primary study area:

- Foothill Middle School, located at 29147 Auberry Road in Prather, California (approximately 2 miles east of the proposed reservoir)
- Auberry Elementary School, located at 33367 Auberry Road in Auberry, California (approximately 2.5 miles east of the proposed reservoir)
- Friant Elementary School, located at 17220 Burroughs Avenue in Friant, California (approximately 3 miles west of the proposed transmission line)

Wildland Fire

The California Department of Forestry and Fire Protection has developed fire hazard severity zones as a way to predict fire damage. The zones take into account the potential fire intensity and speed, production and spread of embers, fuel loading, topography, and climate (e.g., temperature and the potential for strong winds). Proposed facilities would be constructed in both Federal Responsibility Areas and State Responsibility Areas. With the State Responsibility Areas, facilities would be constructed in areas classified as moderate to high fire hazard severity zones (CAL FIRE 2007a, 2007b).

Aircraft Safety

Collisions between aircraft and wildlife can compromise the safety of passengers and flight crews. Damage to an aircraft resulting from a wildlife collision can range from a small dent in the wing to catastrophic engine failure, destruction of the aircraft, and potential loss of life. Damage or potential damage caused by birds and other wildlife is termed a “strike” or “strike hazard.” Federal Aviation Administration (FAA) regulations recommend a separation of at least 5 statute miles from airport facilities to reduce risk of damage to aircraft resulting from high-speed collisions with birds or the ingestion of birds into aircraft engines (FAA 2007). In addition to bird strike, CEQA requires an evaluation of potential hazards to people residing or working in a project area that is within 2 miles of a public airport or in the vicinity of a private airstrip.

Airports and airstrips in the region and their distance from the primary study area are listed in Table 21-2.

As shown in Table 21-2, there are no airports within 5 miles of the FAA-recommended distance for evaluation of bird strike hazards, and there are no airports or airstrips within 2 miles of the primary study area for evaluation of potential hazards to people working in the project area.

Table 21-2. Airports and Airstrips in the Vicinity of the Primary Study Area

Name	Approximate Distance and Direction from Primary Study Area
Arnold Ranch Airport	6 miles southwest
Fresno Yosemite International Airport	12 miles south
Sierra Skypark Airport	16 miles southwest
Fresno Chandler Executive Airport	18 miles south
Madera Municipal Airport	20 miles west
Sallaberry Ranch Airstrip	23 miles northwest

Electromagnetic Fields

EMFs are areas surrounding a source that are influenced by the flow of electricity. EMF sources could include electrical transmission lines, generators, or other magnetized materials.

There has been continued public concern about long-term exposure to high-voltage transmission lines and other EMF sources. However, available evidence has not established a conclusive link between EMF exposure and human or animal health hazards. In light of these inconclusive results, organizations such as the CPUC, National Institute of Environmental Health Sciences, World Health Organization, and National Academy of Science have found there is no evidence that EMF exposure affects most health outcomes. The studies indicating an association between EMF exposure and increased risk of childhood leukemia have not been reproduced by laboratory evidence and lack a scientific explanation (NIEHS 2002).

In the Temperance Flat Reservoir Area, three 115-kV PG&E transmission lines connect the power generation systems at the Kerckhoff and Kerckhoff No. 2 powerhouses to the regional and statewide electrical grid. East of the Temperance Flat Reservoir Area, a high-voltage PG&E electrical transmission corridor runs from north to south. Aboveground electrical

transmission lines extend from the electrical grid to electrical utility boxes in the recreation areas around Millerton Lake, and aboveground distribution lines provide electricity to water pumps that supply water to the recreation areas around Millerton Lake. Additional aboveground electrical distribution lines are located along the Millerton Lake boat ramp and Winchell Cove boat ramp (Reclamation and State Parks 2010).

The CPUC has not adopted numeric exposure limits. It has developed design guidelines to be incorporated into the design of new facilities to reduce EMF exposure. These design measures include increasing structure height, locating power lines near the right of way (ROW) centerline, reducing conductor spacing, and phasing circuits to reduce EMF strength.

Extended Study Area

The extended study area extending from Friant Dam to the confluence with the Merced River, San Joaquin River from Merced River to the Delta, and the Delta is now subject to changed instream flows associated with implementing the SJRRP. However, these changes in water flow would have no impacts on, nor would they be affected by, anthropogenic factors, valley fever, naturally occurring asbestos, wildland fire, aircraft safety, or EMF. Therefore, these public health and hazards for the extended study area are not discussed further in this section.

The discussion of WNV in the West Nile Virus section above does not pertain to the extended study area because implementing any of the action alternatives would not result in modifying land uses or provide increases in water supply that exceed historic amounts. The delivery of water supplies generated by implementing any of the action alternatives and delivering water supplies to the SOD CVP and SWP water service areas would not result in a modification of physical conditions that would result in an increase in mosquito habitat or associated mosquito populations that could pose an increased risk of West Nile virus. Changes in San Joaquin River flows associated with operations of the action alternatives would remain within the historic flow range and would not be substantially different from no action conditions. Mosquito habitats and populations in the extended study area would not substantially vary from existing conditions and the No Action Alternative.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine significance of impacts on public health and hazards. It then discusses the impacts of the Investigation and proposes mitigation where appropriate. The potential impacts on public health and hazards and associated mitigation measures are summarized in Table 21-3.

Methods and Assumptions

This analysis considers foreseeable hazardous materials use, risk of wildland fire, potential risk of damage from acts of terrorism, potential for EMF impacts associated with the proposed electrical transmission line, and risk of disease resulting from constructing the project facilities and delivery of water supplies from the new reservoir. This analysis identifies how these hazards could expose individuals or the environment to health and safety risks. This analysis is based on a review of existing information and various site investigation reports prepared for the Study Area, planning documents applicable to the Study Area, fire insurance maps, consultation with appropriate agencies, and field reconnaissance.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A “[s]ignificant effect on the environment” means “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project” (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

Table 21-3. Summary of Impacts and Mitigation Measures for Public Health and Hazards

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-1: Potential for Exposure to Hazardous Materials	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS	None Required	LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-2: Potential Emission of Hazardous Materials within 0.25 Mile of a School	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-2: Reduce Exposure of Hazards to Schools	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-3: Increase Hazards from a Known Hazardous Materials Contamination Site	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-3: Reduce Hazards from Hazardous Material Sites	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 21-3. Summary of Impacts and Mitigation Measures for Public Health and Hazards (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-4: Interfere with Evacuation Routes and Emergency Vehicle Access	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	HAZ-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-5: Locate Electrical Transmission Facilities Near a School	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-6: Increase Hazards of Wildland Fires	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 21-3. Summary of Impacts and Mitigation Measures for Public Health and Hazards (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-7: Increase Hazards of West Nile Virus	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	HAZ-7: Reduce Hazards of West Nile Virus	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-8: Increase Hazards of Valley Fever	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-8: Reduce Hazards of Valley Fever	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-9: Increase Exposure to Damage from Acts of Terrorism	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 21-3. Summary of Impacts and Mitigation Measures for Public Health and Hazards (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
HAZ-10: Increase Exposure to Hazards Associated with Abandoned Mine Sites	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
HAZ-11: Increase Potential for Blast-Related Injury during Construction	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	HAZ-11: Reduce Hazards from Blasting	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
PS = potentially significant

The following significance criteria are based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on public health and hazards would be significant if project implementation would do any of the following:

- Expose construction workers, the public and the environment to hazardous materials including routine transport, use, disposal, or accident conditions
- Emit hazardous emissions or involve the handling of hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school
- Be located on a site that is included on a list of hazardous materials sites (Cortese List) compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment
- Interfere with emergency evacuation routes and emergency vehicle access
- Expose people or structures to a significant risk of loss, injury, or death involving wildland fires
- Locate electrical transmission facilities less than 150 feet from the property line of an existing or approved school site
- Potential impacts related to health hazards from exposure of people to WNV (or vector-borne illnesses)
- Potential impacts related to health hazards from the exposure of people to valley fever spores
- Increase hazards from the potential risk of damage from acts of terrorism
- Expose construction workers or the general public to hazards associated with abandoned mine sites

Topics Eliminated from Further Consideration

There are no airports within 5 miles of the FAA-recommended distance for evaluation of bird strike hazards, and there are no

airports or airstrips within 2 miles of the primary study area for evaluation of potential hazards to people working in the project area. The airport closest to the primary study area is Arnold Ranch airport, located approximately 6 miles to the southwest in Madera, California. Similarly, the project is not in an area covered by an adopted airport land use plan. These issues are not discussed further in this section.

Water safety hazards posed by the alternatives to water-based recreationists are assessed in Chapter 22, "Recreation;" therefore, this topic has been eliminated from further analysis in this chapter. Similarly, the impacts of hazardous materials on water quality, including impacts related to inundation of historic mine sites, are assessed in Chapter 15, "Hydrology – Surface Water Quality."

Implementing any of the action alternatives would increase the amount of water available for delivery from Millerton Lake. Portions of this water would be conveyed directly to Friant Division water contractors or down the San Joaquin River and rediverted or exchanged for delivery to SOD CVP and SWP water contractors. The conveyance of these water supplies would not exceed channel capacity of the San Joaquin River or Delta waterways. No change in existing use of adjacent lands would occur. Because implementing any of the action alternatives would not result in San Joaquin River or Delta instream flows that would exceed channel capacity or result in changes to land or water uses, their implementation would not create a hazard and would not pose a threat to the health of members of the public using the San Joaquin River or Delta. Therefore, none of the five action alternatives would have an impact on public health or hazards in the San Joaquin River or Delta.

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," of this Draft EIS, implementing any of the action alternatives would increase water reliability for the Friant Division and SOD CVP and SWP water contractors during most water-year types. The delivery of this additional water would not exceed historic maximum deliveries or existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment. Because implementing any of the action alternatives would not result in land use changes or other physical consequences in the CVP and SWP service areas, their implementation would not create a hazard and would not pose

threat to public health. Therefore, none of the five action alternatives would have an impact on public health or create hazards in the CVP or SWP service areas. This issue is not discussed further in this analysis.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact HAZ-1: Potential for Exposure to Hazardous Materials

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable future projects or continuation of existing plans would occur that would result in any increase in exposure of the public or the environment to hazards, hazardous materials, or hazardous waste in the project area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Project construction and operation, including the inspection, maintenance, and repair of project features, may involve the transportation, use, or storage of hazardous materials, including the potential use of explosives and drilling during construction of the diversion tunnel. Local, State, and Federal safety codes and procedures related to hazardous material transport, handling, use, and disposal would be followed for project construction and operation to minimize the risk of a hazardous materials release or exposure to construction workers. However, an accidental release resulting from project activities could create a health risk for construction workers and the public and could degrade the environment.

Project facilities proposed for construction would be located within the primary study area. All construction activities along the San Joaquin River would be conducted during months when instream flows are managed outside the flood season (e.g., June to September) in areas not protected by flow management facilities such as the cofferdams, diversion

channels, or other similar structures. Hazardous materials to be used during the construction of the project would include gasoline, diesel fuel, oil, solvents, and lubricants associated with vehicles and construction activities. Construction workers and the general public could be exposed to hazards and hazardous materials as a result of improper storage, handling, or use during construction activities; transportation accidents; or fires, explosions, or other emergencies. Construction workers could also be exposed to hazards associated with accidental releases of hazardous materials, which could result in adverse health impacts.

Implementing any of the action alternatives would involve both demolition of existing facilities and construction of new structures. Structures constructed before 1981 may contain asbestos, and structures painted before 1978 may have lead-based or lead-containing paint. These buildings may also contain electrical components that contain PCBs and mercury. Improper handling could expose construction workers, the public, and the environment to these hazardous materials.

Possible contaminants would be stored at the aggregate quarry, batch plant, staging area, and waste disposal area. Because of uncertainties in adequacy of rock for aggregate, three quarry and associated batch plant options with varying locations are being considered within each action alterative, as described in Chapter 2, “Alternatives.” Construction staging would occur in one dedicated area directly above the dam’s left abutment. This staging area would be approximately 21 acres in size and outside the proposed inundation area. Aggregate extraction and transport could require operation of heavy equipment next to and in Millerton Lake. Excavation and extraction of aggregate from these sources, and transport of aggregate to construction areas would require the use of construction equipment, which would involve the use of various hazardous materials such as fuel, oils, grease, and other petroleum products. These contaminants could be accidentally introduced into surface and groundwater, either directly or through surface runoff. Chapter 2, “Alternatives,” of this Draft EIS identified environmental commitments to be implemented as part of project development, including the implementation of a Water Quality Control Plan designed to minimize or avoid discharge of materials to surface waters.

The Kerckhoff Project powerhouses and Kerckhoff-Le Grand and Kerckhoff-Sanger transmission lines would be subject to inundation as a result of implementing this project. The

majority of mechanical and electrical equipment for both powerhouses would be removed and salvaged. Inundated sections of the Kerckhoff–Le Grand and Kerckhoff–Sanger transmission lines (approximately 4 miles) would be reconstructed as the Le Grand–Sanger transmission line. Other utilities that could be affected by inundation include potable water, power distribution, telecommunications, and septic facilities. If such utilities are affected by inundation, they would be demolished and relocated (if the associated facility is relocated or required to maintain distribution). Utility demolition or modification, as well as the demolition of other structures and facilities that would be inundated as a result of implementing this project, could potentially require handling of hazardous waste including asbestos, lead paint, and wood preservatives. This hazardous waste, along with any additional forms of hazardous waste materials generated by project construction, would be removed to an approved landfill for disposal according to regulatory requirements.

After the dam modifications are complete, hazardous materials, such as oils, grease, or solvents, could be used in small amounts during project operation. In addition, workers would be required to inspect new facilities, such as the diversion tunnel, as part of routine maintenance activities. As stated above, local, State, and Federal safety codes and procedures would be followed for project operation to minimize the risk of a hazardous materials release or exposure to other safety hazards.

As described in Chapter 2, “Alternatives,” Reclamation has incorporated environmental commitments into the action alternatives to reduce impacts on water quality. Many of these water quality measures apply to public health and hazards because they further limit the potential for accidental releases and/or exposure to hazardous materials. These environmental commitments include the development and implementation of a SWPPP, spill prevention and water quality control plan, and compliance with all applicable permits and requirements relating to water quality protection. Additional water quality BMPs would be implemented to avoid spills from construction equipment and include storage of hazardous materials in double containment, proper disposal of hazardous and nonhazardous products, monitoring of on-site vehicles for fluid leaks and regular maintenance, and containment of bulk storage tanks. BMPs that would be implemented to avoid and/or minimize potential impacts associated with dam construction include minimizing potential impacts associated

with equipment contaminants, minimizing potential impacts associated with access and staging, removing temporary fills as appropriate, and removing equipment from the river overnight and during high flows. These BMPs are further described in Chapter 2, "Alternatives."

As described in Chapter 2, "Alternatives," environmental commitments included in all action alternatives include the preparation and implementation of a Hazardous Materials Business Plan, spill prevention and control plan, and worker health and safety requirements. The actions called for by these plans and requirements would enable the construction crews to safely manage hazardous materials and respond to events where hazardous materials may be accidently released. With implementation of these plans and requirements, the potential environmental threat associated with accidental release of hazardous materials would be substantially lessened, and exposure to the environmental and personnel would be minimized.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact HAZ-2: Potential Emission of Hazardous Materials Within 0.25 Mile of a School

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans would occur that would result in any increase in hazards from potential emission or handling of hazardous materials within 0.25 mile of a school.

There would be **no impact** under the No Action Alternative.

Action Alternatives As described in the Affected Environment section, there are no schools located within 0.25 mile of the primary study area. However project implementation could expose schools along designated truck routes to hazardous materials and waste during the routine transport of materials to the project site.

Foothill Middle School and Auberry Elementary are located 2.5 miles east of the proposed Temperance Flat RM 274 Reservoir site along Auberry Road, which is a designated truck route for this project. As described for Impact HAZ-1 above,

the project would involve transportation of hazardous materials such as fuels (gasoline and diesel fuel), oils, hydraulic fluids, lubricants, and cleaners. Although storage and handling of hazardous materials would not occur within 0.25 mile of a school, the transportation of hazardous materials along Auberry Road could place Foothill Middle School and Auberry Elementary School at risk of exposure to hazardous materials as a result of this project.

Accidental releases during the transport of hazardous materials or attributable to other equipment or maintenance failure could result in an inadvertent spill or release. Depending on the amount released, this accidental release could pose a potential hazard to nearby school occupants.

This impact would be **potentially significant** under the action alternatives. Mitigation for this potentially significant impact is proposed below in the Mitigation Measures section.

Impact HAZ-3: Increase Hazards from a Known Hazardous Materials Contamination Site

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans would occur that would result in any increase in hazards from a known hazardous materials contamination site in the project area.

There would be **no impact** under the No Action Alternative.

Action Alternatives To determine the potential for hazardous materials within the primary project area, a records search of the applicable hazardous materials databases was conducted to identify known hazardous materials sites in the vicinity of the primary study area. The search reviewed more than 100 records for information on sites of “environmental concern” at least three-quarters of a mile from the project component sites. These sites include underground and aboveground storage tanks, underground diesel fuel tanks, a gasoline service station, a wastewater treatment plant, hazardous materials and waste handling sites, and other facilities.

One spill was recorded at one of the 14 known hazardous materials sites identified in the primary study area: the fourth site listed in Table 21-1, which is located 0.75 miles

downstream from Friant Dam. The other 13 sites had no reported violations.

As noted earlier, the first three sites listed in Table 21-1 are underground storage tanks that are located between 50 feet and 600 feet from the proposed inundation area. Inundation of existing underground storage tanks could result in contamination of water in Millerton Lake and downstream in the San Joaquin River.

This impact would be **potentially significant** under the action alternatives. Mitigation for this potentially significant impact is proposed below in the Mitigation Measures section.

Impact HAZ-4: Interfere with Evacuation Routes and Emergency Vehicle Access

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Even without the project, traffic volumes are expected to increase under the No Action Alternative and potentially decrease the level of service on area roadways, which could interfere with emergency evacuation routes and emergency vehicle access. These impacts would be minor and would not result in any substantial interference with emergency evacuation routes or emergency vehicle access in the project area.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives As described in Chapter 24, "Transportation, Circulation, and Infrastructure," regional and local roadways, including SR 99, SR 41, SR 145, Friant Road, Lake Road, Millerton Road, Sky Harbour Road, Auberry Road, North Fork Road, Road 206, Road 208, Road 210, Wellbarn Road, and Powerhouse Road, would be affected by personal vehicles, equipment, and trucks carrying construction materials to and from the project site. In addition, other roads located on land owned by BLM could be affected by the alternatives. Some of these roads are designated as motorized routes, such as Smalley Road, and others are designated as non-motorized routes.

Emergency access to the primary study area could be affected by construction of the project features, and construction-related traffic could delay or obstruct the movement of emergency vehicles due to lane or road closures or roadway detours. Thus,

construction activities could impair the ability of local agencies to respond to an emergency.

This impact would be **potentially significant** under the action alternatives. Mitigation for this potentially significant impact is proposed below in the Mitigation Measures section.

Impact HAZ-5: Locate Electrical Transmission Facilities Near a School

Primary Study Area
No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans would occur that would result in any increase in the risk of EMF exposure in the project area.

There would be **no impact** under the No Action Alternative.

Action Alternatives New transmission lines and other power facilities would be constructed as part of the action alternatives; therefore, EMF levels would increase and there would be some potential for increased exposure by people and the environment to EMF. The California Department of Education regulations require minimum distances between a new school and the edge of a transmission line ROW. The setback distances are 100 feet from the edge of the transmission line ROW for 115- kV lines. Because none of the project components would be within one-quarter mile of an existing or proposed school, this distance criterion would be met.

There would be **no impact** under the action alternatives.

Impact HAZ-6: Increase Hazards of Wildland Fires

Primary Study Area
No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans would occur that would result in any increase in the risk of wildland fire in the project area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Temperance Flat RM 274 Dam site and surrounding areas are located in moderate to high fire hazard severity zones. The area consists mostly of agricultural and

undeveloped lands, and nearby residences could be exposed to wildland fire if one were sparked during construction of the project.

The use of construction equipment, increased human activity, storage and use of potentially flammable materials and presence of charged utility lines increase the potential for fire ignition in the primary study area. Road construction and vegetation clearing would require operation of construction equipment in vegetated areas which would contribute to wildfire potential.

Relevant safety standards/procedures related to fire prevention would be incorporated into the project design, and would be used during construction activities and project operation and maintenance. Applicable safety standards and procedures include the California Building Code; the Fresno and Madera County Fire Plans; U.S. Forest Service safety requirements regarding fire hazards; CPUC General Order 95, which provides procedures for proper removal, disposal, and placement of poles, wires, and associated infrastructure.

Project materials and workers traveling to the construction sites via the designated access roads and haul roads could also increase the risk of fire hazard over their route. Operation of motor vehicles throughout the region, particularly when vegetation adjacent to roadways is dry, imparts a certain level of fire potential from accidental combustion (e.g., sparks), hot metal (e.g., tail pipes, motors), or traffic accidents which could result in fire. Project activities, including those intended to mitigate impacts on vegetation, are expected to reduce the overall fuel loading around Millerton Lake and vicinity portion of the primary study area, thereby reducing the long-term fire hazard.

As described in Chapter 2, “Alternatives,” Reclamation would prepare and implement a fire protection and prevention plan to minimize the risk of wildfire and the potential threat to workers, property, and the public. With implementation of these practices and measures for fire protection, prevention, and control, the potential impact of wildfire would be reduced to a minimum.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact HAZ-7: Increase Hazards of West Nile Virus

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans would occur that would result in substantially increased hazards associated with WNV. Continuation of increased instream flows from the SJRRP would result in increased hazards associated with WNV related to an increase in the extent of wetted areas.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives The proposed Temperance Flat RM 274 Reservoir would be formed by a rolled compact concrete arch gravity dam located in the upstream portion of Millerton Lake at RM 274. Structures, ground depressions, excavation pits, and other features associated with construction and/or implementation of action alternatives that hold permanent sources of standing water provide aquatic habitats for mosquitos and other vector species as an unintended consequence. All counties in the primary study area have reported cases of WNV, and habitat for all mosquito species' life cycles is located in this geographic region within several miles of wetted portions of the San Joaquin River. With the long history of mosquitos in these areas, implementing any of the action alternatives would not introduce a new potential health hazard but could contribute to the spread of and/or increase existing mosquito populations. The creation of standing water during facility construction and the establishment of a new reservoir would constitute a potential additional opportunity where mosquitoes could breed, resulting in an additional source of vector-borne illness from WNV.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact HAZ-8: Increase Hazards of Valley Fever

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or continuation of existing plans or plans would occur that would

result in increased hazards associated with valley fever. Invariably, new construction activities would occur under the No Action Alternative, but such activities would be similar to those under existing conditions.

There would be **no impact** under the No Action Alternative.

Action Alternatives Ground-disturbing activities associated with the proposed Temperance Flat RM 274 Dam and Reservoir, new and relocated transmission line corridors, and construction of other reservoir-related project features would increase fugitive dust emissions that could lead to valley fever exposure if spores are present. The CDC considers valley fever to be endemic in California, and has identified Fresno and Madera counties as "highly endemic" (more than 20 cases per 100,000 population per year). However the incidence of valley fever in Fresno County varies significantly by location. The primary study area is considered to have a lesser potential for incidences of valley fever when compared to western portions of the county. However, because this disease is considered to be particularly prevalent in these counties, the potential exists for valley fever to be present in the primary study area and could be disturbed and become airborne during earthmoving activities.

According to the CDC, workers engaged in soil-disturbing activities in endemic areas should be considered at risk for the disease. Furthermore, severe dust storms can carry fungal spores outside the endemic areas into neighboring counties, where outbreak follow. Since soil conditions within the primary study area could potentially support valley fever spores, it is anticipated that implementing any of the action alternatives could result in health hazards from the exposure of workers and nearby residents to valley fever spores.

As described in Chapter 2, "Alternatives," Reclamation has identified a number of environmental commitments which are incorporated into the project to reduce impacts to air quality. Many of these air quality measures are aimed at fugitive dust emissions which would also reduce the potential risk of valley fever exposure. These measures include compliance with Regulation VIII, and the following SJVAPCD-recommended enhanced and additional control measures to further reduce fugitive dust emissions:

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from adjacent project areas with a slope greater than 1percent.
- Suspend excavation and grading activity when winds exceed 20 miles per hour.
- Limit area subject to excavation, grading, and other construction activity at any one time.

However, even with these dust abatement measures, fugitive dust generated during construction could expose workers to valley fever spores if present in local soils.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact HAZ-9: Increase Exposure to Damage from Acts of Terrorism

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or plans would occur that would result in any increase in exposure of the public or environment to damage from acts of terrorism in the project area.

There would be **no impact** under the No Action Alternative.

Action Alternatives The number and high profile of international and domestic terrorist attacks during the last decade presents a new and realistic threat to the safety and security of the United States population, infrastructure, and resources. There is a potential for intentional destructive acts, such as sabotage or terrorism events, to cause impacts on human health and the environment. Current analysis of terrorist goals and motivations points to domestic and international critical infrastructure and key resources (CI/KR) as potentially prime targets for terrorist attacks (DHS 2013). The U.S. Department of Homeland Security (DHS) has developed the National Infrastructure Protection Plan (NIPP) to provide an approach for integrating the country's many CI/KR protection initiatives into a single national effort.

The NIPP delineates domestic infrastructure and resources into 14 specific sectors, including Agriculture, Defense, Dams, and

Energy. For purposes of this analysis, the Dam Sector Specific Plan and Energy Sector Specific Plan would be most relevant to this project. The Energy Sector includes the "production, refining, storage, and distribution of oil, gas, and electric power, except for hydroelectric and commercial nuclear power facilities" (DHS and U.S. Department of Energy 2007). Although electrical transmission lines are not specifically referred to in the NIPP, they would generally fall into the category of distribution of electric power and are therefore considered a potential target of terrorist attack. Both plans were developed to complement the NIPP in achieving a safer, more secure, and more resilient Dams and Energy Sectors by lessening vulnerabilities, deterring threats, and minimizing the consequences of terrorist attacks, natural disasters, and other incidents.

As indicated in the Energy and Dam Sectors Specific Plans, potential consequences of a terrorist attack on the project site could include:

- Disruption of electrical service
- Physical damage to system features and surrounding facilities
- Flooding and Inundation
- Personal injury or loss of human life

The specific consequences of disruption at the proposed Temperance Flat RM 274 Dam and Reservoir could include loss of electrical generating capacity or transmission equipment, which could affect local or regional electrical power grids. It also could lead to loss of control of water supply, which could affect agriculture, river navigation, and municipal water supply. Failure of the flood control mission of a dam can result from disruption or manipulation of the facility's control mechanisms, as well as from physical destruction of the dam. In the unlikely event of a dam failure or uncontrolled water release, downstream flooding could result in extensive casualties and widespread property damage. Failure of Temperance Flat RM 274 Dam could also compromise the operation at other dams downstream such as Friant Dam, thereby increasing the overall consequences.

Temperance Flat RM 274 Dam would not likely be a high-priority target for acts of terrorism because of its location in a

rural area. The Dam Sector Specific Plan indicates that "because most of the dams and levees in the United States are located in rural areas, they have not been a "high crime" target; in fact, most criminal activities associated with sector assets have been relatively minor, such as vandalism and theft." Despite this fact, the Dams Sector recognizes that assets must be considered possible terrorist targets because such attacks at select sites have the potential to cause significant downstream casualties and economic losses (DHS 2010).

As stated in the Dam Sector Specific Plan, Federal critical infrastructure and key resources owners and operators – in this case, Reclamation – are self-regulating and therefore establish their own protective programs that involve identifying their critical assets, conducting vulnerability assessments, and implementing any required recommendations. Collaborative efforts of members from the private sector, government agencies, and professional organizations, are also leading a significant voluntary effort to increase planning and preparedness, including infrastructure protection and cyber security. These efforts also include building redundancy and implementing backup systems to minimize disruptions or alleviate undesirable consequences, and incorporating hazard resistance into facility design (DHS 2010).

While the potential for a terrorist attack exists for any critical infrastructure system, Temperance Flat RM 274 Dam is not considered an optimal target, and the potential threat would be no greater than for other dams of similar scale located in the country.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact HAZ-10: Increase Exposure to Hazards Associated with Abandoned Mine Sites

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or plans would occur that would result in any increase in hazards to construction workers or the general public associated with abandoned mine sites.

There would be **no impact** under the No Action Alternative.

Action Alternatives As discussed above, three abandoned mine sites are located within the Temperance Flat Reservoir Area, the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. These mines include multiple adits and millsites. Potential hazards associated with abandoned mines include undetonated explosives, decomposed support timbers, unstable ground and rocks, obscure vertical workings, and water-filled excavations (Springer 2005). These hazards pose potential risks to casual entrants. Because none of the project features or recreational facilities would be located in the vicinity of these mine sites, the action alternatives would not expose construction workers or the general public to hazards associated with abandoned mine sites.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact HAZ-11: Increase Potential for Blast-Related Injury during Construction

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built. Moreover, no known changes from reasonably foreseeable projects or plans would occur that would result in any increase in hazards to construction workers or the general public associated with blasting.

There would be **no impact** under the No Action Alternative.

Action Alternatives Blasting may be required for excavation and removal of rock during construction of the diversion tunnel. Blasting entails the placement of explosive materials into a borehole, which is then ignited. The subsequent explosion generates air blasts and seismic waves that fracture the surrounding rock. Reasonably foreseeable accidents associated with blasting include accidental discharge and expulsion of materials beyond the expected distance (i.e., flyrock).

Explosive materials are ignited from sources of energy. During construction-related blasting activities, materials are ignited from the controlled used of electricity. Depending on the amount of material and method of storage, the size and extent of an accidental discharge could cause extensive destruction. Injuries and fatalities could result from the initial explosion

and/or secondary effects such as fires and flyrock (i.e., mud, water, or fragments of rock that accidently travel outside of the expected blast area). Creation of flyrock can be the result of many factors, including anomalies in the geology and rock structure, poor communication, and incorrect blasthole layout and loading.

Section 12101 through 12103 of the California Health and Safety Code describe permit requirements for manufacturing, possession, transportation, and use of explosives, which would apply to blasting activities on the project site, and these permits must be issued or endorsed by the jurisdiction in which blasting would take place. OSHA's Construction Safety and Health Outreach Program sets standards for blaster qualifications, transportation, storage, and loading, execution, and post-explosion requirements. However, accidental discharge of materials or production of flyrock remains possible and could cause injury or fatalities to construction workers or the general public.

This impact would be **potentially significant** under the action alternatives. Mitigation for this potentially significant impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses mitigation measures for each potentially significant impact described in the environmental consequences section, as presented in Table 21-3.

No mitigation is required for Impacts HAZ-1, HAZ-5, HAZ-6, HAZ-9, or HAZ-10 within the primary study area because there would be no impact or the impact would be less than significant for all action alternatives. None of the impacts apply to the extended study area.

Impacts HAZ-2, HAZ-3, HAZ-4, HAZ-7, HAZ-8, and HAZ-11 within the primary study area would be potentially significant for all action alternatives. Implementing Mitigation Measures HAZ-2, HAZ-3, HAZ-4, HAZ-7, HAZ-8, and HAZ-11 would reduce these impacts to less than significant for all action alternatives.

Mitigation Measure HAZ-2: Reduce Exposure of Hazards to Schools

Foothill Middle School and Auberry Elementary are schools located within 0.25 mile of a designated truck route (Auberry Road). To minimize the potential for an accidental spill or

release during transport of hazardous materials to the project site, Reclamation shall implement the following:

- Reclamation shall coordinate hazardous materials transportation routes with the Fresno County Fire Protection District, Madera County Fire Department, the County Sheriff's Offices in both Fresno and Madera counties (which are the designated offices of emergency services for the primary study area), U.S. Forest Service, California Department of Transportation, the California Highway Patrol, representatives from Foothill Middle School and Auberry Elementary, and each county office of emergency services that would be affected in the primary study area. Coordination efforts shall include disclosing and planning proposed hazardous material transportation routes and schedules to allow for site-specific modifications that would lessen the potential impact on nearby schools.

- Transportation of hazardous materials, such as diesel fuel, is regulated by the California Highway Patrol and the California Department of Transportation. Reclamation shall comply with these regulations, including display of proper placards on vehicles containing hazardous materials, and appropriate licensing of drivers.

Implementing Mitigation Measure HAZ-2 would reduce the potentially significant impact associated with the transport of hazardous materials within 0.25 mile of a public school (Impact HAZ-2) to a **less-than-significant** level.

Mitigation Measure HAZ-3: Reduce Hazards from Hazardous Material Sites

Three underground storage tanks identified in Table 21-1 are located between 50 feet and 600 feet from the proposed inundation area. To minimize the risk of waterway contamination resulting from inundation of underground storage tanks, Reclamation shall, before construction begins, permanently remove aboveground and underground storage tanks from areas that are subject to inundation and coordinate with Madera County and Fresno County environmental management departments responsible for their identification and closure.

Implementing Mitigation Measure HAZ-3 would reduce the potentially significant impact of waterway contamination resulting from inundation of underground storage tanks (Impact HAZ-3) to a **less-than-significant** level.

Mitigation Measure HAZ-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan

Reclamation will prepare and implement a TMP in coordination with local emergency service providers that will be used to ensure unimpeded emergency vehicular access and passage, develop detours to ensure acceptable traffic flow through and/or around the construction zone, and minimize traffic congestion. The TMP shall include plans to coordinate all construction activities with emergency service providers in the area. Emergency service providers shall be notified of the timing, location, and duration of construction activities.

Implementing Mitigation Measure HAZ-4 would reduce the potentially significant impact associated with interference with emergency evacuation routes and emergency vehicle access (Impact HAZ-4) to a **less-than-significant** level.

Mitigation Measure HAZ-7: Reduce Hazards of West Nile Virus

As part of final design, Reclamation shall prepare and implement a project-specific health and safety plan that specifies measures to be taken to routinely inspect construction areas to identify soil depressions, pools, or other standing water that may provide suitable breeding habitat for mosquitos. If identified, actions shall be taken to dewater, fill, or apply an approved treatment capable of eradicating identified mosquito populations. This would include identifying and grading excavated areas not located within the Temperance Flat Reservoir Area, including quarry sites used for construction purposes, to minimize the potential for formation of standing water both during and after construction activities cease. In addition, exposed side slopes in the proposed Temperance Flat RM 274 Reservoir that are subject to drawdown during future operations shall be graded to minimize the potential presence of standing water that may form during reservoir operations.

The plan shall provide a general description of the levels of personal protection and safe operating guidelines expected of each employee or contractor engaged in construction and/or fieldwork activities to minimize exposure to mosquitos. Measures shall include providing insect repellent for worker use at construction sites with a minimum of 23.8 percent

diethyl-meta-toulamide (DEET). The plan shall also specify steps to notify the appropriate city or county health department of dead birds seen on the construction site.

The plan also shall identify periodic evaluation of standing water that is created during drawdown of the new Temperance Flat RM 274 Reservoir. This evaluation shall occur annually until exposed reservoir side slopes erode to form minimal bodies of standing water capable of supporting mosquito breeding. As part of this evaluation, actions shall be taken to dewater, fill, or apply an approved treatment capable of eradicating identified mosquitos populations to the major bodies of standing water that pose substantial potential to support such populations.

With implementation of Mitigation Measure HAZ-7, potential health-related impacts from exposure to increased numbers of mosquitoes possibly caring disease such as WNV (Impact HAZ-7) would be minimized and reduced to a **less-than-significant** level.

Mitigation Measure HAZ-8: Reduce Hazards of Valley Fever

As part of final design, Reclamation will prepare and implement project-specific health and safety plan that is designed to test for presence of valley fever spores in the soil, and provide actions to minimize worker exposure. The plan will provide a general description of the levels of personal protection and safe operating guidelines expected of each employee or contractor engaged in construction and/or fieldwork activities to minimize exposure to blowing dust. Reclamation, its contractors, and/or its construction partners will coordinate development and implementation of this plan with jurisdictional agencies (e.g., Fresno County), as appropriate. The plan shall achieve the following performance criteria:

- Confirm presence or absence of valley fever spores in primary study area
- Provide training on the health hazards of valley fever and how to recognize symptoms of illness
- Control dust at the source and minimize worker exposure by watering exposed ground surfaces, limiting the amount of exposed open/cut ground, and covering

open loads of haul trucks and equipment where feasible

- Provide respiratory protection, such as National Institute for Occupational Safety and Health–approved N95 respirators, to reduce the risk of inhalation, when appropriate

- Establish a California Division of Occupational Safety and Health-compliant respiratory program that addresses respirator wearers and includes medical clearance to wear a respirator, fit testing, training, and procedures for cleaning and maintaining respirators, if applicable

- Minimize the transport of spores through development of BMPs, including proper use, maintenance, and washing of equipment, clothing, and enclosed spaces where concentrated levels of dust may occur

If valley fever spores are found to be present in local soils, implementing Mitigation Measure HAZ-8 would reduce potential health-related impacts from soil-disturbing activities and exposure to valley fever (Impact HAZ-8) to a **less-than-significant** level.

Mitigation Measure HAZ-11: Reduce Hazards from Blasting

To reduce the potential for accidental injury or death related to blasting, construction contractors whose work on the project site will include blasting will prepare and implement a blasting safety plan. This plan will be created in coordination with a qualified blaster, as defined by the Construction Safety and Health Outreach Program, Subpart U, Section 1926.901, and distributed to all appropriate members of construction teams.

Upon completion of a blasting safety plan, the construction contractor shall secure any required permits from the Fresno County Fire Protection District, Madera County Fire Department, and the County Sheriff's Offices in both Fresno and Madera counties (which are the designated offices of emergency services for the primary study area).

The plan will include, but is not limited to, the following performance criteria:

- Designate storage locations that meet ATF standards contained in 27 CFR Part 55
- Provide personal protective equipment for all construction personnel
- Establish an accident management plan that considers misfires (i.e., explosive fails to detonate), unexpected ignition, and flyrock
- Provide measures to protect surrounding property (e.g., netting, announcement of dates of expected blasting, barricades, audible and visual warnings)

Implementing Mitigation Measure HAZ-11 would reduce potentially significant impacts related to blasting activities (Impact HAZ-11) to a **less-than-significant** level.

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Chapter 22
Recreation

This chapter describes the affected environment for recreation, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion focuses on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (the San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The primary and extended study areas contain a number of parks and public lands offering diverse recreation opportunities, particularly associated with the many reservoirs, rivers, and other water bodies found throughout this portion of California. In addition, numerous recreation opportunities exist on private lands, including fishing, hunting, and other activities.

Primary Study Area

Recreation resources within the primary study area include the Millerton Lake SRA and the SJRG SRMA (Figure 22-1). The Millerton Lake SRA is managed by State Parks through agreements with Reclamation and CDFW. The SJRG SRMA is managed by BLM. Each of these areas is discussed in more detail below.

Millerton Lake State Recreation Area

The Millerton Lake SRA contains about 10,500 acres and is one of the most popular recreation areas in the San Joaquin Valley. The north side of the City of Fresno is 10 miles from the Millerton Lake SRA via Friant Road, while the town of Madera and SR 99 are about 22 miles to the west.

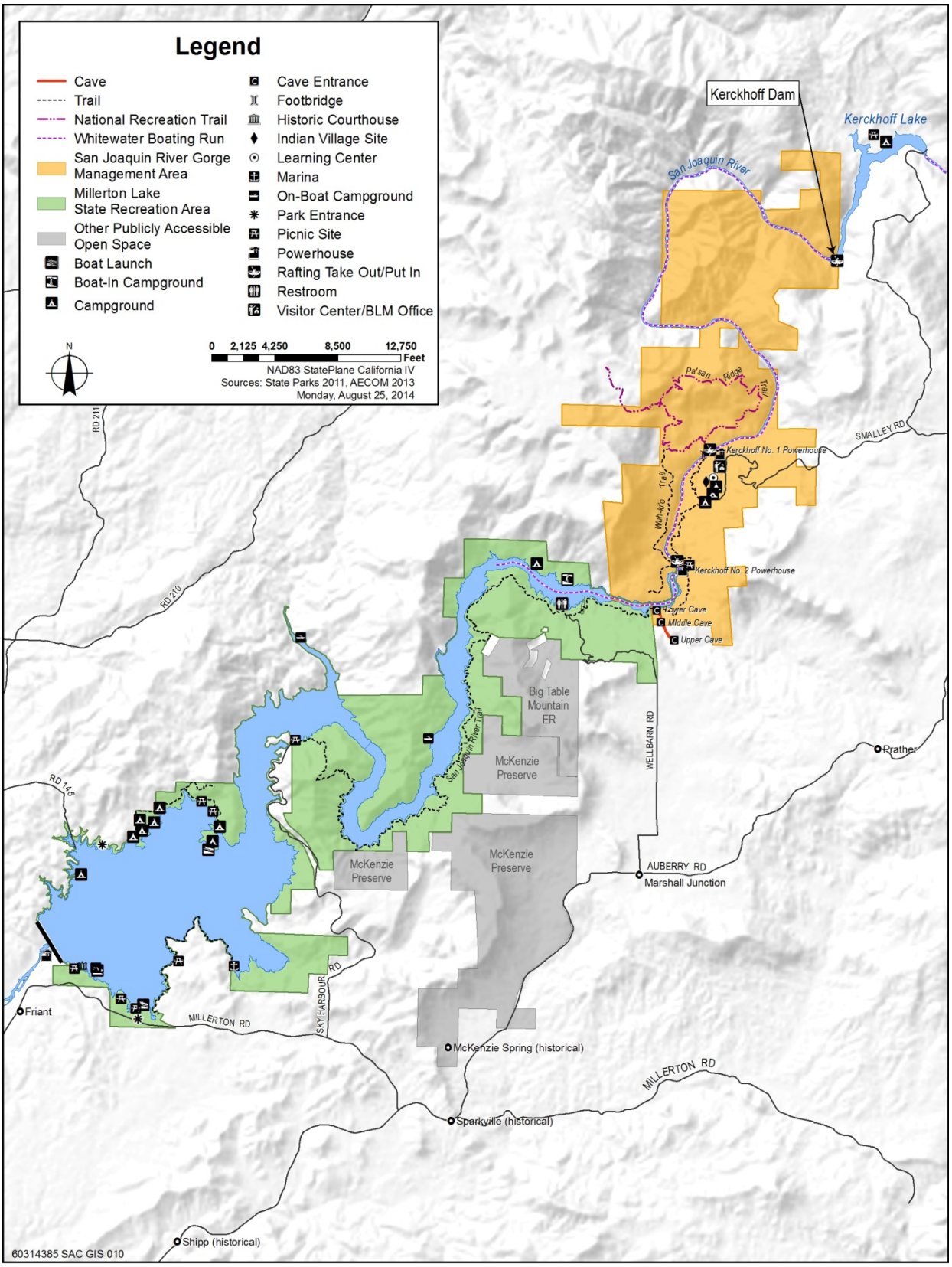

Figure 22-1. Recreation Facilities in the Vicinity of the Primary Study Area

Recreation Opportunities Millerton Lake, the centerpiece of the Millerton Lake SRA, is more than 15 miles long and was formed by the construction of Friant Dam across the San Joaquin River in 1942. The reservoir has a surface area of about 4,900 acres and a shoreline length of about 63 miles at top-of-active storage. The main body of the reservoir is about 3 miles long and 1.5 miles wide. The seasonal fluctuation of its surface elevation is substantial under normal operations.

Annual maximum water levels typically occur in May or June and nearly reach the top-of-active storage elevation of 581 feet msl in most years. The reservoir is typically drawn down 75 to 100 feet, with the minimum annual elevation occurring in October or November, before refilling of the reservoir begins with the onset of winter rains (Reclamation 2006).

Visitors are drawn to the Millerton Lake SRA for water-oriented recreation opportunities. Motor boating, sailing, waterskiing, jet skiing, swimming, and fishing are the primary activities. Shoreline activities include picnicking, hiking, biking, camping, and nature watching. Fall and spring, when temperatures are cooler, are the most popular periods for activities such as hiking and mountain biking and some types of angling. Special recreation events that have been held at the lake include sailing regattas, water-ski competitions, and triathlons. Figure 22-1 shows recreation areas and facilities within the Millerton Lake SRA.

Fishing Fishing is a popular activity from both the shore and boats, with several popular game species available including largemouth, smallmouth, and spotted bass; striped bass; American shad; and catfish, crappie, and bluegill. The season is open year-round and as many as 40 bass fishing tournaments are held year-round on the lake, primarily focusing on black bass. Anglers look for rocky underwater points or bars and similar fish-holding structure in coves and along the shoreline. Striped bass are pursued in deeper water, often by trolling. The number of bass tournaments per year is expected to decrease because of enforcement of a non-formant two-stroke motor ban at the Millerton Lake SRA (beginning May 11, 2013), which affects bass boats that often use nonconforming outboard motors. Bass tournaments are expected to decrease from 40 tournaments per year to 5 to 10 (Gresham 2013).

Boating A range of boating opportunities are possible in the Millerton Lake SRA. Millerton Lake's shoreline offers three

launch ramps and a marina. Local boating groups stage sailboat races and regattas in June and July.

Whitewater Boating The south shore of the upper portion of Millerton Lake below Kerckhoff No. 2 Powerhouse, commonly known as Temperance Flat, serves as a take-out for the 3 mile whitewater boating run on the San Joaquin River below Kerckhoff No. 2 Powerhouse, known as Millerton Bottoms. The Class II-III+ run with up to six rapids becomes available when the reservoir is drawn down to elevations of at least 520 feet msl and PG&E Kerckhoff No. 2 Powerhouse is releasing water. A typical whitewater rafting season extends from August through November when Millerton Lake has been sufficiently drawn down to expose the upstream river channel. The last rapid on the run only appears when the reservoir is drawn down below 480 feet (American Whitewater 2013a).

Interpretation and Education The Millerton Lake SRA interpretive and education programs include school tours of a historical Millerton courthouse, bald eagle tours, and junior ranger and summer campfire programs. Activities such as guided hikes and nature tours are also available during certain times of the year.

Trail Use Trails within the Millerton Lake SRA are used for hiking, horseback riding, and bicycling and several other shorter trails intended for lake access or nature observation. Trails range from level hiking areas to challenging mountain bike trails.

Camping Year-round tent and recreational vehicle (RV) camping is allowed at campsites dispersed along the north shore of the Millerton Lake SRA. Boat-in campsites and boat camping are also available. Some campsites with wheelchair-accessible features are also available.

Picnicking Picnicking is a common activity throughout the Millerton Lake SRA, with most areas providing picnic facilities with barbeque grills.

Swimming Areas within the fluctuation zone of the reservoir are used as informal beaches by both land-based and boating visitors and attract many visitors throughout summer. Several popular swim areas are marked with buoy lines to exclude boats.

Wildlife Viewing and Nature Observation Wildlife viewing and nature observation occur throughout the Millerton Lake SRA, where public access to the lake and adjacent lands exists. Wildlife viewing within the Millerton Lake SRA is enhanced by the biological diversity of the area and the variety of plant and animal species present. The lake has the largest population of wintering bald eagles in the San Joaquin Valley. From December through February, group boat tours to view bald and golden eagles around the lake are offered.

Special Events In addition to bass tournaments, 10 nonboating/fishing events per year are held at the lake (e.g., triathlons, motorcycle rallies). Another special event that occurs in the Millerton Lake SRA is the archery-only spring turkey hunt in the Pincushion Mountain and Temperance Flat areas. Only 14 hunters are allowed (two per week for 7 weeks) at this upland game bird heritage hunt sponsored by CDFW. In addition, a competitive mountain bike race is held on the San Joaquin River Trail in late March/early April. The race starts in the SJRG SRMA and ends at the South Finegold picnic area and draws up to 500 spectators and participants (Gresham 2013).

Recreation Facilities The Millerton Lake SRA includes several day-use and overnight recreation facilities to support these activities, most of which are located on the gently sloping southern and northern shores of the lower portion of the reservoir, closest to population centers (Figure 22-1). Facilities include boat ramps, picnic areas, campgrounds, trails, a marina, and a historic courthouse. Table 22-1 provides a list of boating and day-use facilities within the Millerton Lake SRA and a description of site amenities.

Table 22-2 provides a list of overnight facilities at the Millerton Lake SRA and a description of site amenities.

At Big Bend, about 6 miles upstream from Friant Dam near RM 274, the reservoir extends into a narrow, winding canyon. Most of the upper 8.5 miles of the reservoir, beginning at Big Bend, is less than 1,000 feet in width and is bordered by steep hillsides and table mountains reaching from 800 to 1,400 feet above the reservoir. Although boating is allowed, water skiing and other high speed boating are not permitted in this narrow portion of the reservoir.

Table 22-1. Millerton Lake State Recreation Area Day-Use Recreation Facilities

Facility Type/Name	Primary Site Amenities	Parking Facilities	Sanitary Facilities[1]
Boat Ramps[2]			
Ramp #1 (Crow's Nest Ramp)	2 lanes 1 boarding dock	25 vehicle-with-trailer spaces	4 flush toilets
Ramp #3 (Grange Grove Ramp)	10 lanes 3 boarding docks	560 vehicle-with-trailer spaces	6 flush toilets
Ramp #6 (Meadows Ramp)	2 lanes 1 boarding dock	50 vehicle-with-trailer spaces	4 flush toilets
Picnic Areas			
Grange Grove	74 picnic tables 33 fire rings, 28 BBQs Group shelter	50 vehicle spaces (part of large Grange Grove boat ramp lot)	4 flush toilets and 1 vault toilet
La Playa	95 picnic tables 1 fire ring, 62 BBQs	Several areas with designated and undesignated spaces	4 flush toilets
Crow's Nest	13 picnic tables 2 fire rings, 6 BBQs	50 vehicle spaces	4 flush toilets and 1 vault toilets
Millerton Courthouse	3 picnic tables	16 parking spaces	4 flush toilets
Blue Oak	3 picnic tables 3 fire rings, 3 BBQs	Undesignated spaces	1 chemical toilet
South Bay	9 picnic tables 7 fire rings, 6 BBQs	Undesignated spaces	1 vault toilet
McKenzie Point	Low water ramp	10 vehicle spaces	1 vault toilet
Eagle's Nest	2 picnic tables	Undesignated spaces	None
Buzzard's Roost	2 picnic tables 12 fire rings, 2 BBQs Trailhead	Undesignated spaces	None
Sunset Point	10 picnic tables 9 BBQs	100 vehicle spaces (at Meadows Ramp)	2 vault toilets (at boat ramp)
South Finegold	10 picnic tables 1 fire ring, 3 BBQs Group shelter	Paved lot, 40 spaces	4 flush toilets
Marina			
Winchell Cove	326 boat slips (wet) 55 dry storage spaces Office/store Fuel dock	80 vehicle spaces	1 vault toilet

Table 22-1. Millerton Lake State Recreation Area Day-Use Recreation Facilities (contd.)

Facility Type/Name	Primary Site Amenities	Parking Facilities	Sanitary Facilities[1]
Entrance Stations/Office			
South shore entrance	3 entrance lanes/booths	5 parking spaces	None
North shore entrance	2 entrance lanes, booth	5 parking spaces	1 chemical toilet
Millerton Lake SRA Office	3,000-square-foot building	14 public, 10 staff parking spaces	1 toilet

Sources: Reclamation and State Parks 2010; Reclamation 2006

Notes:

[1] Several day-use facilities are also served by portable chemical toilets, which are not listed here.

[2] Ramps #2, #4, and #5 are low-water ramps used when the lake is drawn down over 40 feet, 60 feet, and 80 feet, respectively.

Key:

BBQ = barbeque

SRA = State Recreation Area

Table 22-2. Millerton Lake State Recreation Area Overnight Facilities

Facility Name	Campsites and Amenities	Toilet Facilities	Shower Facilities
North Shore Area			
Rocky Point	21 sites with table, fire ring	4 flush toilets	2 shower buildings
Mono	16 sites with table, fire ring	2 flush toilets	2 shower buildings
Fort Miller	36 sites with table, fire ring	4 flush toilets	2 shower buildings
Dumna Strand	10 sites with table, fire ring	1 facility with chemical toilet	None
Meadows	59 sites with table, fire ring (27 electric sites) 28 sites have shelters	2 flush toilet buildings	2 shower buildings
Valley Oak	6 sites with table, fire ring	1 chemical toilet	None
Group camps (large and small)	Space for 115 people 30 picnic tables 4 fire rings, large BBQs RV dump station	1 flush toilet building 2 vault toilets	1 shower building
Other Area			
Temperance Flat	25 sites (walk-in/boat-in)	1 pit toilet	None

Sources: Reclamation and State Parks 2010; Reclamation 2006
Key:
BBQ = barbeque
RV = recreational vehicle

The south shore area, located immediately south of the dam, contains the Grange Grove boat ramp (Ramp #3), the primary boat launching facility on the lake. The cement ramp is several hundred feet wide and is served by three boarding docks, allowing several boats to be launched or retrieved at one time. The parking area at the ramp has spaces for 560 vehicles with boat trailers. This ramp is usable down to a pool elevation about 44 feet below top-of-active storage, and three low-water ramps in the cove provide for launching at progressively lower pool levels. An additional two-lane ramp in the south shore area provides launching down to about 95 feet below top-of-active storage, or 486 feet msl.

The south shore area also contains several picnic areas, which in total provide about 150 picnic sites. Picnic areas are furnished with tables, barbecue grills and flush or vault toilet facilities. The largest facility, the Grange Grove picnic area, provides a large irrigated lawn with shade trees and a group picnic shelter that is available by reservation for groups of up to 100 people. Also in this area is the historic 1867 Millerton Courthouse, reconstructed on the site from its original location that is now beneath the lake, and open for guided tours. The park headquarters is near the south shore entrance and a ranger office and maintenance facility is located nearby.

A few miles east of the south shore area is the full-service Winchell Cove Marina with approximately 330 wet berths; dry boat storage; and services that include fishing boat rentals, boat fueling, and bait and tackle sales. A large number of slips at the marina are occupied by sailboats.

The north shore area of the Millerton Lake SRA, about 2 miles northeast of the dam, is primarily occupied by several shoreline campground loops that provide 148 campsites among oak and pine woodlands (Table 22-2). Each site contains a table and fire ring. Several of the camp loops have flush toilets and showers, and one loop provides full hook-up RV sites. Additionally available are one equestrian camping area and two group camps with space for up to 115 people. The area also provides three small picnic areas and a two-lane boat ramp usable at all pool elevations.

There are a few, more isolated facilities on the upstream portion of the lake. About 6 miles upstream from the dam, the North Finegold area offers boat-in camping on a first-come, first-served basis for up to 15 boats. Only fully contained boats (i.e., boats with marine toilets) are permitted to use this area. Across the lake, the South Finegold picnic area provides tables, barbeques, and shade structures that can accommodate 150 people.

The Temperance Flat boat-in campground, located about 13.5 miles upstream from the dam, offers 25 primitive walk-in campsites accessible only by boat. Organized groups have access to primitive sites at the nearby Hewitt Valley Environmental Camp.

In addition to boat access, visitors can reach the south shore of the Temperance Flat area on foot or bicycle via gravel roads that link to Wellbarn Road, where vehicle access ends at a locked gate. A vault restroom has been installed in the area.

Visitors to the Millerton Lake SRA can take advantage of several trails for hiking, biking, and equestrian use year-round (Table 22-3). The 4-mile Blue Oak Trail is a multiple-use trail that follows the shore between the south shore area and Winchell Marina. The North Shore Trail runs through the north shore area and links to the half-mile Buzzard’s Roost hiking trail that leads to a high viewpoint overlooking the lake. Also in the north shore area is a quarter-mile nature trail posted with interpretive information about the natural and cultural resources in the area.

Table 22-3. Millerton Lake State Recreation Area Trails

Trail Name	Approximate Trail Length	Trailhead and Uses
Blue Oak Trail	4 miles	Trailhead at Blue Oak picnic area Multiple-use trail (hiking, biking, equestrian)
San Joaquin River Trail	12 miles	Trailhead at South Finegold picnic area Multiple-use trail (hiking, biking, equestrian)
North Shore Trail	2 miles	Trailheads at large group campsites and Valley Oak Campground Multiple-use trail (hiking, biking, equestrian)
Buzzard's Roost Trail	0.5 mile	Trailhead in north shore area Hiking only
Nature Trail	0.25 mile	Trailhead near Fort Miller Campground Hiking only

Sources: Reclamation and State Parks 2010; Reclamation 2006

The South Finegold picnic area serves as the trailhead for the San Joaquin River Trail, which runs along the east side of the reservoir for more than 12 miles upstream. This is a regional backcountry trail that connects to trails in the upstream SJRG SRMA and is planned to ultimately extend higher into the Sierra Nevada when the trail is completed. The trail is popular, particularly in spring, with both hikers and mountain bikers.

Recreational Use

Estimated Annual Recreation Use Total annual visitor use from 2006 to 2012 averages 357,792 visitors (Table 22-4). Many factors influence visitor use, including time of year, weather, economic conditions, fee increases, and gas prices. Between 2000 and 2002, before the period shown in Table 22-4, annual use estimates exceeded 600,000 visitors. Typically, the highest use at the Millerton Lake SRA occurs between May and July, with use beginning to decline in August. Two-thirds of annual visitation to the Millerton Lake SRA occurs between May and August.

Table 22-4. Millerton Lake State Recreation Area Annual Visitation Estimates

Year	Paid Day Use	Free Day Use	Camping	Total
2006–2007	261,618	1,850	48,406	311,874
2007–2008	237,880	3,616	51,311	292,807
2008–2009	266,047	26,505	47,266	339,818
2009–2010	270,079	53,505	49,217	372,801
2010–2011	236,547	69,816	49,512	355,875
2011–2012	330,571	89,555	53,452	473,578
6-year average	267,124	40,808	49,861	357,792

Sources: State Parks 2007, 2008, 2009, 2010, 2011, 2012

Composition of Recreation Use by Season The composition of recreation uses in the Millerton Lake SRA varies between the recreation season (April 1 through September 30) and the off-season (October 1 through March 31). Throughout the year (both seasons), day use is generally evenly divided between boating activities (50 percent) and land-based activities (50 percent) (Table 22-5). Boating activity use in the recreation season is composed of personal watercraft (PWC) use (20 percent), waterskiing/wakeboarding (30 percent), general recreational boating (20 percent), and boat fishing (30 percent).

Table 22-5. Estimate of Millerton Lake State Recreation Area Day Use by Activity and Season

	Percent of Day Use Occurring During the Recreation Season[1]	Percent of Day Use Occurring During the Off-Season[2]
Boating Activities – 50% of Total Day Use		
Personal watercraft	20	0
Waterskiing/wakeboarding	30	0
General	20	10
Boat fishing	30	90
Land-Based Activities – 50% of Total Day Use		
Picnicking/swimming	80	5
Shoreline fishing	5	50
Trail use	8	15
Birdwatching	2	15
Sightseeing	5	15

Source: Gresham, personal communication, 2013

Notes:

[1] Recreation season is from April 1 through September 30.

[2] Off-season is from October 1 through March 31.

During the off-season, PWC and waterskiing/wakeboarding use declines, and the composition of boating activities shifts mainly to boat fishing (90 percent) with some general recreational boating (10 percent). Sailboating, although possible, receives limited use at Millerton Lake. It occurs in the off-season, and minimal use occurs in the recreation season (2 percent of boating use, or 10 percent of the 20 percent of general recreational boating use).

As for land-based activities at the Millerton Lake SRA, picnicking is the primary activity, making up 80 percent of land-based day use. The remaining 20 percent of land-based day use is composed of trail use (8 percent), sightseeing (5 percent), shoreline fishing (5 percent), and birdwatching (2 percent).

During the off-season, land-based day use shifts to primarily shoreline fishing (50 percent), along with trail use (15 percent), birdwatching (15 percent), and sightseeing (15 percent). Picnicking accounts for only 5 percent of land-based day use during the off-season (Gresham 2013).

Recreation Use Upstream and Downstream from RM 274
Recreation use also varies by location, particularly upstream and downstream from RM 274 where the project would be located. Based on the breakdowns of use by activity and use above and below RM 274, in the recreation season, 82 percent of total day use occurs below RM 274, and 18 percent occurs above RM 274. In the off-season, about 68 percent of total day use occurs below RM 274, and 32 percent occurs above RM 274.

Because of the restriction on waterskiing above Fine Gold Creek, all waterskiing use occurs downstream from RM 274 (Table 22-6). Most of the PWC use also occurs below RM 274 (80 percent). Boat fishing use is split evenly upstream and downstream from RM 274 (50 percent each), whereas slightly more general recreational boating use occurs downstream from RM 274 (60 percent).

As for land-based activities, almost all picnicking and shoreline fishing use (99 percent of each) occurs below RM 274 because of the lack of day-use facilities and shoreline access above RM 274. In addition, the vast majority of sightseeing and birdwatching use (99 percent of each) occurs below RM 274, in part because of the lack of access above RM 274 and bald

eagle tours primarily occurring on the main portion of Millerton Lake (below RM 274).

Table 22-6. Estimate of Millerton Lake State Recreation Area Day Use Above and Below RM 274 by Activity

	Percent of Total Activity Use Occurring Above RM 274	Percent of Total Activity Use Occurring Below RM 274
Boating Activities		
Personal watercraft	20	80
Waterskiing/wakeboarding	0	100
General	40	60
Boat fishing	50	50
Land-Based Activities		
Picnicking/Swimming	1	99
Shoreline fishing	1	99
Trail use	90	10
Birdwatching	5	95
Sightseeing	5	95

Source: Gresham 2013
Key:
RM = River Mile

The San Joaquin River Trail is located above RM 274 and is the most likely trail to be used by visitors whose primary activity is trail use (hiking/biking/horseback riding). Therefore, most trail use (as a primary day-use activity) occurs above RM 274.

Mountain biking is the primary use of the San Joaquin River Trail in the Millerton Lake SRA. Although there are no counters along the trail in the Millerton Lake SRA, an estimated 40 bikes per day (Friday or Saturday) use the trail on weekends in the recreation season, along with 10 hikers and some equestrians, all of which enter the trail from South Finegold day-use area (Table 22-7). In the off-season, use of the trail decreases to about 20 bikes per day on the weekends, along with five hikers and a few equestrians. Trail use during the week (Sunday through Thursday) is intermittent, with likely 10 bikers and a couple of hikers during the week in the recreation season and less use in the off-season.

Table 22-7. Estimate of San Joaquin River Trail Use in the Millerton Lake State Recreation Area (per Weekend Day and per Week)

	Average Number of Bikers	Average Number of Hikers	Average Number of Equestrians
Recreation Season[1]			
Friday or Saturday	40	10	5
Sunday through Thursday	10	3	0
Off-Season[2]			
Friday or Saturday	20	5	2
Sunday through Thursday	5	1	0

Source: Gresham 2013

Notes:

[1] Recreation season is from April 1 through September 30.

[2] Off-season is from October 1 through March 31.

All drive-in camping occurs downstream from RM 274; however, most boat-in camping (75 percent) occurs upstream from RM 274 at the Temperance Flat Campground. During the recreation season, an average of four boat-in campsites are used on Friday and Saturday nights; of those four sites, three would be located at the Temperance Flat Campground. There is very limited weekend boat-in camping use in the off-season (no sites to one site used on average) and limited weekday use in either season (no sites to less than one site used on average). In addition, Temperance Flat Campground is not accessible for camping at lake elevations below 520 feet (Gresham 2013).

Facility Capacity Estimates On-water boating use is not currently at capacity, but future capacity exceedance is anticipated upstream from Fine Gold Creek after the Boating Management Plan is completed and new boating densities (based on the new Water Recreation Opportunity Spectrum [WROS] classes) are enforced. Capacity exceedance is not anticipated in the remainder of Millerton Lake in the near future.

Day-use facilities currently reach capacity on holiday weekends when there are high pool levels because less space is available for parking; therefore, State Parks institutes closures at boat ramps and day-use areas. On holiday weekends with lower pool levels (20–30 feet below top-of-active storage), more space is available for parking on dirt roads and facility closures are not necessary. If closures occur, they are typically on the Memorial Day and July 4 holiday weekends; pool levels

are substantially below top-of-active storage by Labor Day weekend, so adequate parking is usually available.

The Millerton Lake SRA has six campgrounds, large and small group camps, and one boat-in campground (Temperance Flat). According to the Millerton Lake SRA general plan, overnight use is highest in spring and summer, when individual days can have campground occupancy over 90 percent and an average seasonal occupancy rate of 40 percent. Occupancy is much lower in fall and winter, below 5 percent on average. Campgrounds can reach capacity on holiday weekends and may meet capacity on other summer weekend days (Gresham 2013).

San Joaquin River Gorge Special Recreation Management Area

The SJRG SRMA is located 5 miles northwest of Auberry and covers approximately 6,700 acres of land on both the north and south sides of the San Joaquin River. The area ranges from 640 feet to 2,200 feet msl in elevation, and is characterized by the rugged and steep-walled river canyon surrounded by chaparral and oak woodland covered hills.

Recreation Opportunities The SJRG SRMA provides year-round recreation opportunities and access between Millerton Lake SRA, Kerckhoff Lake, and the Sierra National Forest (Figure 22-1). The area was designated a Special Recreation Management Area by BLM in the late 1960s. The SJRG SRMA is a popular destination for hunters, anglers, hikers, mountain bikers, horseback riders, kayakers, wildlife watchers, sightseers, gold prospectors, and people participating in nature study. Other recreation opportunities within the SJRG SRMA include caving; backpacking; picnicking; and family, group, and equestrian camping. The SJRG SRMA also provides opportunities for cultural heritage and interactive learning, including through two signature national programs, the Project Archaeology and Hands on the Land programs, which received national recognition in 2006 with the receipt of BLM's Silver Award for Excellence in Interpretation and Environmental Education (BLM 2010a).

Fishing Angling at the SJRG SRMA typically occurs in spring and early summer on the shoreline of Millerton Lake, when the water surface elevation is high enough to reach into the SJRG SRMA, and on the accessible portions of the river. Catfish, trout, and striped bass are among the available gamefish species. In the northern portion of the management

area, there is no public vehicle access and the river is accessible only on foot, horse, or via boat. The main river access point is the Ya Gub Weh Tuh trailhead/campground, with other river access provided from the San Joaquin River Trail and its feeder trails. There is also river access via a short trail at the west end of Smalley Road.

Boating Most boating use in the SJRG SRMA consists of kayaking, rafting, and PWC use. Motorized boating access is not available within the SJRG SRMA; however, access from Millerton Lake provides some motorized boating use on the river at the southern end of the management area during periods of high flows.

Whitewater Boating Two whitewater boating runs are located in the SJRG SRMA. With the put-in at the base of Kerckhoff Dam, at the eastern boundary of the area, the Patterson Bend Run (the San Joaquin River between Kerckhoff Dam and Kerckhoff Powerhouse) is a 9.8-mile Class III–V run that is available during peak runoff in wet years (American Whitewater 2013b); however, the river is reported to be navigable over a wide range of flows, although portaging may be required (Rowland 2013). At the conclusion of the run, boaters can either take-out at Kerckhoff Powerhouse or continue past the powerhouse on the Squaw Leap Run (American Whitewater 2013b). This run is a 1.9-mile Class IV+ run that is available yearly and ends at Kerckhoff No. 2 Powerhouse. The typical season lasts 4 weeks from late October to November, when Kerckhoff No. 2 Powerhouse is not operational and instream releases from Kerckhoff Lake into the Patterson Bend run are low (American Whitewater 2013c). Flows can often be erratic in both runs (Rowland 2013). The Kerckhoff No. 2 Powerhouse is also the put-in location for the Millerton Bottoms run within the Millerton Lake SRA, which was discussed previously.

BLM found that the portion of the San Joaquin River from Kerckhoff Dam downstream to the Kerckhoff Powerhouse was suitable and eligible for designation as a Wild and Scenic River with outstandingly remarkable scenic, cultural, and wildlife values. The study also found that the portion of the river from Kerckhoff Powerhouse to the start of Millerton Reservoir was eligible for designation as a Wild and Scenic River because of its recreational and scenic values (BLM 2010b). For additional information, refer to Chapter 17, “Land Use Planning and Agricultural Resources.”

Trail Use All trails in the SJRG SRMA are shared by hikers, backpackers, horseback riders, and mountain bike users with heaviest use occurring on weekends. Trails provide SJRG SRMA users with access to both sides of the San Joaquin River. Trails also provide access to the Madera County portion of the SJRG SRMA, which is managed as a primitive, nonmotorized area. The SJRG SRMA offers a National Recreation Trail (the Pa'san Ridge and Wuh-ki'o Trails, including the bridge trail from the Ya Gub Weh Tuh trailhead to the San Joaquin River bridge), which covers prehistoric trade routes of the Mono and Dumna-Kechayi Yokut Indians, and there are plans to connect the San Joaquin River Trail through the gorge and Sierra National Forest to the Devils Postpile National Monument. The San Joaquin River Trail is used mostly by hikers (60 percent of users) and mountain bikers (30 percent of users), with some equestrian use (10 percent of users) occurring in winter and early spring (Rowland 2013). Equestrians, mountain bikers, and hikers often use the San Joaquin River Trail as an out-and-back trail, although some hikers travel only one way on the trail (and shuttle using two cars). There is also a competitive mountain bike race that has been held for the last 5 years on the San Joaquin River Trail in late March/early April. The race begins within the developed area in the SJRG SRMA and ends at the South Finegold picnic area in the Millerton Lake SRA and draws up to 500 spectators and participants each year.

Camping Year-round walk-in tent campsites with group sites are available for use at the SJRG SRMA. Wheelchair-accessible campsites are available at the group and walk-in campgrounds (one accessible site at each campground). Backpacking camping is available on the Madera County side of the river only, and campsites are to be located at least 200 feet from water, trails, cultural sites, and wildlife watering holes.

Interpretation and Education The SJRG SRMA participates in the Hands on the Land program, "a national network of field classrooms linking students, teachers, and parents to their public lands" (Hands on the Land Network 2014). The program explores natural resources, geology, and hydrology, and over 2,800 elementary and high school students participate yearly. The Hands on the Land program cooperates with such educational partners as the Sierra Mono Museum, Sierra Unified School District, Three-Forests Interpretive Association, Reclamation, and the U.S. Forest Service to

support the programs and facilities associated with Hands on the Land.

Wildlife Viewing and Nature Observation The wide variety of flora and fauna in the SJRG SRMA provides many opportunities for nature study and appreciation. In addition to the extensive wildflower displays, vegetation includes oak woodlands, riparian forest, foothill pine woodlands, and chaparral. The SJRG SRMA is also used as an outdoor laboratory by local colleges and universities.

Hunting Deer, bear, and quail hunting are allowed in fall and winter for 4–5 months. Turkey hunting occurs in spring, and dove hunting occurs in early September and throughout November and December. Hunters must adhere to the rules and regulations of CDFW. A shooting closure exists around all occupied areas, such as the campgrounds, trails, visitor center, and power facilities. No target shooting, paintball, or airsoft is permitted on these lands; only shooting for legal taking of game species is allowed.

Caving The SJRG SRMA offers entrance to the Millerton Lake Cave System for exploration. The system of three caves (upper, middle, and lower), separated only by short impassable segments, is near the lake surface and extends about one-half mile upslope from the south shore of Millerton Lake to the boundary of the Millerton Lake SRA and onto privately owned land spanning an elevation of approximately 760–900 feet msl. The lower cave and a portion of the middle cave of the Millerton Lake Cave System are located on land administered by BLM; however, the upper cave and a portion of the middle cave are located on privately owned land. Multiple entrances are found along each section of the cave system (Richards 1986).

The caves have been eroded from granitic rock by flows of nearby Big Sandy Creek. The upper cave is the longest and most complex of the three cave segments. It is listed as the sixth deepest granite cave in the United States and the ninth longest cave known in this category. Additionally, the middle cave is the twentieth longest granite cave known in the country. The Millerton Cave System has been proposed for designation by BLM as a significant cave resource under the Federal Cave Resource Protection Act (BLM 2012). This designation would only apply to the portion of the cave system on Federal lands.

Gold Panning Gold panning frequently occurs on sections of the river. Rockhounding and gold panning are permitted activities on public land administered by BLM. BLM also sponsors programs on the history of the gold rush for schools, groups, and the public.

Picnicking Picnicking occurs at the fishing access day-use area at the Kerckhoff No. 2 Powerhouse, the only developed picnic area within the SJRG SRMA. Informal picnicking also occurs at the learning and visitor centers.

Rock Climbing Rock climbing (bouldering) and canyoneering are possible within the canyon. Downstream from the San Joaquin River Trail bridge, there are several identified bouldering routes on the south side of the river and many (more than 30) on the north side of the river. There are also many (more than 30) identified bouldering routes on the north side of the river upstream from the trail bridge. Bouldering routes within the river gorge range in difficulty from V0 to V6. Most of the rock climbing opportunities are located on large boulders right along the river channel. Although rock climbing during summer can be hot because of sun exposure, the area provides good winter climbing because of the lower elevation and sun exposure (Rockclimbing.com 2014).

Recreation Facilities The SJRG SRMA offers several educational and recreation facilities, concentrated in the developed zone on the Fresno County (south) side of the river, accessible via Smalley Road from Auberry (Figure 22-1; 22-8). The developed zone extends from the visitor center on the eastern end of the zone to the fishing access at the locked gate above Kerckhoff No. 2 Powerhouse (across the road from the switchyard) on the western end of the zone. There are three developed campgrounds; an equestrian camp; a group camp (Aholul) with a large, open, flat area available for tents; and a walk-in campground with five walk-in tent sites (Ya Gub Weh Tuh trailhead/campground). Camping fees are required and reservations are required for the group camp. At the equestrian camp, corrals are available, along with three campsites. Area parking lots can accommodate large trailers and recreational vehicles. SJRG SRMA visitor center/park headquarters are located east of the equestrian camp. A visitor center featuring unique, multimedia displays on the natural environment and cultural history of the area is open daily from 10 a.m. to 2 p.m. In addition, a bookstore operated by Three-Forests Interpretive Association is located inside the visitor center. Outdoor

classrooms are located outside the visitor center and throughout the developed zone.

Table 22-8. San Joaquin River Gorge Special Recreation Management Area Recreation Facilities

Facility Name/Type	Primary Site Amenities	Parking	Sanitary Facilities
Learning center	1,200-square-foot building with full kitchen, shop, storage Open-sided pole barn with tables adjacent	Gravel parking area	2 wheelchair-accessible flush toilets and 2 portable toilets (1 is wheelchair accessible)
Visitor center	1,300-square-foot building, exhibits on natural and cultural resources, bookstore, multi-media exhibits, outdoor classrooms	10–12 spaces	1 public restroom
Ya Gub Weh Tuh Trailhead Campground	5 sites (walk-in)	Paved parking area	Double vault toilet
Group camp	Large, open flat area for tents	Paved parking area	Double vault toilet
Equestrian camp	3 campsites, corrals, water	Gravel parking area	Two portable toilets
Fishing access day-use area	Picnic area, provides trail access to San Joaquin River for fishing, gold panning, sightseeing	Large gravel parking area	Single vault toilet

Source: Reclamation 2006; Rowland 2013

Note:

The San Joaquin River Gorge Special Recreation Management Area also includes a recreated Native American village, which does not contain any permanent structures.

The Hands on the Land and Project Archaeology programs make use of a learning center and a replica Native American village, which are located near the visitor center. The learning center is housed in a new building with a full kitchen, restrooms, and storage/shop space and in an adjacent outdoor space sheltered by an open-sided pole barn, with several picnic tables beneath. The replica Native American village is an integral part of the learning center and incorporates outdoor classrooms such as a bedrock mortar, pond study area, nature trail, and other sites. The bedrock mortar provides for hands-on acorn processing. A nature trail is adjacent to the equestrian camp, near the learning center, which is focused on ethnobotany or Native American cultural uses of native plants. The trail features a diversity of plants and habitats and crisscrosses a small stream several times (BLM 2010a).

Various trails are available for hiking, mountain biking, and horseback riding (Table 22-9). The San Joaquin River Trail continues about 1.5 miles from the boundary of the Millerton Lake SRA into the SJRG SRMA (on the Fresno County side of the River) and terminates at the Ya Gub Weh Tuh trailhead/campground. The San Joaquin River Trail bridge at Big Sandy Creek, within the Millerton Lake SRA, has been installed and is open for use. This bridge links the SJRG SRMA trail system to the State Parks' trail system at Millerton Lake (BLM 2010a). BLM is working to acquire the final one-quarter mile necessary to continue the trail eastward to connect to the more recently acquired BLM lands in the Patterson Bend area, then on to the Sierra National Forest boundary. After the trail is completed, estimated San Joaquin River Trail mileage within the SJRG SRMA would be approximately 8–10 miles.

Table 22-9. San Joaquin River Gorge Special Recreation Management Area Trails

Trail Name	Trail Length	Trailhead and Uses
San Joaquin River Trail	1.5 miles (from Millerton Lake SRA boundary)	Ya Gub Weh Tuh trailhead at campground Multiple-use (hiking, biking, equestrian)
Bridge Trail	1.2 miles	Ya Gub Weh Tuh trailhead at campground Multiple-use (hiking, biking, equestrian), part of the National Recreation Trail within the SJRG SRMA
Pa'san Ridge Trail	6 miles (loop trail)	Begins at San Joaquin River Trail bridge Multiple-use (hiking, biking, equestrian)), part of the National Recreation Trail within the SJRG SRMA
Wuh-ki'o Trail	4 miles	Begins western side of Pa'san Ridge Trail Multiple-use (hiking, biking, equestrian)), part of the National Recreation Trail within the SJRG SRMA

Source: Reclamation 2006

Note:

Additional short unnamed trails lead to the river. A quarter-mile nature trail is located near the learning center.

Key:

SJRG SRMA = San Joaquin River Gorge Special Recreation Management Area
SRA = State Recreation Area

In addition to the San Joaquin River Trail, hikers, mountain bikers, and horseback riders in the SJRG SRMA use the 1-mile Bridge Trail, which leads from the Ya Gub Weh Tuh trailhead/ campground to a trail bridge over the San Joaquin River to two trails on the opposite side of the river, the Pa'san Ridge and Wuh-ki'o Trails. All three trails (Bridge, Pa'san Ridge, and Wuh-ki'o Trails) compose the National Recreation Trail within the SJRG SRMA.

The 6-mile Pa'san Ridge Trail begins on the north side of the San Joaquin River. This loop trail leads to uplands dominated by chaparral, shrubs, and seasonal wildflowers on the south-facing, steep canyon slopes, as well as upland vegetation dominated by oak grassland and oak/foothill pine woodlands with riparian forests bisecting the trail in the side canyons. The trail is a mix of old road and single-track trail and provides strenuous hill climbs. The Wuh-ki'o Trail is a 4-mile out-and-back trail that starts on the western side of the Pa'san Ridge Trail and passes along the river through oak woodlands and foothill pines connecting to the Temperance Flat area within the Millerton Lake SRA via an informal user-created trail. The Wuh-ki'o Trail is popular with mountain bikers, hikers, and equestrians. In 1981, these trails were designated as a National Recreation Trail (American Trails 2013).

Several additional areas provide recreation opportunities in the immediate vicinity of the primary study area. The Big Table Mountain Ecological Reserve and McKenzie Table Mountain Preserve are located between Friant and Prather, on the north side of Auberry Road. The main gate to the McKenzie Table Mountain Preserve is 3.3 miles uphill from the intersection of Auberry Road and Millerton Road. The preserve offers opportunities for hiking, wildlife viewing, and nature appreciation. Most hikes on the preserve include a climb to the top of the table formation where visitors can enjoy views of the San Joaquin River drainage and the Sierra Nevada. In spring, there are displays of wildflowers on the slopes and table tops. Trails are located at the low end of the preserve, including a 4-mile self-guided Discovery Trail along the ranch road and part of the old San Joaquin and Eastern Railroad right-of-way (Sierra Foothill Conservancy 2013).

Kerckhoff Lake provides boating, camping, and access to trails in the Sierra National Forest and will provide access to the San Joaquin River Trail after it is completed in this area. Smalley Cove at Kerckhoff Lake, operated by PG&E, is located just east of the SJRG SRMA and offers group and individual picnic sites, as well as five campsites with fire pits, potable water, and vault toilets (Stewardship Council 2007). The Sierra National Forest provides opportunities for dispersed, undeveloped camping and highly developed campsites with group sites. Nearby Shaver Lake also provides boating and camping opportunities. Camp Edison at Shaver Lake is operated by Edison International Company and provides 252 campsites with resort amenities, including a general store, heated showers, electricity, cable TV, laundry, and Wi-Fi.

Recreational Use

Estimated Annual Recreation Use Table 22-10 presents the total SJRG SRMA annual visitor use from 2006 through 2013. The 8-year average for annual visitation is approximately 54,468, although recent visitation (last 4 years) has been well below this average. As mentioned previously, visitor use varies because of many factors, including time of year, weather, economic conditions, fees, and gas prices. With high summer temperatures common, the most popular use seasons are spring, winter, and fall, but activities such as swimming, fishing, gold panning, and rock climbing are popular in summer and mountain biking occurs year-round. The SJRG SRMA is also especially popular when higher elevation areas in national parks and national forests are closed in fall, winter, and early spring.

Table 22-10. San Joaquin River Gorge Special Recreation Management Area Annual Visitation Estimates

Year	Dispersed Area	Intensive Use Area	Total
2006	53,769	4,822	58,591
2007	61,413	8,475	69,848
2008	78,302	8,275	86,577
2009	82,039	1,132	83,171
2010	16,500	19,650	36,150
2011	16,722	17,450	34,172
2012	15,310	16,825	32.135
2013	16,900	18,200	35,100
8-year Average	--	--	54,468

Sources: BLM 2010a, Rowland 2013
Key:
-- = not applicable
BLM = U.S. Department of the Interior, Bureau of Land Management

It is estimated that most visitors are from the Fresno/Clovis/ Madera area (60 percent) or the Auberry/Prather area (25 percent), with the remainder of visitors from the San Francisco Bay Area (10 percent), and the Los Angeles area or out of state (5 percent). BLM expects a slight increase in visitor use in 2014 and also expects visitation to increase fairly dramatically in the next 5–10 years once the San Joaquin River Trail is completed to the Sierra National Forest (Rowland 2013).

Visitor Participation by Activity By far, the most popular use within the SJRG SRMA is trail use with an estimated 98 percent of visitors using area trails (Table 22-11). About 30 percent of visitors use the San Joaquin River Trail, while 70

percent of visitors use the other trails (Pa'san Ridge, Wuh-ki'o) in the SJRG SRMA. Wildlife viewing/nature observation is the second most popular activity with 50 percent of visitors participating in this activity. Picnicking is also a popular activity, with about 33 percent of visitors participating in picnicking. Other popular activities include interpretive/educational programs (25 percent of visitors participating), hunting (25 percent), and camping (20 percent).

Table 22-11. Estimate of San Joaquin River Gorge Special Recreation Management Area Visitor Participation by Activity

	Percent of SJRG SRMA Visitors Participating
Trail Use	98
San Joaquin River Trail	30
All other trails (Pa'san Ridge, Wuh-ki'o, Bridge)	70
Wildlife viewing/nature observation	50
Picnicking	33
Interpretation/education programs	25
Hunting	25
Camping	20
Gold panning	18
Shoreline fishing	16
Caving	15
Rock climbing	10
Boating	3.5
Whitewater boating	3
General river boating	0.5

Sources: Rowland 2013

Note:

Percentages do not add up to 100 percent because some visitors participate in multiple activities.

Key:

SJRG SRMA = San Joaquin River Gorge Special Recreation Management Area

Other land-based recreation activities receive less participation by SJRG SRMA visitors, including gold panning (18 percent of visitors participating), shoreline fishing (16 percent), caving (15 percent), and rock climbing (10 percent). Few visitors participate in water-based activities such as whitewater boating (3 percent) and general river boating (0.5 percent) (Rowland 2013).

Recreation Use within Fresno and Madera Counties

Generally, the majority of use for each activity occurs in Fresno County, as shown in Table 22-12. This is likely because most facilities within the SJRG SRMA, as well as primary

public access points, are located within Fresno County. Because the county line is located within the San Joaquin River, whitewater and general river boating equally occur in Fresno and Madera counties. Recreation activities that occur exclusively within Fresno County include use of the San Joaquin River Trail and caving as the trail and caves are located solely in Fresno County. Rock climbing and trail use are the only activities that have more use occurring in Madera County than Fresno County. Trail access is available in Madera County without crossing the San Joaquin River Bridge via the Wuh-ki'o Trail, which connects to an informal trail from the Millerton Lake SRA.

Table 22-12. Estimate of San Joaquin River Gorge Special Recreation Management Area Activity Use by County

	Percent of Total Activity Use Occurring in Fresno County	Percent of Total Activity Use Occurring in Madera County
Trail Use	40	60
San Joaquin River Trail	100	0
All other trails (Pa'san Ridge, Wuh-ki'o, Bridge)	15	85
Wildlife viewing/nature observation	75	25
Picnicking	98	2
Interpretation/education programs	90	10
Hunting	65	35
Camping	90	10
Shoreline fishing	90	10
Caving	100	0
Rock climbing	20	80
Boating	50	50
Whitewater boating	50	50
General river boating	50	50

Source: Rowland 2013

There is limited recreation use upstream from the trail bridge over the San Joaquin River within the SJRG SRMA (up to Kerckhoff Dam). There is no trail access upstream from the bridge except for the Pa'san Ridge Trail. When sufficient flow is available, kayakers use the river from Kerckhoff Dam downstream to the trail bridge across the San Joaquin River. Other recreation uses within the river/canyon area include rock climbing/bouldering, gold panning, and swimming in deep holes above Kerckhoff Powerhouse. BLM anticipates the San Joaquin River Trail providing trail access to the area upstream from the trail bridge on the Fresno County side of the river. If

access cannot be acquired the trail would cross the San Joaquin River into Madera County then cross back to Fresno County at Patterson Bend. Only one-quarter mile of access is still needed within this area to connect the trail to the Sierra National Forest boundary (Rowland 2013).

Facility Capacity Estimates Day-use parking capacity at the Ya Gub Weh Tuh trailhead/campground is often exceeded during fall and spring. During these seasons, the campground is also at capacity (Rowland 2013).

Extended Study Area

This discussion addresses recreation opportunities located in the greater San Joaquin Valley in the vicinity of the extended study area, including a description of opportunities, uses, and facilities. It is based on information presented in the SJRRP PEIS/R (SJRRP 2012).

San Joaquin River from Friant Dam to Merced River

Public access to portions of this reach of the San Joaquin River is available in the vicinity of the San Joaquin River Parkway (Parkway). Public access is sparse along most areas of the river downstream from the Parkway, with the exception of access provided by a city park at the Mendota Pool and Federal and State wildlife refuges located along the river in Reaches 4 and 5. Informal access is available to the river corridor at numerous locations where State and local roads are located adjacent to or cross the river channel.

The Parkway is composed of multiple parks, trails, and ecological reserves located along the San Joaquin River between Friant Dam and SR 145. The Parkway is managed by the San Joaquin River Conservancy, a state agency, and several local and State partner agencies. Figure 22-2 identifies the parks, public access areas, and trails located along this reach of the San Joaquin River.

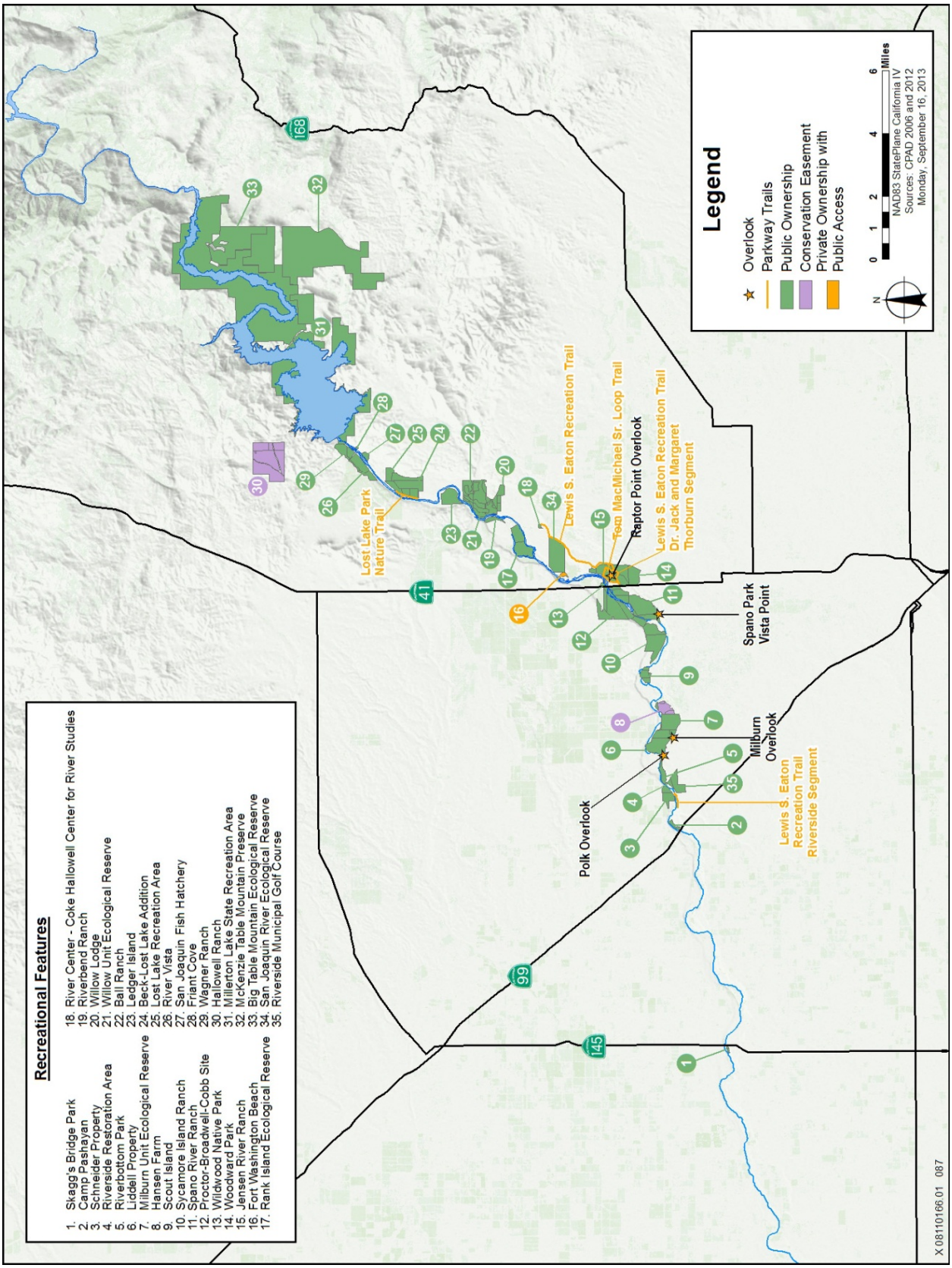

Figure 22-2. Recreation Opportunities near Millerton Lake

Existing recreation opportunities, including water-dependent uses such as boating and fishing, are available in the Parkway because of public access to the river. With the implementation of interim flows of the SJRRP, river boating opportunities have been enhanced from Friant Dam to the Chowchilla Bypass Bifurcation Structure from February through mid-March and from July through late November. Because instream flows are now higher from mid-March through June, boating opportunities on the river in Reach 1 could be reduced because of hazardous conditions when flows approach 1,000 cfs. Additionally, fishing opportunities along the main channel in Reach 1 are greatly reduced during flows over 1,500 cfs because the high flows create hazardous conditions for boating and wading; however, new fishing opportunities could become available along the margins of the main channel when flows are over 1,500 cfs (SJRRP 2009).

A public outreach program was initiated to educate the public, agencies, and organizations of changes in San Joaquin River flows and potential effects on river boating and fishing opportunities. Although instream flows have been restored below the Chowchilla Bypass Bifurcation Structure, the structure is a barrier to boat traffic, and public access is minimal downstream to Mendota Pool. Public access is also minimal in Reach 3 downstream from Firebaugh to Reach 4. Therefore, increased recreation use along the San Joaquin River resulting from implementation of interim flows has occurred primarily upstream from the bypass structure (SJRRP 2009).

Lands adjacent to the San Joaquin River are primarily managed for agricultural land uses; however, several Federal wildlife refuges and State wildlife management areas are located within the valley, along with several State Park units. Some areas are located directly adjacent to the San Joaquin River within the extended study area, while others are some distance away from the river. Several Federal refuges and State wildlife management areas, including the Great Valley Grasslands State Park, are part of the 160,000-acre Grasslands Ecological Area, which represents the largest remaining areas of unplowed land on the Central Valley floor (National Audubon Society 2013).

Both the San Luis and San Joaquin River NWRs are located on the San Joaquin River, but only the San Luis NWR, the largest of the Federal refuges, is in the San Joaquin Valley. The San Luis NWR contains a mixture of managed seasonal and permanent wetlands, riparian habitat associated with the San

Joaquin River and two tributary sloughs, and native grasslands/alkali sinks/vernal pools. The refuge is managed primarily to provide habitat for migratory and wintering birds. Major public uses include interpretive wildlife observation programs and waterfowl and pheasant hunting. Foot traffic is permitted on the three auto tour routes and on trails in the NWR. Fishing, by rod and reel only, is also permitted (USFWS 2007). The Merced NWR is located a few miles east of the San Joaquin River in Merced County. The San Luis NWR receives about 150,000 annual visits, and the Merced NWR receives about 100,000 annual visits (Grasslands Water District 2001). Figure 22-3 shows the refuges in the vicinity of the extended study area.

Two initiatives are underway by Federal and State agencies that include proposals to expand recreation access and opportunities along the San Joaquin River. America's Great Outdoors is a Federal initiative led by the U.S. Department of the Interior to develop a 21st-century conservation and recreation agenda. The America's Great Outdoors initiative has identified projects in all 50 states. The Federal government could partner with states or local communities to advance the goals of the America's Great Outdoors initiative with existing resources by providing technical support and with its administrative authorities. One such project is the San Joaquin River Blueway, proposed by the San Joaquin River Partnership, a collaboration of 13 nonprofit organizations (San Joaquin River Partnership 2011).

The vision for the San Joaquin River Blueway is to create a corridor of recreational access and important landscapes, with a system of recreational and natural areas linked by the river. The San Joaquin River Blueway would provide access and opportunities for boating, fishing, swimming, hiking, biking, wildlife-watching, picnicking, and hunting. The San Joaquin River Partnership also envisions a San Joaquin River Water Trail as an early component of the San Joaquin River Blueway linking existing river access points, and providing enhanced recreational access in the long term and becoming a backbone of the San Joaquin River Blueway (San Joaquin River Partnership 2011). The Central Valley Vision, an initiative of State Parks, proposes two new State parks on the San Joaquin River.

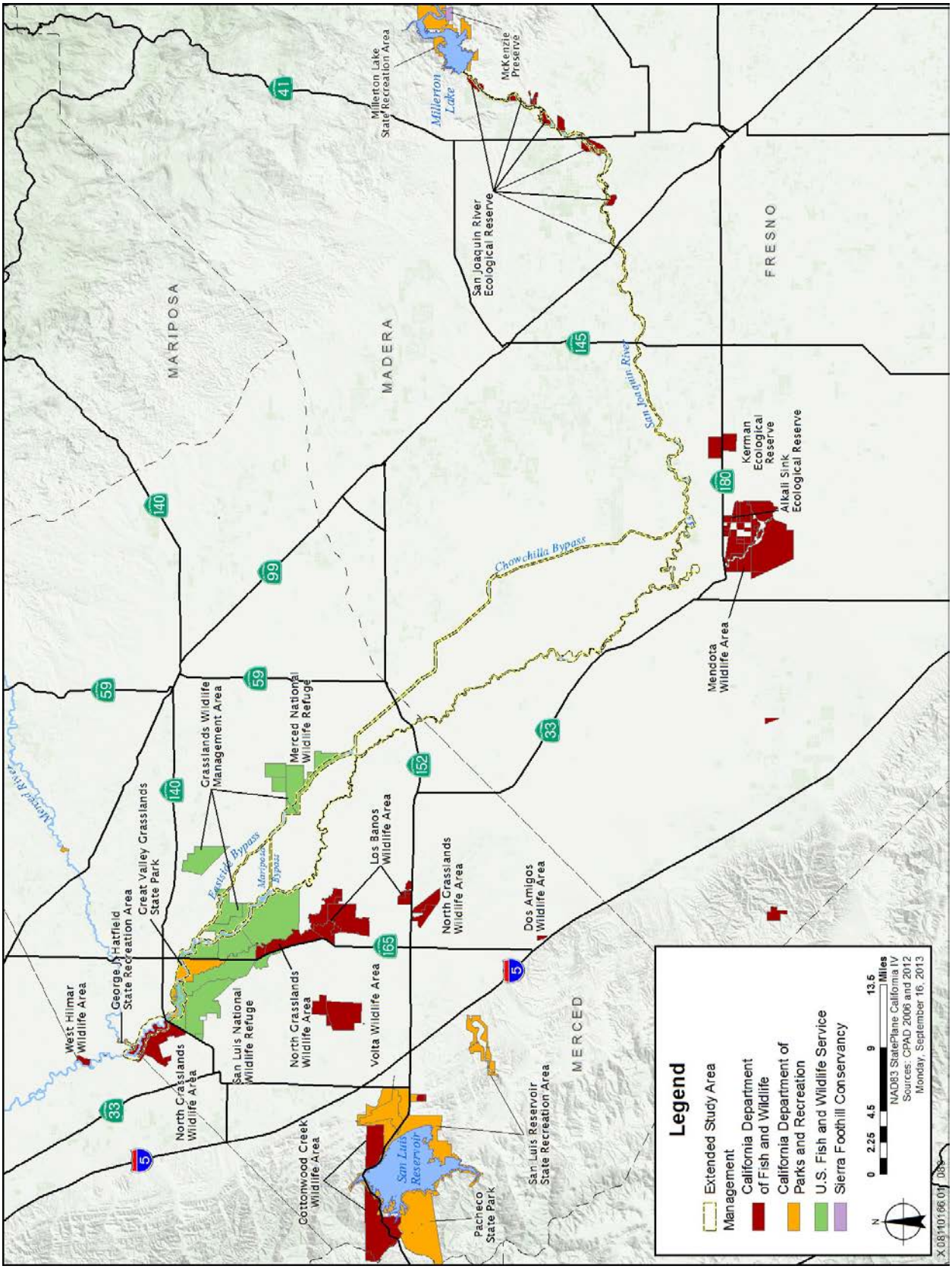

Figure 22-3. Publicly Accessible Open Space in the Extended Study Area

San Joaquin River from Merced River to the Delta

Two Stanislaus County parks provide the only developed recreation access to this segment of the San Joaquin River. The Las Palmas Fishing Access, located a few miles east of the town of Patterson, is a 3-acre park providing a concrete boat ramp and day-use facilities (Stanislaus County 2009a). Laird Park, located 2 miles east of the town of Grayson, is a 97-acre "community park" providing river access and day-use facilities (Stanislaus County 2009b).

The San Joaquin River NWR is located along the San Joaquin River in between the Tuolumne and Stanislaus Rivers, two major tributaries to the San Joaquin River. The refuge boundaries encompass over 7,000 acres of riparian woodlands, wetlands, and grasslands. Although the refuge is primarily undeveloped, a wildlife viewing platform has been constructed at a favored location for viewing geese and other waterbirds (USFWS 2007).

The West Hilmar Wildlife Area, on the west bank of the river a few miles downstream from the Merced River confluence, is a 340-acre State wildlife area, with no facilities and accessible only by boat (DFG 2009).

Not on the San Joaquin River, but in the vicinity, State Parks manages two small developed park units, each less than 75 acres, on the bank of the lower Merced River in Merced County. George J. Hatfield SRA is near the confluence with the San Joaquin River and McConnell SRA is approximately 18 miles upstream from the confluence with the San Joaquin River. Both parks provide access to the Merced River for boating, fishing, swimming, picnicking, camping, and hiking on short trails.

Farther north, the Turlock Lake SRA furnishes camping, boating, and day-use facilities at the 3,500-acre Turlock Lake and the adjacent Tuolumne River, on the eastern edge of the valley in Stanislaus County. Caswell Memorial State Park is located along the Stanislaus River in San Joaquin County, approximately 5 miles upstream from the confluence with the San Joaquin River. This 258-acre park offers opportunities for fishing and swimming in the Stanislaus River and camping facilities and nature trails through the park's riparian oak woodland.

Delta

At the southeast margin of the Delta on the San Joaquin River are two boating facilities that provide access both to the Delta and the river upstream. The Mossdale Crossing Regional Park, operated by San Joaquin County, provides a paved two-lane boat ramp and day-use facilities. Across from the park is the privately operated Mossdale Marina, with 23 boat berths, and services such as fueling, a restaurant and bar, and a store. A few miles downstream is Dos Reis County Park, a San Joaquin County-operated facility providing a boat ramp and day-use area, as well as a 26-site RV camp. Nearby is Haven Acres Marina, a small private facility with a boat ramp and bar and grill.

Numerous additional recreation opportunities are available in the Delta. The Delta has many miles of rivers and sloughs for boating and fishing, and recreation visitors have a choice of many private recreation facilities, primarily small marinas and resorts, and two State Park units. Brannan Island SRA, in the central Delta on the Sacramento River, offers boat access to the river and sloughs, and camping, swimming, and day-use facilities. Franks Tract SRA consists of a large flooded island that was formerly farmland, surrounded by remnant levees; there are no developed facilities in the SRA.

CVP and SWP Water Service Areas

CVP and SWP water service areas are located throughout much of California. Facilities include multiple dams, reservoirs, and canals that provide substantial water-based recreational activities. Releases from dams on major tributaries to the Sacramento River provide numerous recreational opportunities, especially boating and fishing. Reservoirs such as Folsom, Oroville, and New Melones provide boating, fishing, camping, and other recreational activities.

The CVP and SWP water service areas consist primarily of lands in agricultural production or urban areas composed of residential, commercial, or industrial land uses. Recreational opportunities on agricultural lands are limited to informal recreational activities such as hunting. Recreational opportunities in urban areas vary by community, with recreation facilities limited in some communities to smaller urban parks, whereas in other communities facilities consist of larger open spaces and regional recreation facilities.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on recreation. It then discusses the impacts of the alternatives and proposes mitigation where appropriate. The potential impacts on recreation and associated mitigation measures are summarized in Table 22-13.

Table 22-13. Summary of Impacts and Mitigation Measures for Recreation

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-1: Permanent Loss or Closure of a Recreation Facility	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-1a: Allow On-Boat Camping, REC-1b: Create New Shoreline Access Site	LTS
		Alternative Plan 2	S		LTS
		Alternative Plan 3	S		LTS
		Alternative Plan 4	S		LTS
		Alternative Plan 5	S		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-2: Permanent Loss of a Resource Used for Recreation	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-2: Preserve Fine Gold Creek Watershed Cave System	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 22-13. Summary of Impacts and Mitigation Measures for Recreation (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-3: Substantial or Long-Term Reduction or Elimination of Recreation Opportunities or Experiences	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	S	REC-3a: Limit Construction Activities near Recreation Areas, REC-3b:Instream Whitewater Boating Improvements, REC-3c: Extend the San Joaquin River Trail through the SJRG SRMA	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-4: Loss of Access to a Locally Important Recreation Site or Area	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	REC-4: Maintain Public Access	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 22-13. Summary of Impacts and Mitigation Measures for Recreation (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
REC-5: Increased Use of Existing Neighborhood and Regional Parks or Other Recreation Facilities such that Substantial Physical Deterioration of the Facilities Would Occur or Be Accelerated	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
REC-6: Impacts Associated with New or Expanded Recreation Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	Beneficial		Beneficial
		Alternative Plan 2	Beneficial		Beneficial
		Alternative Plan 3	Beneficial		Beneficial
		Alternative Plan 4	Beneficial		Beneficial
		Alternative Plan 5	Beneficial		Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
S = significant
SJRG SRMA = San Joaquin River Gorge Special Recreation Management Area
SU = significant and unavoidable

Methods and Assumptions

The project could affect recreation resources by a variety of impact mechanisms. In the primary study area, impacts on recreation facilities and activities at the Millerton Lake SRA and the SJRG SRMA would be associated with inundation of existing recreation facilities, loss of access to recreation facilities, and changes to recreation experiences or opportunities. Additional impacts could result at Millerton Lake SRA from changes in reservoir operations that alter the magnitude, rate, or timing of reservoir drawdown.

In the extended study area, the action alternatives would affect flows and water temperature of the San Joaquin River below Friant Dam.

More specifically, this chapter evaluates the potential impacts on recreation resulting from the following mechanisms:

- Inundation of existing recreation facilities and resources used for recreation activities
- Loss of or changes to motorized and nonmotorized access to recreation sites/areas
- Changes in the magnitude, rate, or timing of reservoir drawdown
- Displacement of users attributable to changes in access, inundation of facilities, or changes in setting
- Changes in surface area and shoreline miles for water-based recreation opportunities and experiences
- Conversion of a riverine recreation setting to a reservoir setting
- Changes to the recreation setting and access from construction activities

Evaluation of direct impacts on recreation was based primarily on a GIS analysis of the inundation area of the proposed Temperance Flat RM 274 Reservoir. The GIS analysis used available information to estimate impacts, including locations of recreation facilities and access roads, topography, management area boundaries, and new reservoir pool acreage based on top-of-active storage elevations. The GIS analysis was used to determine acreage of land inundated and specific

facility components inundated, such as trails, access roads and campgrounds.

During facility planning, several existing recreation facilities would be unable to continue to operate in current locations because of the potential for inundation in some years. These facilities would need to be relocated to lands outside the new inundation zone. Therefore, an additional GIS analysis was conducted to determine whether potential recreation facility relocation areas were present in the vicinity. Suitable areas were considered to have a slope of less than 10 percent, be located on public property, be located within 1 mile of the proposed Temperance Flat RM 274 Reservoir shoreline, be located outside of habitat or protected sensitive species areas, be located within one-half mile or less of existing roads or haul routes, and be located no closer than 1,000 feet from the new dam or outlet structures. The criteria to determine suitability are presented in Table 22-14, and are based on refinements to criteria identified in the 2006 Draft Recreation Opportunities Technical Appendix (Reclamation 2006).

Table 22-14. Suitability Analysis Criteria

	High Suitability	Moderate Suitability	Low Suitability	Not Suitable
Location	Within 1 mile of maximum pool elevation (985 feet)	Within 1 mile of maximum pool elevation (985 feet)	Within 1 mile of maximum pool elevation (985 feet)	Below maximum pool elevation (985 feet)
Property ownership	Public property	Public property	Public property	Private property
Slope	Less than 5% slope	5–10% slope	5–10% slope	Greater than 10% slope
Distance from existing roads/project haul routes	Within one-quarter mile of existing roads or haul routes	Within one-half mile of existing roads or haul routes	Within 1 mile of existing roads or haul routes	More than 1 mile from existing roads or haul routes
Distance from CNDDB sites	More than 1,000 feet	More than 1,000 feet	More than 1,000 feet	Within 1,000 feet
Distance from environmental areas	No overlap with designated environmental reserve areas	No overlap with designated environmental reserve areas	No overlap with designated environmental reserve areas	Overlap with designated environmental reserve areas
Distance from reservoir facilities	More than 1,000 feet from new dam or intake structures	More than 1,000 feet from new dam or intake structures	More than 1,000 feet from new dam or intake structures	Within 1,000 feet of new dam or intake structures

Key:
% = percent
CNDDB = California Natural Diversity Database

After suitable areas were identified, locations were delineated for relocating inundated recreation facilities. Relocation areas were then incorporated into the project description, as presented in Chapter 2, “Alternatives.”

Indirect impacts of the action alternatives on recreation opportunities are those impacts that result from the direct impacts listed above, such as potential reductions in recreation use of various types related to loss of the facilities and shoreline land areas that support that use. Other indirect impacts that may occur relate to changes in the types and quality of recreation opportunities under the action alternatives. Examples of such indirect impacts include increased density of use (crowding), increases or decreases in the occurrence of boating hazards (such as submerged rocks), increases or decreases in particular types of recreation opportunities (such as flatwater boating or river boating), or recreation settings (such as developed and primitive settings) accessible to visitors.

Estimating the indirect impacts of implementing any action alternative is based on information such as the number and types of recreation visitors (e.g., shore-based day users, boaters, and campers) who use individual facilities. Visitor use data for the Millerton Lake SRA and SJRG SRMA were available for the management areas as a whole and by activity and location (above/below RM 274 and Fresno/Madera County). Assessment of indirect impacts is also based on existing descriptions of the types of recreation opportunities and settings currently existing in the project area, and similar qualitative information.

CalSim II modeling results characterizing changes to reservoir operations at Millerton Lake were also used to evaluate indirect impacts on recreation. Model simulation data produced using the CalSim II model were provided that indicated the elevation of both Temperance Flat RM 274 Reservoir and Millerton Lake for each month of the year. The analysis for Millerton Lake focused on pool elevation of the lake minus the area that would be inundated with the Temperance Flat RM 274 Dam and focused specifically on the key May through August peak water-based recreation season. Millerton Lake SRA attendance data indicate that nearly two-thirds of use occurs between May and August.

A key factor in determining the impacts of the action alternatives is the influence Temperance Flat RM 274

Reservoir operations would have on the Millerton Lake pool elevation range most conducive to shoreline use that occurs on the lake. This elevation range is approximately 540–560 feet (20–40 feet below top-of-active storage); a pool level that exposes a wide band of gently sloping shoreline in the south shore and north shore areas. Recreation visitors are permitted to drive their vehicles on much of this exposed area, and these areas are very popular for informal beach use by both land-based and boating recreation visitors. Elevations above 560 feet provide little area for this informal use, although developed shoreline day-use areas above the high water line would be available, but parking is limited at these sites. Elevations below 540 feet continue to provide desirable shoreline use conditions, but at a greater distance from developed picnic facilities, paved roads and parking, restrooms, and other amenities located above the high water line. Lower elevations would result in a more substantially reduced reservoir surface area and negative impacts on the operation of the marina as the floating docks must be relocated.

Reservoir operations would also influence recreation opportunities available on the proposed Temperance Flat RM 274 Reservoir created under each action alternative. Recreation opportunities and relocated facilities at the new reservoir would be influenced by operations, particularly by pool elevations most likely to exist during the summer water-based recreation season, and seasonal fluctuation in pool elevation.

The CalSim II results also describe flow characteristics for the San Joaquin River downstream from Friant Dam, and for other rivers downstream from CVP and SWP reservoirs whose operations may be affected by the project. These data were used to determine potential impacts on recreation and public access on the San Joaquin River downstream from Friant Dam and on tributary rivers and CVP and SWP reservoir elevations. Similarly, river temperature modeling was used to determine the suitability of river water temperatures for recreation. Monthly average increases and decreases in flows and river temperatures were considered for the extended study area.

Additional details and results of CalSim II and river temperature modeling are provided in the Modeling Appendix.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing

the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4[a]).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consideration of the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on recreation would be significant if project implementation would do any of the following:

- Result in the permanent loss or closure of a recreation facility
- Result in the permanent loss of a resource used for recreation activities
- Result in the substantial or long-term reduction of recreation opportunities or experiences, including a reduction in area available for a particular type of recreation or substantial reduction in recreation experience quality, or substantial increase in recreation opportunities or experiences
- Result in the loss of access to a locally important recreation site/area
- Increase the use of existing neighborhood and regional parks or other recreation facilities such that substantial physical deterioration of the facilities would occur or be accelerated
- Include recreation facilities or require the construction or expansion of recreation facilities that might have an adverse physical impact on the environment

Topics Eliminated from Further Consideration

As described in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," of this Draft EIS, implementing any action alternative would increase water reliability for the Friant Division and SOD CVP and SWP contractors during most water-year types. Delivery of this additional water would not exceed historical maximum deliveries or existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment.

Implementing any action alternative or the No Action Alternative would not substantially affect recreation opportunities or experiences and would not result in the loss of recreation access or facilities within the CVP and SWP water service areas, the Delta, or along the San Joaquin River downstream from the Merced River confluence. Therefore, impacts on these portions of the extended study area are not discussed further. The extended study area impacts described for the action alternatives and No Action Alternative relate only to the San Joaquin River below Friant Dam to the Merced River confluence.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any action alternative.

Impact REC-1: Permanent Loss or Closure of a Recreation Facility

Primary Study Area

No Action Alternative Under the No Action Alternative, the Temperance Flat RM 274 Dam would not be built; therefore, there would be no loss or closure of any facility used for recreation attributable to inundation of the San Joaquin River following construction of the new dam. Continued implementation of existing land management and plans would not substantially alter existing recreational facilities in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Impoundment of the San Joaquin River by the proposed Temperance Flat RM 274 Dam would inundate about 5,700 acres at top-of-active storage, which would result in the seasonal or permanent inundation of several recreation facilities, or portions of facilities, within the SJRG SRMA and

Millerton Lake SRA. Table 22-15 identifies the recreation facilities that would be inundated by Temperance Flat RM 274 Reservoir at top-of-active storage.

As part of each action alternative, a number of these recreation facilities would be relocated to areas outside the inundation zone during construction and before inundation (Table 22-15). Replacement facilities would be of equivalent overall capacity and quality compared to the affected facilities, would provide comparable shoreline access, where applicable, and would comply with Americans with Disabilities Act and Architectural Barriers Act guidelines.

In addition, to provide shoreline access and reduce water hazards, complete vegetation removal would occur within the inundated area near all new and relocated recreation facilities. There would be no loss of recreation facilities and equivalent capacity, quality, and access provided for those facilities that would be relocated. This impact would be less than significant under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

However, for three recreation facilities, relocation is infeasible or would not completely replace the experience associated with the displaced facility. These facilities consist of Hewitt Valley Environmental Camp, the Temperance Flat boat-in campground, and the trail bridge over the San Joaquin River.

Table 22-15. Recreation Facilities that Would Need to Be Relocated or Replaced

Inundated Facility	Inundated Facility Components	Relocation/Replacement
Hewitt Valley Environmental Camp	Primitive campsites	Relocate the campsites to the peninsula near the Temperance Flat RM 274 Dam on the Madera County side of the Temperance Flat RM 274 Reservoir. Also allow on-boat camping within a portion of the reservoir during periods with lowered water surface, and provide a floating restroom for on-boat campers.
Temperance Flat boat-in campground	25 boat-in campsites, 1 pit toilet	Relocate the campground to the peninsula near the Temperance Flat RM 274 Dam on the Madera County side of the Temperance Flat RM 274 Reservoir. Also allow on-boat camping within a portion of the reservoir during periods with lowered water surface, and provide a floating restroom for on-boat campers.
Temperance Flat vault toilet	1 vault toilet	Relocate toilet uphill of the existing location to the new terminus of Wellbarn Road.
San Joaquin River Trail	14.75 miles of multiuse trail	Relocate the affected portion of the trail (southern end) to follow a ridgetop and then follow the 1,020-foot contour up to relocated facilities in the BLM developed zone.
Road access to Temperance Flat via Wellbarn Road	Road	Wellbarn Road would continue to provide shoreline access but would have a new terminus at the maximum pool elevation. No relocation is necessary.
Fishing Access Day-Use Area at Kerckhoff No. 2 Powerhouse	Picnic area, gravel parking area, single vault toilet, shoreline trail	Relocate the facilities, trail, and parking uphill of the existing location to the end of Smalley Road.
Ya Gub Weh Tuh Trailhead Campground	5 walk-in campsites, paved parking, double vault toilet	Relocate campground uphill of the existing location in the developed zone.
Visitor center/BLM Office	1,300-square-foot building, outdoor classrooms, 10–12 parking spaces, 1 public restroom	Relocate facilities uphill of the existing location in the developed zone.
BLM learning center	1,200-square-foot learning center building, open-sided pole barn, pond classroom, gravel parking area, and 4 toilets	Relocate facilities uphill of the existing location in the developed zone.
BLM Native American village site	No permanent facilities, but estimated 0.6 acre needed for temporary village structures	Relocate site uphill of the existing location in the developed zone.
Wuh-ki'o Trail	1.89 miles	Relocate the affected portion of the trail uphill of the existing location and provide access via a water taxi from the developed zone.
Pa'san Ridge Trail	1.2 miles	Relocate the affected portion of the trail uphill of the existing location and provide access via a water taxi from the developed zone.
Trail bridge over San Joaquin River	Bridge spanning the San Joaquin River and 1 mile of Bridge Trail	Provide a water taxi across the reservoir to reach trails on the Madera County side of the reservoir. Provide a new shoreline access site at the developed zone to continue providing shoreline access and a whitewater boating take-out that was available at the bridge site.

Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
No. = number
RM = river mile

The boat-in camping facilities and Hewitt Valley Environmental Camp sites could be relocated to the peninsula located upstream from the proposed Temperance Flat RM 274 Dam and thus facilities and capacity would be similar to what is currently available to recreationists. However, the peninsula area is steep and because of the drawdown of the water surface elevation anticipated for Temperance Flat RM 274 Reservoir, particularly during summer, campers would have a long, steep walk to the campsites across the drawdown zone, substantially reducing the quality of the recreation experience for boat-in campers. It is anticipated that the campsites would be inhospitable and may be used infrequently during periods with a lowered reservoir water surface, which could occur over several months of the year. Therefore, only relocating the campsites would not provide replacement boat-in camping experiences, resulting in a significant impact on this recreation activity. Mitigation for this impact is proposed below in the Mitigation Measures section.

Currently, the Wuh-ki'o and Pa'san Ridge Trails are accessed by a bridge over the San Joaquin River and the bridge functions as a recreational shoreline access location/boating take-out. This bridge would be inundated with establishment of the Temperance Flat RM 274 Reservoir. Because of the width of the proposed Temperance Flat RM 274 Reservoir, replacing the bridge is infeasible. Access to these trails would be maintained by operation of a water taxi across the Temperance Flat RM 274 Reservoir near the location of the existing footbridge. However, loss of the bridge as a shoreline access location/boating take-out would result in a significant impact on recreation. Mitigation for this impact is proposed below in the Mitigation Measures section.

As part of developing Temperance Flat RM 274 Reservoir, boat ramps would be provided at the new terminus of Wellbarn Road and at the new terminus of Smalley Road. Providing these boat ramps would be part of relocating recreation facilities to allow boat-in camping to occur at the relocated campground. In addition, these new boat ramps would allow on-water recreation, such as fishing, waterskiing, PWC use, and other activities, as well as water-based special events, to occur at the reservoir. However, the large fluctuation in pool levels during the recreation season (ranging from about 75 to 180 feet) may make boat navigation difficult due to submerged hazards and reduced surface area. Therefore, some boating activities, such as high-speed activities like PWC use and waterskiing, may not be safe during lowered reservoir

conditions. Consequently, these activities may require lower speed limits and prohibition in certain areas.

Some level of water-based recreation on Temperance Flat RM 274 Reservoir is anticipated. During periods of lowered water surface elevation, particularly during low water years, the two proposed boat ramps may become inoperable, limiting boating use to smaller craft that could be carried to the water's edge during these periods. Final accessibility limits would need to be defined as part of final design and operations planning. The resource management plan for the reservoir area will include a discussion of allowable water-based recreation uses, as well as management and facilities for such uses.

Temperance Flat RM 274 Reservoir would also affect the location of a future storage building near the visitor center mentioned in the *Business Plan for the San Joaquin River Gorge Special Recreation Management Area* (BLM 2010a), but this facility would be relocated outside of the inundation area to avoid potential impacts.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, instream flows in the San Joaquin River downstream from Friant Dam in December, January, and April would be higher than existing conditions with the release of full Restoration Flows. Flows would not exceed instream flows for the SJRRP, which could reach 4,000 cfs. Higher flows have the potential to damage recreation facilities along the river, such as canoe/kayak put-ins, picnic areas, campgrounds, restrooms, and parking areas.

Public and private recreation facilities on the river have withstood flows exceeding 4,000 cfs without permanent damage when Millerton Lake has spilled large volumes of water. Park facilities along the San Joaquin River continued to operate during floods in 2005 and 2006 when flows were well over 4,000 cfs. Increased flows would not affect the two auto tour routes within the San Luis NWR. Thus, it is unlikely that the increased flows under the No Action Alternative would lead to the permanent loss or closure of recreation facilities along the San Joaquin River.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives With implementation of the action alternatives, instream flows in the San Joaquin River below Friant Dam to Mendota Pool would be higher in several months of the year when compared to the No Action Alternative or existing conditions. Operation of the new reservoir would result in increased discharges from Friant Dam in certain months that would reach 4,000 cfs. Because recreation facilities on the San Joaquin River have withstood flows exceeding 4,000 cfs without permanent damage, it is unlikely that the higher flows would result in the permanent loss or closure of recreation facilities along the river.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact REC-2: Permanent Loss of a Resource Used for Recreation

Primary Study Area

No Action Alternative Under the No Action Alternative, the Temperance Flat RM 274 Dam would not be built; therefore, there would be no loss of resources used for recreation attributable to inundation of the San Joaquin River following construction of the new dam. Continued implementation of existing land management and plans would not substantially alter existing recreational resources in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives At top-of-active storage elevation, the action alternatives would inundate the Millerton Lake Caves system. Inundation of these caves would result in the loss of the cave resources for recreation. Therefore, implementing any action alternative would result in a substantial impact on this recreation resource.

An estimated 10 percent of visitors to the SJRG SRMA participate in rock climbing (bouldering), 80 percent of which occurs in the Madera County portion of the primary study area. Most of the rocks used for climbing are located near the edge of the river channel and would be inundated by creation of Temperance Flat RM 274 Reservoir. Inundation of the rocks along the river would likely eliminate most, if not all, of the identified rock climbing opportunities within the SJRG SRMA.

Because few other rock climbing opportunities are available in the vicinity of the SJRG SRMA, the loss of this climbing area would result in a substantial impact on recreation.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, instream flows in the San Joaquin River downstream from Friant Dam in spring and early summer would be substantially greater than historical average flows below Friant Dam during those seasons, due to release of full Restoration Flows. Inundation and damage from debris and sediment associated with these increased flows could affect recreation facilities along Reach 1. However, even the highest scheduled flows are considerably less than the flows that have occurred in recent years during periods of high inflow into Millerton Lake. Also, recreational development on the river has generally been designed to withstand periodic flooding and has withstood high flows in recent years without permanent damage.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives With implementation of the action alternatives, instream flows in the San Joaquin River below Friant Dam would be higher in most months of the year when compared to the No Action Alternative or existing conditions. Operation of the new reservoir would result in increased discharges from Friant Dam in certain months that would reach 4,000 cfs. Because recreation facilities on the San Joaquin River have withstood flows exceeding 4,000 cfs without permanent damage, it is unlikely that the higher flows would result in the permanent loss of resources used for recreation activities along the river.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact REC-3: Substantial or Long-Term Reduction or Elimination of Recreation Opportunities or Experiences

Primary Study Area

No Action Alternative Under the No Action Alternative, the Temperance Flat RM 274 Dam would not be built; therefore,

there would be no substantial or long-term reduction or elimination of recreation opportunities or experiences attributable to inundation of the San Joaquin River from the new dam. Continued implementation of existing land management and plans would not substantially alter existing recreational opportunities in the primary study area. Millerton Lake has historically experienced substantial seasonal fluctuation under normal operations, and would continue to do so under the No Action Alternative.

The annual maximum water level of Millerton Lake would typically occur in June with a median end-of-month pool elevation of about 557 feet (about 24 feet below top-of-active storage). The reservoir would continue to be drawn down about 80–100 feet below top-of-active storage, with the minimum annual elevation occurring in August or September. Overall, changes to reservoir operations from changes in demand and other factors would be small, with the reservoir being operated at slightly lower elevations than under existing conditions.

When no action conditions are compared to existing conditions, the change in Millerton Lake water surface elevation under the No Action Alternative would be minimal, typically ranging between 1 and 14 feet lower. The greatest change would occur during April and May; however, in most years, the reservoir water surface would remain within the preferred shoreline use elevations (between 540 and 560 feet msl) and fall below the preferred elevation range only during drier years. The minor change in reservoir surface elevation would have a minor impact on the recreation opportunities or experiences provided at the Millerton Lake SRA or SJRG SRMA.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives

Impacts on Millerton Lake SRA Placement of Temperance Flat RM 274 Dam, including a permanent restricted-boating area near the dam, would decrease the surface acreage and shoreline available for recreation in the Millerton Lake SRA. The dam would obstruct boat access, including during special boating and fishing events that currently use the area upstream from RM 274, by isolating the Temperance Flat and Big Bend areas from Millerton Lake.

Temperance Flat RM 274 Dam could affect about 20 percent of PWC use, 40 percent of general boating, and 50 percent of boat fishing activities at Millerton Lake. Almost all land-based recreation opportunities at Millerton Lake, such as picnicking/swimming and shoreline fishing occur downstream from RM 274. It is estimated that, currently during the recreation season, about 27 percent of boaters use the area upstream from RM 274. In the off-season, currently about 49 percent of boaters at the Millerton Lake SRA use the area upstream from RM 274 (Gresham 2013).

Temperance Flat RM 274 Dam would also reduce the range of recreation opportunities available from existing Millerton Lake access points because of the loss of recreation opportunities available in Rural Natural and Semi Primitive WROS zones. The Big Bend and Temperance Flat areas are the only Millerton Lake SRA areas offering these WROS classifications; the remainder of the lake is classified as Suburban. Temperance Flat RM 274 Dam would displace boaters that use the Temperance Flat and Big Bend areas to other areas of Millerton Lake or to the proposed Temperance Flat RM 274 Reservoir, or boaters would visit a different location. Displacing visitors to other locations would affect the amount of recreation use within the Millerton Lake SRA.

Creation of Temperance Flat RM 274 Reservoir would provide a new flat water surface area for boating opportunities and provide new shoreline area for recreation opportunities within the Millerton Lake SRA, upstream from the permanent restricted area near the dam. However, this area would be disconnected from Millerton Lake and not accessible from existing Millerton Lake access points.

Temperance Flat RM 274 Reservoir would provide a comparable flat water area for PWC, boaters, and boat fishing users who now use this portion of Millerton Lake. These users, however, would need to access the new reservoir from Wellbarn or Smalley roads.

The impact on boating at Millerton Lake would begin when cofferdams are installed and access upstream from RM 274 was halted for construction of the dam. During construction, displaced users would likely visit other areas of Millerton Lake or visit another reservoir. Overall, the loss of water-based recreation opportunities and experiences within a portion of the Millerton Lake SRA would be a significant impact, but the establishment of additional flat water area associated with

Temperance Flat RM 274 Reservoir and re-operation of Millerton Lake would partially offset the loss of flat water area on Millerton Lake.

Use of the tunnel waste disposal site in Sea Scout Cove and development of the powerhouse (and related facilities), transmission line, and access roads would permanently decrease the surface area for on-water recreation, decrease the shoreline available for recreation, and decrease the land area of the Millerton Lake SRA available for recreation. No existing recreation facilities are located in these areas, and no known recreational uses of the land are located in the area to be used for the powerhouse, transmission line, or access roads. Therefore, the recreation opportunities primarily affected by these project facilities would be boating and fishing activities on the lake. It is likely that any on-water or shoreline users displaced from these areas because of construction activities would visit other areas within the main part of Millerton Lake downstream from RM 274. Because similar boating and fishing opportunities are available on the remainder of the main part of Millerton Lake, this impact would be less than significant. Mitigation for this impact is not needed and thus not proposed.

The Millerton Bottoms whitewater run begins near Kerckhoff No. 2 Powerhouse and ends on the south shore of the Temperance Flat area at Millerton Lake SRA. This whitewater run is the only whitewater run within the Millerton Lake SRA. A typical whitewater boating season extends from August to November, when Millerton Lake has been sufficiently drawn down to expose the upstream river channel. The last rapid on the run appears only when the reservoir is drawn down below 480 feet.

With the inundation of the San Joaquin River from development of the Temperance Flat RM 274 Reservoir and the expected operation of Temperance Flat RM 274 Reservoir under any action alternative, it is unlikely that the reservoir would be drawn down sufficiently (below elevation 520) to create opportunities for whitewater boating on the Millerton Bottoms run.

It is estimated that 75 percent of boat-in camping within the Millerton Lake SRA occurs at the Temperance Flat boat-in campground, which would be inundated by the creation of Temperance Flat RM 274 Reservoir. Relocation related to providing boat-in camping opportunities and experiences is described in the discussion of Impact REC-1.

Existing Millerton Lake shoreline recreation facilities and use would be affected by operation of Temperance Flat RM 274 Reservoir if Millerton Lake pool elevations were altered to a degree affecting recreational use and preferences. Changes that would affect recreation opportunities are of two primary types: (1) increasing or decreasing pool elevation during the first half of the peak recreational use season and (2) extending the peak pool elevation period later into summer.

Hydrologic modeling results indicate that Millerton Lake would maintain a pool elevation of 551 feet for the entire 4-month peak recreational use season with implementation of Alternatives Plans 1through 4. An elevation of 551 feet would be within the preferred shoreline use elevations of 560 and 540 feet. During spring and early summer, a water surface elevation of 551 feet would be both slightly higher and slightly lower than the elevations associated with existing conditions and the No Action Alternative. Implementing Alternatives Plans 1 through 4 would create a water surface elevation that would remain within the preferred shoreline use elevations from April to June; therefore, no impact would occur. Mitigation for this impact is not needed and thus not proposed.

Implementing Alternative Plans 1 through 4 would provide a higher, stable pool elevation during July and August, when, under baseline conditions and the No Action Alternative, the pool elevation would typically fall to an annual minimum elevation. The minimum pool elevation associated with implementing Alternative Plans 1 through 4 would be retained at 551 feet, which is within the preferred shoreline use elevation range. This increase in water surface elevation would provide boaters with additional surface acreage, greatly reduce impacts on marina and floating dock operations from decreasing pool elevation, and allow shoreline use within a comfortable distance of amenities located above the high pool elevation.

Maintaining a 551-foot water surface elevation would also help resolve current capacity issues associated with limited parking capacity on holiday weekends. Because vehicles can drive onto and park on the exposed shoreline slopes, more parking is available at this lower pool elevation, reducing the need for facility closures on holiday weekends when formal parking capacity is exceeded.

The much higher pool elevation during the late season caused by implementing Alternative Plans 1through 4 would also

likely decrease the number of exposed islands and similar obstructions, which would improve boat navigation and the quality of boating experiences on the lake.

Improved shoreline use and boating conditions in the late summer related to a consistent pool elevation of 551 feet under Alternative Plans 1through 4 would improve conditions for recreation and therefore likely increase recreation use (day use primarily) during the late summer (July and August) over an estimated 30,000 visitor days per year. The constant pool elevation would also serve to increase boating and day-use recreation on the Memorial Day and July 4 holiday weekends in wetter years when the lake would have otherwise been at top-of-active storage and facilities would have been closed because of limited parking. This impact would be beneficial.

Under Alternative Plan 5, the reservoir pool elevation would be at elevation 551 feet msl for most of the recreation season. Under future water demand conditions, the reservoir would decrease below the preferred shoreline use elevation of 540 feet msl in August, but would remain within the preferred shoreline use elevation in August under existing water demand conditions. Thus, slightly less benefit to recreation at Millerton Lake would be provided by Alternative Plan 5 compared to the other action alternatives.

Construction activities at the batch plant, at the aggregate quarry, at the staging area, and along the haul roads would temporarily decrease the land available for recreation within the Millerton Lake SRA. However, there are no known recreation uses of these lands. Therefore, temporary use of these lands for construction would have a less-than-significant impact on recreation. Mitigation for this impact is not needed and thus not proposed.

Construction of the powerhouse and related facilities would likely result in noise and visual disturbances for boaters in this area. However, these impacts would be temporary, and boaters could participate in similar boating opportunities within the remainder of Millerton Lake. Therefore, construction of the powerhouse and related facilities would have a less-than-significant impact on boating recreation opportunities and experiences. Mitigation for this impact is not needed and thus not proposed.

The South Finegold picnic area is the only day-use area located upstream from the main body of Millerton Lake. This area

provides picnicking and shoreline fishing opportunities and serves as a trailhead for the San Joaquin River Trail. Although the site is anticipated to remain open during construction, construction activities related to building the powerhouse, transmission line, and access roads could temporarily affect recreation opportunities and experiences for visitors to the picnic area because of delays in accessing the site or visual and noise disturbances to the recreation setting. A substantial reduction in the quality of recreation experiences for picnic area users could occur during construction of the road adjacent to the site if construction were to occur on weekends or holidays, when most recreation use likely occurs at the site.

The Millerton Bottoms whitewater run begins at the Kerckhoff No. 2 Powerhouse and ends at the south side of Temperance Flat, where users walk back upstream to the put-in, get vehicle access to Temperance Flat via Wellbarn Road, or continue paddling 9 miles downstream to the South Finegold picnic area. Temporary impacts on this whitewater boating opportunity and experience could occur from construction of the new Wellbarn Road boat ramp and road, and relocating the San Joaquin River Trail. Noise and visual disturbances may affect the recreation setting, and access delays may occur at the put-in and take-out locations. Given the distance of the river from these construction activities, it is unlikely that the quality of whitewater boating experiences would be substantially reduced.

Removal of vegetation within the new reservoir inundation zone would be an activity that could substantially increase traffic, noise emissions, and visual disturbance upstream from the dam construction site. Depending on when the removal of trees and other vegetation occurs, impacts on recreationists may vary. A significant impact would occur if vegetation removal occurs during higher recreational use periods and would apply to both the Millerton Lake SRA and SJRG SRMA. Other potential impacts on recreational users associated with vegetation removal, such as noise and visual effect, cannot be mitigated to a less-than-significant level because this widespread activity would substantially alter the existing ambient noise level and visual character of the watershed. Therefore, the recreation setting would be greatly adversely affected, resulting in a substantial decrease in the quality of recreation experiences.

Construction activities within the Millerton Lake SRA could affect the archery-only spring turkey hunt by displacing

wildlife in and near construction zones and altering the recreation setting because of visual and noise disturbances. Hunting within the Millerton Lake SRA is limited to a single 14-person archery-only spring turkey hunt each year. This event is the only hunting opportunity within the Millerton Lake SRA; therefore, construction activities could substantially affect recreation experiences for hunters in the Millerton Lake SRA. The loss of this hunt may be considered a loss of an important recreational opportunity.

Construction activities, particularly within the dam and staging areas, as well as construction of new access roads and the outlet works, could alter the recreation setting of the San Joaquin River Trail by creating visual and noise disturbances and delays in accessing trailheads. Construction activities could also potentially require closing portions of the trail. Trail closures or disturbance from construction activities would substantially impact recreation experiences and reduce trail opportunities in the area.

Although the action alternatives would reduce recreation opportunities within the Millerton Lake SRA, the action alternatives would also provide new recreation opportunities and increase recreation use in the area. With the construction of the Wellbarn and Smalley Road boat ramps, additional boating opportunities would be available at Temperance Flat RM 274 Reservoir and thus boating-related recreation use would likely increase. It is anticipated that induced water-based recreation use at Temperance Flat RM 274 Reservoir would increase recreation use within the area over 70,000 visitor days for Alternative Plans 1 through 4 and over 35,000 visitor days for Alternative Plan 5 under future water demand conditions; use is projected to be even higher under existing water demand conditions. These estimates are based on estimated boat launches during the May to September recreation season and surface acres available for boating.

Impacts on the McKenzie Preserve Within the McKenzie Preserve, construction of the new transmission line could temporarily affect recreation opportunities and experiences for visitors because of visual and noise disturbances to the recreation setting. In addition, construction activities could temporarily block access to trails, resulting in reduced recreation opportunities within the preserve. Outside of the preserve, there are few other trail opportunities, and none in a similar setting. The temporary reduction in trail opportunities inside the preserve would be substantial.

Impacts on the SJRG SRMA Inundation of the San Joaquin River and creation of Temperance Flat RM 274 Reservoir would permanently alter the recreation setting of the SJRG SRMA, creating a wide reservoir at the downstream end and a narrow reservoir upstream within the Patterson Bend area. The reservoir would be subject to a large draw down, creating a wide fluctuation zone on the shoreline that would be denuded of vegetation. This would make shoreline recreational use during reservoir drawdown more difficult and less desirable, particularly under Alternative Plan 5, which would have the most reservoir fluctuation and draw down of the action alternatives.

With inundation of the river, recreation opportunities and experiences would be reservoir based rather than river based, therefore generally eliminating activities such as river angling, gold panning, river swimming, general river boating, and river-based interpretation and education activities. When the reservoir was drawn down to 720 feet or less, the river would be exposed within the Patterson Bend area, and water-based river uses could be possible in this area.

However, the river within the developed zone in the SJRG SRMA would rarely be exposed under Alternative Plans 1 through 4 (under both future and existing conditions) in most years, therefore effectively eliminating most river-based recreation opportunities within the SJRG SRMA. Under Alternative Plan 5 with existing water demand conditions, the reservoir would be at elevation 720 or less (50 percent exceedence) from July through December (until February under future water demand conditions), exposing the river down to below the developed zone in the SJRG SRMA during some months. Therefore, some river recreation opportunities would continue to be available under this action alternative, although at a great distance from relocated facilities and within a different recreation setting.

Although recreation opportunities in the Millerton Lake SRA and SJRG SRMA would continue to be available, camping, picnicking, hunting, shoreline fishing, trail use, and wildlife viewing/nature observation activities would occur in a different setting; therefore, different recreation experiences would result. In addition, the relocated facilities and recreation opportunities would be available, but generally significantly farther from the shoreline than under existing conditions, given the draw down anticipated for the reservoir. This would affect visitor experiences and willingness to participate in recreation

activities. The overall change of setting may result in visitors choosing to visit another location for recreation activities. Also, the recreation season may change from a spring/fall season to a predominately summer season because this is the typical use season for reservoirs, such as Millerton Lake. Although shoreline angling may still be possible with creation of the new reservoir, the composition of fish species available for harvesting may be altered.

Based on available existing use estimates, eliminating existing river-based recreation opportunities in the SJRG SRMA would displace about 18.5 percent of recreation users within the SJRG SRMA, including gold panning and general river boating users. Eliminating other river activities (e.g., fishing, swimming) and altering recreation experiences would displace additional visitors. Displaced users could either participate in recreation activities at the new reservoir or visit another river area. Given the permanent change to the river-based recreation setting, a long-term reduction and elimination of recreation opportunities and experiences would occur, resulting in a significant impact on recreational resources.

Temperance Flat RM 274 Reservoir would reduce the land base within the SJRG SRMA for hunting and wildlife viewing/nature observation. Hunting within the SJRG SRMA is a relatively popular activity with an estimated 25 percent of SJRG SRMA visitors participating in this activity. The new reservoir would isolate the Madera County side of the reservoir, affecting 35 percent of hunting use (Table 22-12). Therefore, although a long-term reduction in hunting opportunities would occur, it would have a less-than-significant impact on recreation because most hunting use occurs within Fresno County and could continue, although there would be a slightly smaller land base available for hunting. In addition, hunters could take the water taxi to the Madera County side of the reservoir to access hunting opportunities in this portion of the SJRG SRMA.

Similarly, wildlife viewing and nature observation opportunities would be affected by a reduced land base within the SJRG SRMA. An estimated 50 percent of visitors to the SJRG SRMA participate in wildlife viewing/nature observation. The new reservoir would isolate the Madera County side of the reservoir, affecting 25 percent of wildlife viewing/nature observation use (Table 22-12). Although some long-term reduction in wildlife viewing and nature observation opportunities may occur from inundation, it would have a less-

than-significant impact on recreation because most wildlife viewing/nature observation use occurs within Fresno County and could continue. In addition, visitors could take the water taxi to the Madera County side of the reservoir to access wildlife viewing/nature observation opportunities in this portion of the SJRG SRMA. Mitigation for this impact is not needed and thus not proposed.

Although interpretation and education opportunities would still exist and facilities could be relocated, any interpretive and educational programs that feature the river, particularly in a historical context, would not be possible or would need to be altered because the reservoir would not be comparable to historical river conditions. In addition, the reservoir would eliminate about 10 percent of interpretation and education use that occurs on the Madera County side of the river. The potential decrease in interpretation and educational opportunities from inundation of the river would be a less-than-significant impact on recreation because opportunities exist for other interpretation and educational activities and programs in the area, including within the Fresno County portion of the SJRG SRMA. In addition, visitors could take the water taxi to the Madera County side of the reservoir to access interpretation and education opportunities in this portion of the SJRG SRMA. Mitigation for this impact is not needed and thus not proposed.

An estimated 10 percent of camping and shoreline fishing use occurs in the Madera County portion of the SJRG SRMA, including all backpack camping. Opportunities for camping and shoreline fishing would be slightly reduced because of a decreased ability to access the Madera County side of the reservoir and SJRG SRMA. However, visitors could take the water taxi to the Madera County side of the reservoir to access camping and shoreline fishing opportunities in this portion of the SJRG SRMA. In addition, the campgrounds in the Fresno County portion of the SJRG SRMA would continue to be available for camping and shoreline fishing access within the developed zone. Therefore, the slight decrease in camping and shoreline fishing opportunities would have a less-than-significant impact on recreation. Mitigation for this impact is not needed and thus not proposed. Impacts regarding the general loss of river fishing opportunities are discussed above.

Currently, horseback riding is allowed on the Wuh-ki’o and Pa’san Ridge Trails. Because the San Joaquin River Trail bridge would be inundated, equestrian use of these trails would cease as the water taxi would not be able to support transport of

horses to the Madera County side of the reservoir. This elimination of 11.2 miles of available equestrian trails (Pa'san Ridge and Wuh-ki'o Trails and trail to bridge) would reduce the total trail mileage available for horseback riding opportunities by more than 36 percent. The only remaining trails available to equestrians would be the San Joaquin River Trail in the SJRG SRMA and Millerton Lake SRA, and the Blue Oak and North Shore Trails in the Millerton Lake SRA.

Currently, two whitewater boating runs are located in the SJRG SRMA. The Patterson Bend Run is available during peak runoff in wet years (American Whitewater 2013b); however, the river is reported to be navigable over a wide range of flows, although portaging may be required (Rowland 2013). The Squaw Leap Run is available yearly, and a typical season lasts 4 weeks, from late October to mid-November, when Kerckhoff No. 2 Powerhouse is not operational, and instream releases from Kerckhoff Lake into the Patterson Bend run are low (American Whitewater 2013c). An estimated 3 percent of SJRG SRMA visitors participate in whitewater boating.

Under Alternative Plans 1 through 3, on average, most of the San Joaquin River containing the 6-mile-long Patterson Bend whitewater run would be exposed between August and December. During these 5 months, the reservoir water surface would be below elevation 760, which would expose all but the last 2 miles of the river channel to the developed zone. On average, Alternative Plan 4 would not fall below elevation 760. Under Alternative Plan 5 with future water demand conditions, the reservoir water surface would be below elevation 760 all year on average, exposing almost the entire Patterson Bend run; with existing water demand conditions, the run would be exposed for 7 months of the year (July to January).

San Joaquin River inflow modeling information from Kerckhoff Lake was reviewed to determine whether river flows would be within the 700- to 6,000-cfs boatable flow range for this run. Model results showed that under a wide variety of hydrologic conditions, end-of-month inflows would be within the run's boatable range for the entire year under all five action alternatives. Therefore, when the reservoir was drawn down and the San Joaquin River channel was exposed, conditions would still allow for whitewater boating on the Patterson Bend run.

Although whitewater boating opportunities would still be possible on the Patterson Bend run, the setting would be

different because the vegetation and rock along the run length would be altered. In addition, remnant trees and other debris could create potential boating hazards along the run. Also, the Squaw Leap run would be exposed infrequently, displacing whitewater boaters to other rivers in the region.

Relocation of utilities, the transmission line, the San Joaquin River Trail, and recreation facilities, as well as vegetation removal and construction of the new boat ramp at Smalley Road, could temporarily affect both land- and water-based recreation opportunities and experiences associated with delays in access to recreation facilities and sites or visual or noise disturbances to the recreation setting. All recreation facilities and sites would be expected to remain open for use during construction, although it is assumed that a temporary transition period would occur where visitors would use the replacement facilities and sites while old facilities were being removed.

A substantial reduction in the quality of recreation experiences could occur if construction activities, including vegetation removal, were to occur at night while people were camping, during group/school interpretation and education programs, or on weekends or holidays when most recreation use occurs. This impact would be temporary.

Overall, the action alternatives would result in loss of water-based opportunities within the Millerton Lake SRA, loss of whitewater boating opportunities, degradation of recreation experience quality due to vegetation removal activities, and loss of river-based recreation opportunities and experiences.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, instream flows in the San Joaquin River below Friant Dam in December, January, and April would be higher than under existing conditions. Flows would not exceed instream flows for the SJRRP, which could reach 4,000 cfs. Higher flows of more than 1,500 cfs would likely occur only during April and may make it temporarily unsafe to fish on the riverbank or by boat, make conditions undesirable for swimming, and make the river unusable for boating. However, trout fishing and similar boating opportunities would be available on the Kings River, and boaters and anglers would be informed of these

opportunities as well as the changes to river flows from the SJRRP via the Recreation Outreach Program developed for the SJRRP. In addition, swimming is likely not popular in the river in April because of lower air temperatures. It is not expected that increased flows would affect auto touring, hiking, or hunting in the San Luis NWR. Therefore, there would be no substantial or long-term reduction or elimination of recreation opportunities or experiences.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Swimming in the San Joaquin River is a popular activity in summer, when the water and air temperatures are suitably warm. Implementing Alternative Plans 1, 2, or 3 would result in releases from Millerton Lake that would be warmer than releases under the No Action Alternative from December through April, June, July, or September, depending on the water-year type. Releases under Alternative Plans 1, 2, or 3 would be colder than releases under the No Action Alternative in late summer through early winter. Overall, no dramatic difference would occur in river water temperature in summer, when most swimming occurs. This impact would be less than significant. Therefore, mitigation for this impact is not needed and thus not proposed.

Releases from Millerton Lake under Alternative Plan 4 would be colder in late fall and early winter than under the No Action Alternative and Alternative Plans 1, 2, 3 or 5, and warmer than releases under the No Action Alternative and Alternative Plans 1, 2, or 3 in summer. Releases under Alternative Plan 4 would be particularly warmer in summer in wet and normal-wet water-year types, when a faster occurring increase in river water temperature would occur than under Alternative Plans 1, 2, 3 or 5. Overall, there would be no dramatic difference in river water temperature during summer in dry and normal-dry water-year types, resulting in a less-than-significant impact on recreation. In addition, implementing Alternative Plan 4 would provide beneficial impacts on swimming with warmer summer water temperatures in wet and normal-wet water-year types. Therefore, mitigation for this impact is not needed and thus not proposed.

Implementing Alternative Plan 5 would result in warmer releases from Millerton Lake than under the No Action Alternative from January through April, October, or December, depending on the water year type. Releases would be similar to

or slightly colder than the No Action Alternative in fall and early winter. In dry water year types, releases under Alternative Plan 5 would be warmer all year compared to the No Action Alternative. In the summer of normal-dry and dry water year types, releases under Alternative Plan 5 would be the warmest of all action alternatives. However, overall, no dramatic difference would occur in river water temperature in summer, when most swimming occurs.

Under any action alternative, instream flows would be greater in the San Joaquin River below Friant Dam (50 percent exceedence) in most months of the year compared to existing conditions and the No Action Alternative. Although flows could be higher than existing conditions for several months of the year, flows would generally not exceed instream flows for the SJRRP, which may reach up to 4,000 cfs. High flows of more than 1,500 cfs would likely occur only during April and may temporarily affect boating, fishing, and swimming opportunities as described in No Action Alternative section. However, trout fishing and similar boating opportunities would be available on the Kings River, and swimming use is likely low in April because of lower air temperatures. Therefore, there would be no substantial or long-term reduction or elimination of recreation opportunities or experiences.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact REC-4: Loss of Access to a Locally Important Recreation Site or Area

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be built; therefore, there would be no inundation of the San Joaquin River from the new dam. For this reason, access to existing recreation sites and areas would not be altered.

There would be **no impact** under the No Action Alternative.

Action Alternatives

Impacts on Millerton Lake SRA Within the Millerton Lake SRA, construction of the Temperance Flat RM 274 Dam would permanently block existing on-water access to the Temperance Flat and Big Bend areas of Millerton Lake from on-water users of Millerton Lake (from existing access points

on the lake). The Temperance Flat and Big Bend areas are locally important recreation areas and as stated previously, there are no other similar boating areas (with similar WROS classification) at Millerton Lake SRA. These two areas receive between 27 and 49 percent of on-water boating use at Millerton Lake, respectively (Gresham 2013).

Recreational visitors would be able to access the relocated recreation facilities and sites via Wellbarn Road and Smalley Road. This access would provide boaters ability to use the new Temperance Flat RM 274 Reservoir for flat water recreational purposes. Although existing gravel roads that link to Wellbarn Road would be inundated, direct shoreline access at top-of-active storage would continue to be provided at Wellbarn Road, which is currently gated to public access.

Millerton Lake SRA administrative access would also continue to be available via Wellbarn Road. Informal shoreline access below top-of-active storage, which is provided by gravel roads, would be available via the new boat ramp at Wellbarn Road. Therefore, the loss of access from portions of Smalley Road, Wellbarn Road, and informal gravel roads would be a less-than-significant impact. Mitigation for this impact is not needed and thus not proposed.

After construction of the Temperance Flat RM 274 Dam is initiated, boat access to the Temperance Flat boat-in campground and Hewitt Valley Environmental Camp from Millerton Lake would be obstructed; there are no boat ramps upstream from RM 274 from which to access the camping areas. The Temperance Flat boat-in campground is a locally important recreation site because it is the only boat-in campground on Millerton Lake. Therefore, construction activities would result in a temporary significant impact on recreation because access to the Temperance Flat boat-in campground would be eliminated. After the river is inundated, access to (and use of) the relocated campground would be possible.

Construction activities in the Wellbarn Road area could require the closure of public nonmotorized access on Wellbarn Road and the gravel roads linked to the road. The Wellbarn Road area is a locally important recreation area because it is the only area for recreation opportunities such as shoreline fishing and nature observation located between the South Finegold picnic area and the fishing access at Kerckhoff No. 2 Powerhouse.

This area also provides access to the San Joaquin River Trail. This impact would be temporary.

Impacts on the SJRG SRMA Inundation of the San Joaquin River Trail bridge would result in the loss of access to recreation lands on the Madera County side of the SJRG SRMA. Loss of access to these recreation lands would be a significant impact. The proposed water taxi would provide access to the Madera County-side of the SJRG SRMA to partially offset the loss of the bridge; however, visitors would lose some flexibility in when they can access the Madera County side of the reservoir as the water taxi would not be available at all times of the day.

As described above, access to lands in the SJRG SRMA in Madera County would be maintained by operation of a water taxi across the reservoir, retaining opportunities for hunting, wildlife viewing/nature observation, interpretation and education, shoreline fishing, and camping. However, the lands in Madera County are not locally important recreation areas or sites for these activities. There would be a less-than-significant impact related to access to lands in the SJRG SRMA in Madera County for these activities. Therefore, mitigation for this impact is not needed and thus not proposed.

In terms of trail access, the relocated San Joaquin River Trail would continue to provide nonmotorized access between the Millerton Lake SRA and the SJRG SRMA. There is also an informal trail between the Wuh-ki'o Trail and the Temperance Flat area in the Millerton Lake SRA. Because the trail is not a formal trail, inundated portions would not be relocated. Therefore, informal access between the Millerton Lake SRA and the SJRG SRMA on the Madera County side of the reservoir would be obstructed. The Temperance Flat Reservoir Area would be inundated, and formal trail access between the SJRG SRMA and the Millerton Lake SRA would be provided on the relocated San Joaquin River Trail. The loss of this informal trail access would be a less-than-significant impact on recreation. Mitigation for this impact is not needed and thus not proposed.

It is anticipated that modifications to Kerckhoff Dam would affect the area around the dam. Within the lake, some boating may occur near the dam, but use is likely very low, and most of the lake would not be affected by construction activities. The main recreational use of the dam area (downstream side) is as a put-in for the Patterson Bend whitewater run. Closure of access

to the put-in for construction activities would temporarily eliminate access to and use of the run. This impact would be temporary.

Within the SJRG SRMA, construction activities would involve relocating the existing transmission line, recreation facilities, and the San Joaquin River Trail, as well as vegetation removal and construction of the new boat ramp at Smalley Road. Temporary closure of access to any recreation site or facility within the SJRG SRMA would result in a substantial impact on recreation because all recreation facilities and sites within the SJRG SRMA are locally important recreation sites. Recreation facilities within the river corridor are limited.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed in the Mitigation Measures section.

Extended Study Area

No Action Alternative Under the No Action Alternative, instream flows in the San Joaquin River below Friant Dam in December, January, and April would be higher than existing conditions. Flows would generally not exceed instream flows that would occur with the SJRRP.

High flows have the potential to damage recreation facilities along the river, such as canoe/kayak put-ins, picnic areas, campgrounds, restrooms, and parking areas. Public and private recreation facilities on the river have withstood flows exceeding 4,000 cfs without permanent damage when Millerton Lake has spilled large volumes of water following very high inflows. Park facilities along the San Joaquin River continued to operate during floods in 2005 and 2006 when flows were substantially more than 4,000 cfs.

Although some facilities could be temporarily closed or have reduced access to the river during or after higher flows (for cleanup), this impact would be temporary. In addition, other similar recreation opportunities and experiences would be available on the Kings River, so access to locally important recreation sites with similar opportunities would be available nearby.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any action alternative would result in higher flows throughout most of the year on the San Joaquin River below Friant Dam compared to existing conditions and the No Action Alternative. Although instream flows could be higher than existing conditions for several months of the year, flows would generally not exceed instream flows established by the SJRRP. Flows of more than 1,500 cfs would likely occur only during April. Although some facilities could be temporarily closed or have reduced access to the river during higher flow events, this would be a temporary condition. In addition, other similar recreation opportunities and experiences would remain available on the Kings River, so access to locally important recreation sites with similar opportunities would be available nearby.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact REC-5: Increased Use of Existing Neighborhood and Regional Parks or Other Recreation Facilities such that Substantial Physical Deterioration of the Facilities Would Occur or Be Accelerated

Primary Study Area

No Action Alternative Under the No Action Alternative, the Temperance Flat RM 274 Dam would not be built; therefore, recreation facilities would not be inundated, and users would not be displaced to other facilities. Continued implementation of existing land management and plans would not substantially alter existing recreational facilities in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives Creation of Temperance Flat RM 274 Reservoir would temporarily and/or permanently displace water-based users from upper Millerton Lake; river-based users, such as whitewater boaters, river anglers, or gold prospectors, from the SJRG SRMA; and other recreationists who prefer a natural river recreation setting. These users may be displaced to recreation facilities at Millerton or Kerckhoff Lake or to other nearby facilities, such as parks along the San Joaquin River downstream from Friant Dam or rivers and lakes within Sierra National Forest.

Multiple facilities for displaced visitors are available nearby, and no single nearby facility would completely replace the recreation opportunities and experiences provided at the

facilities within primary study area. It is expected that displaced recreational users would visit a variety of locations, slightly increasing the use of any particular facility. Such an increase would not cause or accelerate substantial physical deterioration of these other facilities.

This impact would be **less than significant** under the action alternatives. Therefore, mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative Under the No Action Alternative, instream flows in the San Joaquin River below Friant Dam in December, January, and April would be higher than existing conditions. Flows would not exceed instream flows established by the SJRRP, which could reach 4,000 cfs. Flows of more than 1,500 cfs would likely occur only during April and may make it temporarily unsafe to fish on the riverbank or by boat, make conditions undesirable for swimming, and make the river unusable for boating. However, trout fishing and similar boating opportunities would be available on the Kings River, and boaters and anglers would be informed of these opportunities, as well as the changes to river flows from the SJRRP via the Recreation Outreach Program developed for the SJRRP (2012).

In addition, swimming is likely not popular in the river in April because of lower air temperatures. Also, it appears that ample capacity exists at Kings River facilities to absorb what is most likely a low number of spring-time anglers and boaters who could be displaced from the San Joaquin River. Therefore, it is unlikely that any regional park facilities would receive an increase in use such that substantial physical deterioration of facilities would occur.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Under any action alternative, instream flows in the San Joaquin River below Friant Dam would be higher in most months of the year compared to existing conditions and the No Action Alternative. Although flows could be higher than existing conditions for several months of the year, flows would not exceed instream flows for the SJRRP, which could reach 4,000 cfs. Flows of more than 1,500 cfs would likely occur only during April and could temporarily affect boating, fishing, and swimming opportunities as

described for the No Action Alternative. However, trout fishing and similar boating opportunities would be available from facilities on the Kings River, and swimming use is likely low in April because of lower air temperatures.

Changes in flows or water temperatures related to implementing any action alternative would not be expected to induce a substantial increase in recreation use, and ample capacity exists at Kings River facilities to absorb what is most likely a low number of spring-time anglers and boaters who could be displaced from the San Joaquin River during high flows. Therefore, it is unlikely that any regional park facilities would receive an increase in use such that substantial physical deterioration of facilities would occur.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact REC-6: Impacts Associated with New or Expanded Recreation Facilities

Primary Study Area

No Action Alternative The No Action Alternative does not include the construction or expansion of recreation facilities. Continued implementation of existing land management and plans would not substantially alter existing recreational facilities in the primary study area.

There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives include the construction of recreation facilities to replace facilities that would be inundated by the creation of Temperance Flat RM 274 Reservoir. Construction of these facilities could have an adverse physical impact on the environment, resulting in the loss of vegetation and associated habitat, but would be mitigated to a less than significant impact with implementation of typical facility siting and avoidance measures, where needed.

Relocated recreation facilities would provide the same facility capacity as existing facilities and would assist in providing recreation opportunities and experiences similar to those provided by existing facilities, although the setting would change with the creation of Temperance Flat RM 274 Reservoir. Temporary impacts on recreation from construction

of replacement recreation facilities are addressed in the discussion of Impacts REC-3 and REC-4.

In addition to relocating inundated recreation facilities, two new boat ramps would be constructed at Temperance Flat RM 274 Reservoir, increasing the recreation facilities provided in the area. These boat ramps would allow boating-related activities to occur on the reservoir and would increase recreation use.

This impact would be **beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Extended Study Area

No Action Alternative The No Action Alternative does not include the construction or expansion of recreation facilities.

There would be **no impact** on under the No Action Alternative.

Action Alternatives The action alternatives do not include the construction of recreation facilities within the extended study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 22-13.

No mitigation is required for Impacts REC-5 and REC-6 within the primary study area or for Impacts REC-1 through REC-6 within the extended study area because there would be no impact or the impacts would be less than significant for all action alternatives.

Impact REC-1 within the primary study area would be significant. Implementing Mitigation Measures REC-1a and REC-1b would reduce this impact to a less-than-significant level. Therefore, Impact REC-1 (within the primary study area) would be **less than significant** under the action alternatives.

Impact REC-2 within the primary study area would be significant. Implementing Mitigation Measure REC-2 would reduce this impact, but not to a less-than-significant level because it would not avoid the loss of the Millerton Lake Cave system or rock climbing opportunities. Therefore, REC-2

(within the primary study area) would be **significant and unavoidable** under the action alternatives.

Impact REC-3 within the primary study area would be significant. Implementing Mitigation Measures REC-3a, REC-3b, and REC-3c would reduce this impact, but not to a less-than-significant level because it would not avoid the permanent loss of water-based opportunities within the Millerton Lake SRA, loss of whitewater boating opportunities, degradation of recreation experience quality due to vegetation removal activities, and loss of river-based recreation opportunities and experiences. Therefore, Impact REC-3 (within the primary study area) would be **significant and unavoidable** under the action alternatives.

Impact REC-4 within the primary study area would be significant. Implementing Mitigation Measure REC-4 would reduce this impact but not to a less-than-significant level because it would not avoid the temporary loss of access to the Temperance Flat boat-in campground or Millerton Lake SRA Temperance Flat and Big Bend areas during construction. Therefore, Impact REC-4 (within the primary study area) would be **significant and unavoidable** under the action alternatives.

Mitigation Measure REC-1a: Allow On-Boat Camping

Reclamation will allow recreational on-boat camping on Temperance Flat RM 274 Reservoir during periods of lowered reservoir water elevation and provide a floating restroom for on-boat campers.

Mitigation Measure REC-1b: Create New Shoreline Access Site

Reclamation will create a new shoreline access site in the developed zone.

Implementing Mitigation Measures REC-1a and REC-1b would reduce the significant impact related to the permanent loss or closure of a facility used for recreation to a less-than-significant level. This impact would be **less than significant** under the action alternatives.

Mitigation Measure REC-2: Preserve Fine Gold Creek Watershed Cave System

Comments received after scoping for the Investigation suggested that a cave system, with similar attributes to the Millerton Lake Cave system, may occur within the Fine Gold

Creek watershed in Madera County (Western Cave Conservancy 2004). Although the nature and extent of the cave system is unknown, such a cave system may be the closest similar cave system to the Millerton Lake Caves. Reclamation will study, explore, and, if appropriate, preserve the Fine Gold Creek watershed cave system.

Implementing Mitigation Measure REC-2 may reduce Impact REC-2, but not to a less-than-significant level. This impact would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure REC-3a: Limit Construction Activities near Recreation Areas

Reclamation will implement the following actions to reduce conflicts with recreation opportunities and experiences in the primary study area:

- A Traffic Management Plan, as identified in Chapter 24, "Transportation, Circulation, and Infrastructure," shall be prepared and implemented to minimize conflicts and hazards that may occur in the vicinity of the area of project features, including portions of the proposed Temperance Flat RM 274 Reservoir area used by recreationists.

- Construction zones and activities shall be located to avoid conflicts along the San Joaquin River Trail east of Wellbarn Road. If existing access cannot be safely maintained, Reclamation will reroute the trail to ensure continued trail-related recreation opportunities east of Wellbarn Road.

- No construction on or near the San Joaquin River Trail east of Wellbarn Road shall occur on weekends, holidays, or during the annual mountain bike race.

- A public information program shall be implemented and a Web site shall be created to provide information (including signage and maps, as appropriate) regarding construction schedule and locations, any facility or access changes and rerouting, and updates on construction schedules and facility relocations. Appropriate signage notifying the public of any trail reroutes shall be posted as needed, and maps and information regarding rerouting shall be provided.

- No construction shall be allowed on weekends or holidays within the McKenzie Preserve. Construction zones and activities shall be located so that the existing trail access and use are not impeded within the McKenzie Preserve. If access cannot be safely maintained, trails shall be rerouted to ensure continued trail-related recreation opportunities.

- No construction shall be allowed in the SJRG SRMA after dusk on weeknights, and no construction shall be allowed on weekends, holidays, or during special events within the SJRG SRMA.

Mitigation Measure REC-3b: Instream Whitewater Boating Improvements

Reclamation will investigate, and if feasible implement, instream modifications to a nearby river to provide Class II-III+ and Class IV+ whitewater boating opportunities similar to those provided on the Millerton Lake Bottom and Squaw Leap runs, respectively. Reclamation will conduct an investigation of rivers within a 2-hour driving distance of the project area to identify any potential stretches where whitewater boating opportunities could be provided at the Class II-III+ or IV+ level similar to the opportunities provided on the Millerton Lake Bottom and Squaw Leap runs. Instream modifications will be limited to Class II-III+ and Class IV+ rapids and limited to areas where public access is already provided or could easily be obtained and public use of the river for whitewater boating would be allowed. If a stretch of river is identified that meets these criteria, Reclamation will implement the necessary instream modifications and if necessary, obtain public access to the river for whitewater boating.

Mitigation Measure REC-3c: Extend the San Joaquin River Trail through the SJRG SRMA

Reclamation will assist BLM with completing the San Joaquin River Trail through the SJRG SRMA to the Sierra National Forest border to provide additional trail mileage for equestrian use.

Implementing Mitigation Measures REC-3a, b, and c would reduce the significant impact related to substantial or long-term reduction or elimination of recreation opportunities or experiences, but not to a less-than-significant level. This impact would remain **significant and unavoidable** under the action alternatives.

Mitigation Measure REC-4: Maintain Public Access

Reclamation will develop and implement a plan to locate construction zones and activities to avoid impeding nonmotorized public access to the San Joaquin River from Wellbarn Road, public access to the San Joaquin River immediately downstream from Kerckhoff Dam, and access to recreation sites and facilities within the SJRG SRMA. If public safety concerns prohibit safe access, public access to the river and/or recreation facilities will be rerouted to ensure continued recreation access.

Implementing Mitigation Measure REC-4 would reduce the significant impact related to loss of access to a locally important recreation site or area but not to a less-than-significant level. This impact would remain **significant and unavoidable** under the action alternatives.

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Chapter 23
Socioeconomics, Population, and Housing

This chapter describes the affected environment for socioeconomics, population, and housing, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion of socioeconomics, population, and housing focuses on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

The term "socioeconomics" describes basic attributes and resources associated with the human environment, with particular emphasis on population, employment, and housing. Substantial changes in these fundamental socioeconomic indicators may influence related variables, such as provision of community services and utilities and the cost of available housing. Chapter 10, "Environmental Justice," describes race, ethnic origin, and economic status in the primary and extended study areas and analyzes the potential of the action alternatives to result in disproportionately high and adverse impacts on minority and low-income populations.

Affected Environment

This section includes discussion of historic population and housing data, employment and labor force trends, prominent business and industry types, and government and finance. The description of socioeconomic conditions is both qualitative and, where possible, quantitative.

Primary Study Area

The primary study area can be described in terms of Census Tract 64.05 in Fresno County and Census Tract 1.02 in Madera County, which together include the area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274 (see Figure 10-1 in Chapter 10, "Environmental

Justice”). Census Tract 64.05 and Census Tract 1.02 encompass the area in which most of the impacts of the alternatives would occur.

Because of the often wide-ranging, interdependent nature of socioeconomic resources, economic impacts of the alternatives would be dispersed over a geographical area larger than that encompassed by Census Tract 64.05 and Census Tract 1.02. The following discussion includes a description of population, housing, and socioeconomic conditions for the nearby Cities of Clovis and Fresno within Fresno County and the City of Madera in Madera County because these areas would likely contribute goods and services and housing to the construction activities. Comparable data for the State are also presented below.

Population

Population and Growth Trends Table 23-1 presents historical, current, and projected population trends for Fresno and Madera counties; the nearby Cities of Clovis, Fresno, and Madera; and the State of California as a whole. This information was obtained from the DOF because it provided the most comprehensive dataset for these geographic areas. Current population data for Census Tract 64.05 and Census Tract 1.02 were obtained from the 2010 decennial census because the decennial census is the most recently completed dataset that can be used to show population at the Census Tract level.

As of 2010, the population in Fresno and Madera counties was approximately 1.1 million people. From 2000 to 2010, the Fresno County population increased by 21.4 percent. During this 10-year period, the population of Madera County grew at a greater rate than that of Fresno County, with a growth rate of 22.5 percent. The growth rate between 2000 and 2010 was less in Fresno and Madera counties and in the Cities of Fresno and Madera than the growth rate between 1990 and 2000.

From 2000 to 2010, the population of the Cities of Clovis and Madera increased at a greater rate than the populations of Fresno and Madera counties as a whole. The City of Clovis increased in population by 40.2 percent, and the City of Madera increased in population by 41.6 percent during this 10-year period. Because of Madera’s small population, the percent increase was greatest, whereas the actual numeric increase (at 18,046 for the 10-year period) was less than for other cities (e.g., Clovis, Fresno, and Madera).

Table 23-1. Historical, Current, and Projected Population for the Primary Study Area, Fresno County, Madera County, and Nearby Cities, 1990–2050

Geographic Area	Historic/Current Trends					Projected Conditions			
	1990	2000	2010	Percent Change, 1990–2000	Percent Change, 2000–2010	2020	2030	2050	Percent Change, 2010–2050
Fresno County	667,490	799,407	930,450	19.8	21.4	1,083,899	1,232,151	1,535,761	65.1
City of Clovis	50,323	68,197	95,631	35.5	40.2	—	—	—	NA
City of Fresno	354,091	427,224	494,655	20.7	15.8	—	—	—	NA
Madera County	88,090	123,109	150,865	39.8	22.5	183,176	219,908	314,546	108.5
City of Madera	29,283	43,370	61,416	48.1	41.6	—	—	—	NA
State of California	29,758,213	33,871,648	37,253,956	13.8	10.0	40,817,839	44,574,756	51,013,984	36.9

Sources: DOF 2012a; U.S. Census Bureau 2010

Key:
— = data unavailable
NA = not applicable

Population growth projections through 2050 indicate that Madera County is projected to grow at a rate more than double the State's rate of growth (36.9 percent) with a projected increase of 108.5 percent from 2010 to 2050. Fresno County is projected to experience a growth rate (65.1 percent) close to double the State's projected growth rate by 2050.

In 2010, the population of Census Tract 64.05 was 4,795 persons and the population of Census Tract 1.02 was 4,163 persons for a total population of 8,958 persons in the primary study area (U.S. Census Bureau 2010). Therefore, approximately 1 percent of the population in Fresno and Madera counties resided in and near the primary study area.

The community of Auberry is located approximately 10 miles northeast of Millerton Lake in Census Tract 64.05. Almost 50 percent of those persons residing in Census Tract 64.05 live in Auberry (2,369 persons) (U.S. Census Bureau 2010). Future population growth in Census Tract 64.05 would occur from planned and approved development along Millerton Road from the intersection of Millerton Road and Sky Harbour Road in the north to the intersection of Millerton Road and Auberry Road in the south. At buildout, these future developments would generate approximately 8,000–10,000 people in Census Tract 64.05 (see Chapter 17, "Land Use Planning and Agricultural Resources," for further discussion).

Age Distribution Table 23-2 summarizes 2010 age characteristics for the primary study area, Fresno and Madera counties, and the State. School-age children (aged 5–19), adults (19–64), and senior citizens (65 and older) represent approximately 23.1, 56.6, and 10.2 percent, respectively, of the total population in Fresno and Madera counties. This age composition is generally similar to that of the State, with most of the total population of working age.

School-age children (aged 5–19), adults (19–64), and senior citizens (65 and older) represent approximately 17.3, 56.4, and 21.2 percent, respectively, of the total population in the primary study area. Similar to Fresno and Madera counties and the State, most of the population is of working age; however, there is approximately double the percentage of senior citizen population in the primary study area than in both counties and the State. The median age in the primary study area was 49.7, which is greater than that in Fresno and Madera counties and the State.

Table 23-2. Age Distribution for the Primary Study Area, Fresno County, Madera County, and California, 2010

Population Segment	Primary Study Area[1]	Fresno County	Madera County	California
Total population	8,958	930,450	150,865	37,253,956
< 5 years	453	78,980	11,983	2,531,333
5–19 years	1,556	231,755	35,735	7,920,709
20–64 years	5,056	526,294	85,903	22,555,400
65+ years	1,899	93,421	17,244	4,264,514
Median age	49.7	30.6	33.0	35.2

Source: U.S. Census Bureau 2010

Note:
[1] The primary study area consists of Census Tract 64.05 in Fresno County and Census Tract 1.02 in Madera County.

Housing

Table 23-3 presents housing trends as well as the percentage of single-family dwellings, vacancy rates, and average household size for Fresno and Madera counties; nearby Cities of Clovis, Fresno, and Madera; and the State of California as a whole. In 2010, Fresno County and Madera County contained approximately 365,000 housing units. From 2000 through 2010, Fresno and Madera counties experienced a 16.6-percent and 21.7-percent, respectively, increase in the total number of housing units. The Cities of Clovis and Madera had the greatest percent increase in housing units (39.7 percent and 36.2 percent, respectively) during this 10-year period. Similar to the population trends shown in Table 23-1, the percent increase of housing units in the City of Madera was greatest, whereas the actual numeric increase (at 4,529 for the 10-year period) was less than for other cities in the area (e.g., Clovis and Fresno).

Overall, single-family dwelling units in all the jurisdictions listed in Table 23-3 are the predominant housing type and composed more than 64 percent of the total housing units. Vacancy rates were generally higher than the State average (5.9 percent), with the exception of the Cities of Clovis (3.6 percent) and Madera (4.3 percent). Madera County registered the highest vacancy rate, with 10.1 percent of all housing units vacant. As shown on Table 23-3, the majority of housing units were single-family attached and detached homes. Approximately 70 percent and 81 percent of housing units in Fresno and Madera counties, respectively, were single-family housing units.

Table 23-3. Housing Trends and Characteristics of the Primary Study Area, Fresno County, Madera County, Nearby Cities, and California, 2000–2010

Geographic Area	Trends			Characteristics (2010)		
	2000	2010	Percent Change	Single Family[1] (%)	Vacancy (%)	Average Number of Persons per Household
Fresno County	270,767	315,531	16.6	70.2	6.4	3.17
City of Clovis	25,265	35,306	39.7	73.6	3.6	2.86
City of Fresno	149,025	171,288	14.9	64.1	6.0	3.07
Madera County	40,387	49,140	21.7	81.4	10.1	3.23
City of Madera	12,520	17,049	36.2	74.8	4.3	3.63
State of California	12,214,550	13,670,304	11.9	64.4	5.9	2.96

Sources: U.S. Census Bureau 2010; DOF 2012b

Note:

[1] Includes single-family attached and single-family detached homes.

In addition, approximately 25 percent of housing units were multi-family homes and approximately 5 percent were mobile homes. In Madera County, approximately 12 percent of housing units were multi-family homes and approximately 7 percent were mobile homes (DOF 2012b).

The average household size ranged from as low as 2.86 persons per household (Clovis) to as high as 3.63 persons per household (Madera). The average number of persons per household in Fresno County and Madera County (3.17 and 3.23, respectively) was greater than the average number of persons per household at the State level (2.96 persons).

In 2010, Census Tract 64.05 and Census Tract 1.02 contained approximately 5,116 housing units (Table 23-4). This total represents less than 1 percent of the housing units in Fresno and Madera counties. Vacancy rates were generally higher than in Fresno and Madera counties and the State average. The vacancy rate for Census Tract 1.02 was approximately 43.6 percent. This high vacancy rate can be largely attributed to vacant seasonal, recreational, or occasional use rental units (U.S. Census Bureau 2010). The average number of persons per household in Census Tract 64.05 and Census Tract 1.02 (2.63 and 2.34, respectively) was less than the average number of persons per household in Fresno and Madera counties and in the State (2.96 persons).

Table 23-4. 2010 Housing Characteristics of Census Tract 64.05 and Census Tract 1.02

Location	Housing Units	Vacancy (%)	Average Number of Persons per Household
Census Tract 64.05 (Fresno County)	1,967	10.0	2.63
Census Tract 1.02 (Madera County)	3,149	43.6	2.34
Total	**5,116**	**—**	**—**

Source: U.S. Census Bureau 2010

Income Trends

Table 23-5 presents the median household income, per capita income, and proportion of individuals living below the poverty threshold for Census Tract 64.05 and Census Tract 1.02, Fresno and Madera counties, and the State as a whole. Chapter

10, "Environmental Justice," provides greater detail regarding the median income and distribution of low-income populations.

Table 23-5. Median Household Income and Poverty Levels in the Primary Study Area, Fresno County, Madera County, and California, 2011

Geographic Area	Median Household Income	Per Capita Income	Percent of Population Below Poverty Level
Census Tract 64.05 (Fresno County)	$73,750	$34,854	3.9
Census Tract 1.02 (Madera County)	$51,339	$27,547	12.9
Fresno County	$49,903	$20,638	23.4
Madera County	$47,724	$18,817	19.8
California	$60,632	$29,674	14.4

Source: U.S. Census Bureau 2011

Note:
Values are presented in 2011 dollars.

Census Tract 64.05 had a median household income of $73,750, which was substantially greater than the statewide median household income of $60,632, and the per capita income of Census Tract 64.05 ($34,854) was greater than the statewide per capita income of $29,674. Census Tract 1.02 had a median household income of $51,339 and per capita income of $27,547, which were less than the State's averages but greater than the median household income and per capita income of Fresno County and Madera County. The percent of the population below the poverty threshold in Census Tract 64.05 and Census Tract 1.02 was 3.9 percent and 12.9 percent, respectively, and was lower than that for both counties and lower than the per capita income for the State as a whole (14.4 percent).

Table 23-6 shows the historical, current, and projected personal income for Fresno and Madera counties, which provides a measure of consumer consumption. Total personal income consists of total earnings, adjusted for place of residence, plus dividends, interest and rent, and transfer payments received by the residents. The total personal income for Fresno County ($28.5 billion) was approximately seven times more than the total personal income for Madera County ($4.1 billion). Between 2010 and 2030, the total personal income in Fresno and Madera counties is anticipated to increase to $83.4 billion (2010 dollars), which would represent a 155-percent increase

in personal income over the 20-year period. Consumer consumption, which includes spending on durable, non-durable, and services, such as housing, food, gas, insurance, and health care, would also increase over the 20-year period. Therefore, increases in personal income would not necessarily result in greater spending.

Table 23-6. Historical, Current, and Projected Personal Income for Fresno County and Madera County, 2010–2040

County	Total Personal Income (billion $)			
	2010	2020	2030	2040
Fresno County	28.5	45.2	73.0	111.7
Madera County	4.1	6.4	10.4	16.0
Total	32.6	51.6	83.4	127.7

Sources: Caltrans 2013a, 2013b

Note:
Values are presented in 2010 dollars.

Labor Force, Employment, and Industry

Labor force, employment, and industry indicators provide useful insight into an area's economy. A description of industrial composition provides an aggregate depiction of the types of industries that are established in an area, while identifying major employers illustrates which types of businesses are most successful and represent major employment opportunities for the people of the area. The following discussion describes labor force, recent employment trends, unemployment rates, and industry data.

Information regarding labor force, employment, and industry characteristics described in this section was obtained mainly from the California Employment Development Department (EDD) Labor Market Information Division. The discussion focuses on Fresno and Madera counties because of the limited economic data available for their constituent cities and for Census Tracts 64.05 and 1.02.

Labor Force Table 23-7 presents the total number of workers in the labor force for Fresno and Madera counties and the State as a whole from 1990 to 2010. In total, Fresno County and Madera County had a labor force of 507,400 in 2010.

Table 23-7. Labor Force for Fresno County, Madera County, and California, 1990–2010

Geographic Area	Number of Workers in Labor Force			Percent Change, 1990–2010
	1990	2000	2010	
Fresno County	328,900	388,100	440,100	33.8
Madera County	41,600	54,900	67,300	61.8
Total	**370,500**	**443,000**	**507,400**	**37.0**
State of California	15,168,500	16,857,600	18,316,400	20.8

Source: EDD 2010a

EDD reported 440,100 people in the 2010 labor force in Fresno County; this is an increase of 33.8 percent since 1990. Fresno County's labor force was approximately eight times that of Madera County. Madera County has a small labor force (at 67,300 workers in 2010), but the labor force has grown by 61.8 percent since 1990. Overall, the labor force for Fresno and Madera counties has increased by 37.0 percent in the 20-year period from 1990 to 2010.

Employment The United States experienced an economic recession that began in late 2007 and became apparent beginning in 2008. Changes to the California and U.S. economies attributable to the recession resulted in increases in unemployment rates statewide. California's unemployment rate has been generally 2.0 percent greater than the nation's since April 2009, with the difference reaching a high of 3.4 percent in December 2010. Declines in construction spending and related losses in financial sectors are main contributing factors behind the State's long-term unemployment rates (EDD 2012a).

Employment and labor data for Fresno County, Madera County, and the State as a whole from 2007 to 2010 are shown in Table 23-8. The unemployment rate in the State registered at 12.4 percent in 2010. This is generally a result of the seasonality of agricultural workers in these two counties. Since 2007, unemployment rates in Fresno and Madera counties have been consistently and substantially higher than State trends. From 2007 through 2010, unemployment rates in the two counties ranged between 2.1 percent and 4.4 percent above the statewide rate. In 2010, Fresno County registered a 16.8-percent unemployment rate, while unemployment in Madera County totaled 15.6 percent of the population. Unemployment rates are expected to decline to 9.2 percent and 8.6 percent, respectively in Fresno County and Madera County by 2020 and

to 8.7 percent for both counties by 2040 (Caltrans 2013a, 2013b).

Table 23-9 summarizes EDD data regarding the top employers by employee class for each county. This list of employers includes a range of businesses with a payroll of more than 500 people.

As shown on Table 23-9, the top employers in Fresno County consist of universities and local school districts, hospitals and other health care facilities, county service offices, a correctional facility, fruit and vegetable growers, and meat processing operations.

In Madera County, two of the top five businesses provide health care to local residents and the other top employers consist of a casino, correctional institution, a hospital, and a winery.

Table 23-8. Labor Force and Employment for Fresno County, Madera County, and California, 2007–2010

Geographic Area	2007		2008		2009		2010	
	Labor Force	Employment[1]	Labor Force	Employment[1]	Labor Force	Employment[1]	Labor Force	Employment[1]
Fresno County	419,200	383,400 (8.6%)	430,200	385,100 (10.5%)	434,500	369,400 (15.0%)	440,100	366,000 (16.8%)
Madera County	63,500	58,700 (7.5%)	65,100	59,000 (9.4%)	66,500	57,500 (13.6%)	67,300	56,800 (15.6%)
State of California	17,921,000	16,960,700 (5.4%)	18,203,100	16,890,000 (7.2%)	18,208,300	16,144,500 (11.3%)	18,316,400	16,051,500 (12.4%)

Source: EDD 2010a

Note:

[1] Unemployment percentage in parentheses.

Table 23-9. Top Employers in Fresno County and Madera County, 2012

FRESNO COUNTY	
Employee Class Size of More Than 5,000	
Community Regional Medical Center	Fresno Unified School District
County of Fresno	State Center Community College
Employee Class Size of More Than 1,000	
ABC Bartending	Pleasant Valley State Prison
Cargill Meat Solutions	Saint Agnes Medical Center
City of Fresno	Stamoules Produce
Foster Farms	U.S. Veterans Hospital
Fresno County Economic	Valhalla Sales and Marketing
Fresno County Police Department	Zacky Farms
Fresno State University	
Employee Class Size of More Than 500	
Atnea	Pelco-Schneider Electrical
Fresno County Department of Public Heath	Play It Safe International
Harris Ranch	Quest Diagnostics
Kaiser Medical Center	Sun-Maid Growers
MADERA COUNTY	
Employee Class Size of More Than 1,000	
Children's Hospital	Valley State Prison for Women
Chukanski Gold Resort and Casino	
Employee Class Size of More Than 500	
Madera Community Hospital	Mission Bell Winery

Sources: EDD 2013a, 2013b

Industry Table 23-10 shows the industry composition and growth estimate by section for Fresno and Madera counties and for the State for EDD industry categories. The top five industries in both Fresno and Madera counties are the same: government, educational and health services, professional and business services, manufacturing, and wholesale and retail trade. Government represents the largest industry in both Fresno and Madera counties (23.1 percent and 31.3 percent, respectively). Wholesale and retail trade and educational and health services are the second and third largest industries in Fresno County, whereas in Madera County, educational and health services is the second largest industry and wholesale retail trade is the third largest industry. Professional and business services and manufacturing are the fourth and fifth industries, respectively, in both counties.

As shown in Table 23-10, projections of future growth in Fresno County and Madera County coincide in many ways

with the industrial composition of the State as a whole, but they do vary in some respects. Similar to the State, future job growth in educational and health services is expected to substantially increase in both Fresno and Madera counties. The construction industry is expected to be the fastest growing industry in the State at a rate of 26 percent, but less than 3 percent of the job growth in Fresno County and less than 1 percent in Madera County is associated with the construction industry. In both Madera County and the State, the wholesale and retail trade industry is expected to grow by more than 13 percent and 23 percent, respectively, but it is not in the top growth industries of Fresno County.

The transportation, utilities, and warehousing industries are expected to grow by more than 11 percent in both Fresno and Madera counties, but these industries are not identified as a top growth industry in the State. Job growth in Fresno County is expected to occur in information and finance (12.8 percent and 6.8 percent, respectively) and within the State; however, there is no growth projected in these industries in Madera County. The leisure and hospitality industries are expected to grow substantially in the State (25.5 percent). Although growth in leisure and hospitality is also expected to occur in Fresno County and Madera County (more than 6 percent in both counties), leisure and hospitality is not identified in the top growth industries for these counties.

Government and Finance

This section provides background information on local government and recent financial trends. Local governments provide a wide range of services. Using a mix of funding sources, local officials allocate financial resources for a diverse collection of activities, including providing police and public safety, development review, and educational services in their jurisdictions. The two largest sources of revenue for most local jurisdictions are property taxes and funding from the Federal and State governments. These two sources provide a relatively stable revenue base for funding important local programs.

Public health and safety and social services of various forms represent the two biggest expenditures at the local level. These programs serve as a safety net for the local population and are frequently the most visible local programs.

Table 23-10. Industry Composition and Growth Projections by Sector for Fresno County, Madera County, and California

Industry	Fresno County			Madera County			California		
	2008	2018	Percent Change, 2008–2018	2008	2018	Percent Change, 2008–2018	2010	2020	Percent Change, 2008–2020
Mining and Logging	100 (<1%)	200 (<1%)	100	1,900[1] (5.4%)	1,900[1] (5.0%)	0[1]	26,800 (<1%)	28,400 (<1%)	10.4
Construction	17,900 (5.9%)	18,500 (5.8%)	3.4	–[1]	–[1]	–[1]	599,800 (4.3%)	706,400 (4.3%)	26.2
Manufacturing	27,100 (5.9%)	27,600 (5.8%)	1.8	3,300 (9.4%)	3,400 (9.0%)	3.0	1,246,300 (8.9%)	1,246,300 (7.6%)	0.4
Transportation, Utilities, and Warehousing	11,000 (3.6%)	12,300 (3.8%)	11.8	900 (2.6%)	1,000 (2.7%)	11.1	466,300 (3.3%)	544,000 (3.3%)	16.7
Wholesale and Retail Trade	48,300 (15.9%)	50,900 (15.8%)	5.4	4,300 (12.3%)	4,900 (13.0%)	13.9	1,979,300 (14.2%)	2,656,800 (16.3%)	23.2
Information	4,700 (1.6%)	5,300 (1.6%)	12.8	500 (1.4%)	500 (1.3%)	0	427,700 (3.1%)	463,100 (2.8%)	8.3
Finance	14,800 (4.9%)	15,800 (4.9%)	6.8	800 (2.3%)	800 (2.1%)	0	760,200 (5.4%)	868,700 (5.3%)	14.3
Professional and Business Services	30,700 (10.1%)	33,500 (10.4%)	9.1	2,800 (8.0%)	2,900 (7.7%)	3.6	2,074,400 (14.9%)	2,558,100 (15.7%)	23.2
Educational and Health Services	40,100 (13.2%)	44,700 (13.9%)	11.5	5,900 (16.8%)	6,900 (18.3%)	16.9	1,788,300 (12.8%)	2,246,400 (13.8%)	25.6
Leisure and Hospitality	28,000 (1.0%)	29,700 (1.0%)	6.1	2,800 (8.0%)	3,000 (8.0%)	7.1	1,501,600 (10.8%)	1,884,900 (11.5%)	25.5
Other Services	10,600 (3.5%)	11,100 (3.5%)	4.7	800 (2.3%)	900 (2.4%)	12.5	484,900 (3.5%)	551,400 (3.4%)	13.7
Government	70,000 (23.1%)	71,900 (22.4%)	2.7	11,000 (31.3%)	11,500 (18.3%)	4.5	2,448,400 (17.5%)	2,548,800 (15.6%)	4.1
Total Nonfarm	303,200	321,500	6.1	35,100	37,700	7.7	13,961,700	16,333,100	17.0
Farm Employment	48,900 (12.5%)	47,600 (11.6%)	-2.7	10,300 (20.3%)	10,100 (18.7%)	-1.9	382,800 (2.4%)	388,500 (2.1%)	1.5

Sources: EDD 2010b, 2010c, 2012b

Notes:

Numbers in parentheses indicate the share as a percentage of the total employment. Percentages may not add to 100% if employment for specific industries in a county is excluded because of nondisclosure rules.

[1] The EDD logging and mining category in Madera County also includes the construction industry.

The discussion of the local governments focuses on Fresno County and Madera County because of the limited economic data available for their constituent cities and Census Tract 64.05 and Census Tract 1.02. In many cases, cities and towns work with and share funding with their appropriate county governments. Consequently, county data provide an adequate amount of detail for the area.

Fresno County As one of the larger counties in the San Joaquin Valley, Fresno County provides a wide range of services to its almost 930,000 residents. To meet residents' needs, Fresno County employs a number of funding mechanisms, including property taxes, Federal and State funding, permit fees, and other sources (Table 23-11).

Table 23-11. Revenues and Expenditures in Fresno County, 2007–2010

Revenues and Expenditures	Revenues and Expenditures		
	FY 2007–2008	FY 2008–2009	FY 2009–2010
Revenues			
Property taxes	$191,106,721	$212,215,397	$184,660,522
Other taxes	$44,657,748	$42,918,071	$35,635,093
Licenses, permits, fines, forfeitures, etc.	$34,838,622	$33,212,417	$33,764,375
Federal, State, other	$825,206,297	$802,176,727	$819,741,609
Charges for other services	$106,111,460	$117,136,932	$100,076,675
Total miscellaneous revenue	$5,892,009	$5,570,196	$4,668,983
All other financing sources	$50,410,720	$1,794,747	$0
Total Revenue	**$1,258,223,577**	**$1,215,024,487**	**$1,178,547,257**
Expenditures			
Legislative and administrative, finance, and counsel	$76,475,130	$70,661,374	$45,370,963
Police protection, corrections, fire, etc.	$347,260,408	$346,196,142	$335,109,060
Transportation, airport, etc.	$56,736,269	$56,323,885	$48,859,850
Public health, medical care, etc.	$191,159,586	$190,517,026	$175,946,791
Welfare, social services, and other public assistance	$514,468,999	$523,403,242	$513,734,481
Total education	$33,733,214	$31,280,506	$27,470,313
Total recreation facilities	$3,427,332	$3,589,064	$2,596,198
Costs associated with long-term debt (principal and interest)	$35,949,313	$39,868,120	$40,338,686
Total Expenditures	**$1,259,210,251**	**$1,261,839,359**	**$1,184,283,111**

Sources: California State Controller's Office 2009, 2011, 2012
Note:
Revenues and expenditures for fiscal years 2007-2008, 2008-2009, and 2009-2010 are presented in 2008, 2009, and 2010 dollars, respectively.
Key:
FY = Fiscal Year

Through these various sources, Fresno County generated more than $1.18 billion in total revenues in the 2009–2010 fiscal year. This total represented a decrease of 3.1 percent over the 2008–2009 fiscal year revenues of $1.21 billion. In the 2009–2010 fiscal year, the largest source of revenue was Federal and State funding, with more than $819 million. Property taxes represented another large revenue source for Fresno County, at more than $184 million. Similar to total revenues, Fresno County's total expenditures decreased between the 2007–2008 fiscal year and the 2009–2010 fiscal year. Expenditures in the 2007–2008 fiscal year totaled more than $1.2 billion, compared to more than $1.1 billion spent in the 2009–2010 fiscal year (a 6.1-percent decrease) as a result of decreased spending in all categories with the exception of police, fire, and other public safety. Welfare, social services, and other public assistance have consistently been the largest expenditure for Fresno County (more than $513.7 million in the 2009–2010 fiscal year). Police, fire, and other public safety activities represented the second largest expenditure category, with more than $335.1 million in the 2009–2010 fiscal year. Overall, total revenues exceeded total expenditures in all years.

Madera County Because Madera County's population is much smaller than Fresno County, Madera County's total revenues are substantially less than those of Fresno County (Table 23-12). Madera County experienced an overall decrease in revenue growth between 2007 and 2010. In that 3-year period, Madera County's total revenue decreased from $171.6 million in the 2007–2008 fiscal year to $165.9 million in the 2009–2010 fiscal year, a 3.3-percent decrease. Federal and State funding sources made up the largest revenue source in the 2009–2010 fiscal year, with more than $98.5 million directed to Madera County. Property taxes represent another substantial revenue source ($31.5 million in the 2009–2010 fiscal year).

Expenditures in Madera County decreased from $181.2 million in the 2008–2009 fiscal year to $180.3 million in the 2009–2010 fiscal year, a 0.7-percent decrease. The top two expenditures in Madera County in the 2009–2010 fiscal year were police, fire, and other public safety programs ($55.3 million) and welfare and social service programs ($49.9 million); however, spending on these programs and services decreased over the 3-year period, and costs for legislative and administration services, transportation, and long-term debt increased. Total expenditures were more than total revenues during all three fiscal years.

Table 23-12. Revenues and Expenditures in Madera County—Selected Years, 2007–2010

Revenues and Expenditures	Revenues and Expenditures		
	2007–2008	2008–2009	2009–2010
Revenues			
Property taxes	$34,343,351	$34,259,217	$31,497,786
Other taxes	$11,837,448	$12,119,746	$12,218,298
Licenses, permits, fines, forfeitures, etc.	$8,390,283	$8,273,501	$8,790,108
Federal, State, other	$102,558,371	$101,410,226	$98,504,740
Charges for other services	$13,034,923	$13,598,940	$14,440,655
Total miscellaneous revenue	$1,329,334	$1,578,263	$283,718
All other financing sources	$73,685	$1,873	$114,709
Total Revenue	**$171,567,395**	**$171,241,766**	**$165,850,014**
Expenditures			
Legislative and administrative, finance, and counsel	$30,223,234	$26,796,205	$32,411,741
Police protection, corrections, fire, etc.	$55,640,401	$57,937,839	$55,300,575
Transportation, airport, etc.	$12,543,149	$14,946,060	$15,270,913
Public health, medical care, etc.	$27,473,480	$25,537,160	$24,232,356
Welfare, social services, and other public assistance	$50,676,503	$52,794,668	$49,970,423
Total education	$1,851,770	$1,990,831	$1,409,936
Costs associated with long-term debt (principal and interest)	$1,685,724	$1,636,947	$1,724,310
Total Expenditures	**$180,094,261**	**$181,639,710**	**$180,320,254**

Sources: California State Controller's Office 2009, 2011, 2012
Note:
Revenues and expenditures for fiscal years 2007-2008, 2008-2009, and 2009-2010 are presented in 2008, 2009, and 2010 dollars, respectively.

Extended Study Area

The portion of the San Joaquin River extending from Friant Dam to the confluence with the Merced River is now subject to changed instream flows associated with implementing the Settlement. Restoration Flows have not resulted in physical changes that substantially affect socioeconomic, population, and housing conditions.

Each action alternative would deliver some portion of the new water supply to the Friant Division via the Friant-Kern and Madera canals. Alternative Plans 2, 3, 4 and 5 would also deliver new supply to other CVP SOD contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. Alternative Plans 1, 2, and 4 would also deliver new supply to SWP SOD M&I contractors via the San Joaquin River through exchange at Mendota Pool and the California Aqueduct. Alternative Plan 3 would also deliver new supply to SWP SOD M&I contractors via existing cross-

valley conveyance and the California Aqueduct. Because implementing any of the action alternatives would not substantially alter socioeconomic conditions in downstream counties, including housing supply and vacancy rate, employment, per capita income, or other socioeconomic variables, these counties are not addressed further in this analysis.

CVP and SWP Water Service Areas

Implementing any of the action alternatives would improve surface water supply reliability to the agricultural producers in the CVP and SWP water service areas, resulting in less temporary crop idling and increasing agricultural production on existing agricultural lands. About 30 percent to 60 percent of the water made available for delivery would be conveyed directly to Friant Division water contractors, depending on the alternative plan implemented. Therefore, the increased surface water reliability would provide the greatest economic benefits to agricultural water users in the six counties within the Friant Division and West San Joaquin Division water service areas (i.e., Fresno, Kern, Kings, Madera, Merced, and Tulare counties) (the six-county area).

Agricultural water users in the CVP and SWP water service areas outside of the six-county area would also benefit from increased surface water reliability; however, these economic impacts would be dispersed over the 36 counties that are served by the CVP and SWP and would be less discernible to a single jurisdiction. Therefore, this section emphasizes socioeconomic characteristics in the six-county area.

Population and Housing The Friant Division and West San Joaquin Division water service areas are composed of areas in Fresno, Kern, Kings, Madera, Merced, and Tulare counties (the six-county area). Table 23-13 presents 2010 population and the projected population trends in each of the six counties and in the State. As of 2010, population in the six-county area totaled approximately 2.8 million people.

Between 2010 and 2050, population growth in the six counties is projected to increase by an average of approximately 97.1 percent, and all six counties are expected to grow at a greater rate than the State (36.9 percent increase). Kern County's population is projected to increase by 117.2 percent, which would be the greatest population growth rate among the six counties. This high rate of growth is expected to alter the existing character of Kern County by making it more urban

(i.e., with higher density housing and increased demand for public services). Fresno County is projected to experience the least population growth of the six counties through 2050, at approximately 65.1 percent.

In addition to population estimates and trends, Table 23-13 shows the distribution of housing units, the percentage of single-family dwellings, vacancy rates, and average household size in each of the six counties and in the State. As of 2010, the six counties had a total of approximately 918,300 housing units, representing 6.7 percent of the total number of housing units in the State (approximately 14 million). The highest number of housing units was located in Fresno County, which also had the highest population. Conversely, Kings and Madera counties, which had the smallest populations, also had the fewest number of housing units (43,867 units and 49,140 units, respectively).

Overall, single-family housing makes up the largest proportion of the total housing stock in the six-county area, ranging from 70.2 percent in Fresno County to 81.4 percent in Madera County. Kern County had the highest housing unit vacancy rate at 10.5 percent, and Kings County had the smallest housing unit vacancy rate of the six counties at 6.0 percent.

Households in Kern County (3.15 persons) were the smallest, on average, in the six-county area, whereas Tulare County had the largest average household size (3.36 persons) in 2010.

Table 23-13. Population and Housing Data and Projections for Counties in the Friant Division Water Service Area and California

Characteristic	County						Total	State of California
	Fresno	Kern	Madera	Merced	Kings	Tulare		
2010 total population	930,450	839,631	150,865	255,793	152,982	422,179	2,751,900	37,253,956
2020 projected population	1,083,899	1,041,469	183,176	301,449	179,722	536,429	3,329,144	40,817,839
2030 projected population	1,232,151	1,276,155	219,908	359,789	209,440	636,606	3,934,049	44,574,756
2050 projected population	1,535,761	1,823,277	314,546	506,666	281,866	884,646	5,346,762	51,013,984
Percent change, 2010–2050	65.1	117.2	108.5	98.1	84.2	109.5	97.1	36.9
Total housing units, 2010	315,531	284,367	49,140	83,698	43,867	141,696	918,299	13,670,304
Percent single-family housing	70.2	73.4	81.4	75.8	77.5	78.2	76.1	64.4
Percent Vacancy	6.4	10.5	10.1	9.6	6.0	8.0	8.4	5.9
Average number of persons per household	3.17	3.15	3.23	3.32	3.18	3.36	3.24	2.96

Sources: DOF 2012a, 2012b

Income Trends Table 23-14 presents the median household income and per capita income in 2011 dollars, and the proportion of individuals living below the poverty threshold for the six-county area and the State of California as a whole. The median household income and per capita income were less for the six counties than for the State ($60,632 and $29,674, respectively), and the poverty level was greater for the six counties than for the State. Fresno County had the highest median and per capita income ($49,903 and $20,638, respectively), and Tulare County had the lowest median and per capita income ($43,550 and $17,986, respectively). The percentage of the population at an income level below the poverty threshold ranged from 19.3 percent in Kings County to 23.8 percent in Tulare County.

Table 23-6 and Table 23-15 show the historical, current, and projected personal income in 2010 dollars for the six-county area. The total personal income in the six-county region ranged from $4.1 billion in Madera and Kings counties to $28.5 billion in Fresno County in 2010. Between 2010 and 2040, the total personal income in the six-county region is anticipated to increase to $326.8 billion.

Table 23-14. Median Household Income and Poverty Levels for Counties in the Friant Division Water Service Area and California, 2011

Geographic Area	Median Household Income	Per Capita Income	Percent of Population Below Poverty Level
Fresno County	$49,903	$20,638	23.4
Kern County	$48,021	$20,167	21.4
Kings County	$48,838	$18,296	19.3
Madera County	$47,724	$18,817	19.8
Merced County	$43,945	$18,304	23.0
Tulare County	$43,550	$17,986	23.8
State of California	$60,632	$29,674	14.4

Source: U.S. Census Bureau 2011

Note:
Values are shown in 2011 dollars.

Table 23-15. Personal Income for Counties in the Friant Division Water Service Area and California, 2010–2040

Geographic Area	Total Personal Income (billion $)			
	2010	2020	2030	2040
Kern County	25.1	43.3	68.3	103.5
Kings County	4.1	6.6	10.5	16.0
Merced County	7.0	11.6	19.4	31.0
Tulare County	12.4	20.1	39.9	48.6
Total	**48.6**	**81.6**	**138.1**	**199.1**
State of California	1,558.7	2,627.1	4,190.2	6,354.4

Source: Caltrans 2013c

Note:
Values are presented in 2010 dollars.

Labor Force and Employment The counties within the Friant Division water service area maintain a labor force of more than 1.2 million people, representing approximately 6.9 percent of the labor force of the State (18.3 million) (Table 23-16). In 2010, Fresno County maintained the largest labor force of the six counties, with more than 440,100 people. Kings County maintained the smallest labor force with 61,500 people.

In 2010, all six counties had unemployment rates greater than the State. As shown in Table 23-16, unemployment rates within the six-county area have increased over the 10-year period. The 2010 unemployment rates exceeded 15 percent in each county, with Merced County having the highest unemployment rate at 18.8 percent.

Table 23-16. Labor Force and Employment for Counties in the Friant Division Water Service Areas and California

Geographic Area	2000		2010	
	Labor Force	Employment[1]	Labor Force	Employment[1]
Fresno County	388,100	347,900 (10.4%)	440,100	366,000 (16.8%)
Kern County	293,600	269,400 (8.2%)	373,700	314,300 (15.9%)
Kings County	42,200	44,300 (10.0%)	61,500	51,300 (15.9%)
Madera County	54,900	50,100 (8.7%)	67,300	56,800 (15.6%)
Merced County	90,300	81,600 (9.6%)	109,500	88,800 (18.8%)
Tulare County	171,800	154,000 (10.4%)	208,700	173,400 (16.9%)
Total	**1,040,900**	**947,300 (9.0%)**	**1,260,800**	**1,050,600 (16.7%)**
State of California	17,921,000	16,960,700 (5.4%)	18,316,400	16,051,500 (12.4%)

Sources: EDD 2010a, 2013c

Note:
[1] Unemployment percentage in parentheses.

Industry As shown in Table 23-17, business and industry in the six-county area is composed primarily of four industries: educational and health services, agriculture, retail trade, and leisure and hospitality. The education and health services industry, which consists of elementary and secondary schools, colleges and universities, medical offices, hospitals, and nursing care facilities, was the leading industry in all counties. Manufacturing ranked as a top-five industry in Madera, Merced, and Tulare counties.

Government and Finance Each of the six counties in the Friant Division of the CVP water service area maintains one primary urban center, with a limited number of small cities and towns and large amounts of surrounding rural areas. Because the counties are largely rural jurisdictions, total revenues and expenditures in most of these counties are relatively lower when compared to other counties in the State. Table 23-18 shows revenues and expenditures for each of the six counties in the Friant Division water service area for the 2009–2010 fiscal year. Total revenues were more than total expenditures in Kern and Tulare counties, but expenditures were more than total revenues in Fresno, Kings, Madera, and Merced counties.

Table 23-17. Top Five Industries in Each County in the Friant Division Water Service Area, 2010

Fresno	Kern	Kings	Madera	Merced	Tulare
Educational & Health Services (23.3%)	Educational & Health Services (19.6%)	Educational & Health Services (19.7%)	Educational & Health Services (18.3%)	Educational & Health Services (21.2%)	Educational & Health Services (20.0%)
Retail Trade (11.2%)	Agriculture (14.5%)	Agriculture (16.5%)	Agriculture (17.9%)	Retail Trade (12.1%)	Agriculture (17.3%)
Agriculture (9.8%)	Retail Trade (11.1%)	Public Administration (14.0%)	Retail Trade (11.2%)	Manufacturing (11.9%)	Retail Trade (10.7%)
Professional & Business Services (8.2%)	Leisure & Hospitality (8.4%)	Retail Trade (9.0%)	Maufacturing (8.3%)	Agriculture (11.7%)	Maufacturing (7.9%)
Leisure & Hospitality (8.1%)	Professional & Business Services (8.2%)	Leisure & Hospitality (8.5%)	Leisure & Hospitality (7.5%)	Construction (6.7%)	Leisure & Hospitality (7.1%)

Source: U.S. Census Bureau 2011

Note:

Numbers in parentheses indicate the share as a percentage of the total employment.

Table 23-18. Revenues and Expenditures for Counties in the Friant Division Water Service Area, 2009–2010 Fiscal Year

County	Revenues	Expenditures
Fresno County	$1,178,547,257	$1,184,283,111
Kern County	$1,280,466,587	$1,254,677,156
Kings County	$177,480,965	$184,865,685
Madera County	$165,850,014	$180,320,254
Merced County	$367,348,208	$381,668,855
Tulare County	$636,855,065	$634,359,812
Total	**$3,806,548,096**	**$3,820,174,873**

Source: California State Controller's Office 2012

Note:
Dollar amounts are presented in 2010 dollars.

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine significance for socioeconomics, population, and housing. It then discusses the impacts of the Investigation. The potential impacts on socioeconomics, population, and housing and associated mitigation measures are summarized in Table 23-19.

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-1: Temporary Increases in Employment and Personal Income Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-2: Temporary Increases in Population and Housing Demand Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-3: Temporary Increases in Business Income and Local Sales Tax Revenue Resulting from Construction	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-4: Increases in Employment and Personal Income Resulting from Operations and Maintenance	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-5: Increases in Spending, Employment, and Personal Income from Increased Recreational Visitation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-6: Increases in Population and Housing Demand Resulting from Operations and Maintenance	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-7: Increases in Business Income and Local Sales Tax Revenue Associated with O&M and Recreation Visitation	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
SOC-8: Decreases in Property Tax Revenue from Acquisition of Privately Owned Land	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	S	None Required	SU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial
SOC-10: Increases in Population and Housing Demand Within the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS

Table 23-19. Summary of Impacts and Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
SOC-11: Increases in Business Income and Local Sales Tax Revenue Within the CVP and SWP Water Service Areas	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	S	None Required	SU
		Alternative Plan 1	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 2	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 3	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 4	LTS and Beneficial		LTS and Beneficial
		Alternative Plan 5	LTS and Beneficial		LTS and Beneficial

Key:
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

Methods and Assumptions

This section presents the methods and assumptions used in this socioeconomic, population, and housing analysis. Impacts of the project on local and regional socioeconomic characteristics were assessed quantitatively, when data were available.

Population and Housing

The evaluation and discussion of the potential impacts of the alternatives on population and housing characteristics is based on a review of published material pertaining to the primary and extended study areas.

Population impacts were evaluated based on changes in the total number of temporary and/or permanent residents resulting from construction and operation activities that would be completed as a part of project implementation. Housing impacts were assessed based on estimated short- and long-term housing needs resulting from population changes expected as a result of the project's construction and operation activities. Impacts of the project on local and regional demographic characteristics were assessed quantitatively, when data were available.

Labor Force, Employment, and Industry

To quantitatively assess the potential impacts to labor force, employment, and industry expenditures, as well as personal income, two models were used. To estimate potential changes in regional employment and personal income associated with construction, O&M, recreation, and agriculture for each action alternative the IMpact analysis for PLANning model (IMPLAN), Version 3.0.17.2, was used. In addition to IMPLAN, the SWAP model was used to determine the impacts of the action alternatives on agricultural water users. The regional economic analysis is documented in the Modeling Appendix and summarized below.

IMPLAN is a computer database and modeling system used to create input-output models for any combination of U.S. counties. IMPLAN is the most widely used input-output model system. IMPLAN assumes that activity would occur exclusively within the defined regional study area, providing economic and employment outputs for only those counties included in the analysis. For the purpose of this analysis, two IMPLAN models were developed. The first incorporated economic activity in the six-county area (i.e., Fresno, Kern, Kings, Madera, Merced, and Tulare counties), and the second addresses effects associated with agriculture at the statewide

level. The direct impacts of quantified changes (e.g., construction and operation spending, recreation expenditures, and agricultural production) are input to IMPLAN regional economic models. The resulting output (employment and income) reflects the change from the 2009 California counties' dataset base model estimate.

SWAP simulates economic output (irrigated crop production) based on changes in water deliveries for agricultural production. The SWAP modeling analysis is documented in the Modeling Appendix. Results from the model include changes in the value of production (crop output multiplied by crop price), net income to growers (crop revenues minus production costs), and irrigated acreage. SWAP incorporates project water supplies (SWP and CVP), other local surface water supplies, and groundwater. As the quantity of available project water supply increases or as the cost of groundwater pumping increases, the SWAP model optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs. The model will generally idle land only if the cost of accessing groundwater exceeds a value to generate positive net returns to crop production. SWAP assumes that farmers select the crops, water supplies, and other inputs to maximize profit subject to resource constraints, technical production relationships, and market conditions. Farmers are assumed to face competitive markets in which no single farmer can influence crop prices, but an aggregate change in production can affect crop price. SWAP modeling was performed for CVP and SWP service areas to capture effects of the action alternatives on agricultural production within the State and six-county area.

The regional economic analysis uses the IMPLAN and SWAP results to estimate the potential economic effects of the alternatives to the regional economy as a result of the following factors:

- Temporary and short-term construction expenditures and employment from construction of the Temperance Flat RM 274 Dam, powerhouse, diversion works, intake structure, transmission facilities, and the new Wellbarn Road Boat Ramp and the demolition and relocation of other recreational facilities that would be affected by creation of the Temperance Flat RM 274 Reservoir

- Expenditures and employment from O&M of the Temperance Flat RM 274 Dam, intake structure, powerhouse, valve house, and permanent access roads

- Increases in recreation visitation and associated increases in spending resulting from more stable lake levels at Millerton Lake and the creation of the Temperance Flat RM 274 Reservoir

- Long-term agricultural production and income from improved surface water supply reliability to the six-county area and other SOD CVP and SWP water service areas

As stated above, regional economic effects associated with construction, O&M, recreation, and agriculture were assessed across the six-county area. Although construction, O&M, and recreation activities may take place in Fresno County and Madera County, economic activity (sales and purchases) would likely extend beyond that area both directly and indirectly. For example, the purchase of supplies, including fuel for transportation, would occur in any county from which recreationists travelling to the primary study area would originate. However, for the purposes of analyzing direct, indirect, and induced economic impacts resulting from construction, O&M, and recreation, it is assumed that most of the economic activity associated with construction, O&M, and recreation would occur within Fresno County and Madera County. Agricultural impacts are assumed to occur within the six-county area and other CVP and SWP water service areas, as modeled.

Construction Impacts Direct, indirect, and induced economic impacts resulting from construction-related activities were modeled for each of the alternatives with IMPLAN (documented in the Modeling Appendix). Construction expenditures and employment would occur over 8 years and would represent a temporary and short-term economic benefit on the six-county area. Construction cost estimates for Temperance Flat RM 274 Reservoir have been completed for the action alternatives, and are displayed in the Public Draft Feasibility Report (Reclamation 2014).

The construction crew size was estimated on an average annual basis, considering the size and duration of the construction activity. The generation of direct construction-related jobs would result in indirect employment in businesses that provide

materials to the construction effort; in service-related industries that provide food, beverages, and other goods to construction workers; and in more technical industries, such as engineering consulting, legal services, and other businesses. Personal income would be directly and indirectly generated through payment of wages to construction workers and employees in construction-related and service-oriented businesses, management earnings, and contractor payments. Induced employment and personal income would be generated by increased household and business spending and would not be limited to construction-related activities.

It is assumed that most of the labor, equipment, and materials would originate in the six-county area and that construction expenditures would represent net new spending in those counties over an 8-year construction period. Direct construction expenditures would be associated with the purchase of raw or refined materials and/or equipment required for the construction process, fuel for vehicles and equipment, and other incidental materials and supplies; technical tasks required for project construction, such as engineering, design, and construction management; environmental mitigation costs; and land acquisition costs. Indirect expenditures would consist of spending on goods and services by industries that produce the items purchased as part of construction, and induced expenditures would consist of spending by the households of workers involved either directly or indirectly in the construction process.

Table 23-20 shows the construction-related expenditures, employment, and personal income that would be generated during construction of any of the action alternatives.

Table 23-20. Construction-Related Expenditures, Employment, and Personal Income Under the Action Alternatives

Economic Impact	Alternative Plan 1, 2, 3, or 5	Alternative Plan 4
Construction Expenditures (million $ per year)[1]		
Direct	267.5	277.0
Indirect and induced	151.6	157.0
Total	419.1	434.0
Employment (jobs per year)[2]		
Direct	450	460
Indirect and induced	1,155	1,196
Total	1,605	1,656
Personal Income (million $ per year)[1]		
Direct	109.4	113.2
Indirect and induced	54.7	56.6
Total	164.1	169.8

Notes:
Construction of any of the action alternatives is expected to occur over 8 years.
IMPLAN modeling analysis is documented in the Modeling Appendix.
[1] Construction-related expenditures and personal income are presented in 2013 dollars.
[2] Jobs per year represent the necessary and appropriate size of the construction crew on an average annual basis considering the size and duration of the construction activities. Jobs per year include full-time, part-time, and temporary positions.

O&M-Related Impacts Direct, indirect, and induced economic impacts resulting from O&M were estimated for each action alternative. It is expected that O&M of the Temperance Flat RM 274 Dam, intake structure, powerhouse, valve house, and permanent access roads would directly result in increases in employment and personal income in the six-county area over the project's 100-year lifetime. Direct expenditures for O&M would include the physical part components and other materials required for maintenance of new facilities and labor. Indirect expenditures would consist of spending on goods and services by industries that produce items purchased as part of maintenance activities, and induced expenditures would consist of spending by the households of workers involved either directly or indirectly in maintenance.

Personal income would be directly and indirectly generated through payment of wages to employees required for O&M-related activities and employees in businesses that manufacture part components or otherwise support O&M. Induced employment and personal income would be generated by

increased household and business spending and would not be limited to O&M-related employment and income.

Table 23-21 shows the O&M-related expenditures, employment, and personal income that would be generated per year under any of the action alternatives over the project's lifetime.

Recreation Impacts Increased recreation visitation to the primary study area related to the modified lake levels at Millerton Lake and the creation of the Temperance Flat RM 274 Reservoir would result in direct, indirect, and induced economic impacts in Fresno County and Madera County. Economic impacts resulting from increased visitation would have a long-term average annual economic impact on the region over the project's 100-year lifetime. The quantification of recreation impacts relies on historic use data, an assessment of recreation opportunities associated with the action alternatives, personal interviews with knowledgeable staff members at Millerton Lake, and estimates of future recreation improvements and associated visitation (see the Modeling Appendix for a complete description of the recreation visitation analysis).

Table 23-21. O&M-Related Expenditures, Employment, and Personal Income Generated Under the Action Alternatives

Economic Impact	Any of the Action Alternatives
Expenditures (million $ per year)[1]	
Direct	8.4
Indirect and induced	1.2
Total	9.6
Employment (jobs per year)[2]	
Direct	28
Indirect and induced	10
Total	38
Personal Income (million $ per year)[1]	
Direct	1.9
Indirect and induced	0.4
Total	2.3

Notes:
O&M-related activities are assumed to occur over the project's lifetime (i.e., 100 years).
IMPLAN modeling analysis is documented in the Modeling Appendix.
[1] O&M-related expenditures and personal income are presented in 2013 dollars.
[2] Jobs per year include full-time, part-time, and temporary positions.
Key:
O&M = operations and maintenance

Total direct, indirect, and induced economic impacts of increased recreation visitation were estimated using IMPLAN. Direct impacts included new jobs and personal income generated by increases in recreation-related expenditures at businesses. Indirect impacts would result from spending on goods and services by industries that support these businesses, and induced impacts would consist of changes in household spending by new employees.

Regional impacts related to recreation spending would be different for visitors that originate from outside the defined region and visitors that originate from inside the region. Outside visitors represent a flow of expenditures into the regional economy while spending by residents within the region may represent a redistribution or substitution of spending for other activities. This is offset in part by greater expenditures per capita by more distant visitors (e.g., for food, lodging, and transportation).

Table 23-22 shows the recreation-related expenditures, employment, and personal income that would be generated per year under any of the action alternatives over the project's lifetime.

Table 23-22. Recreation-Related Expenditures, Employment, and Personal Income Generated Under the Action Alternatives

Economic Impact	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Recreation-Related Expenditure (million $ per year)[1, 2]					
Direct	1.6	1.6	1.6	1.8	1.2
Indirect and induced	0.8	0.8	0.8	0.9	0.6
Total	2.4	2.4	2.4	2.7	1.8
Employment (jobs per year)[3]					
Direct	27	27	26	30	20
Indirect and induced	6	6	6	7	5
Total	33	33	32	37	25
Personal Income (million $ per year)					
Direct	0.9	0.9	0.8	1.0	0.5
Indirect and induced	0.3	0.3	0.3	0.3	0.2
Total[4]	1.1	1.1	1.1	1.3	0.7

Notes:
IMPLAN modeling analysis is documented in the Modeling Appendix.
[1] Recreation-related expenditures would occur over the project's lifetime (i.e., 100 years).
[2] Construction-related expenditures and personal income are presented in 2013 dollars.
[3] Jobs per year represent full-time, part-time, and temporary positions and would continue throughout the project's lifetime (i.e., 100 years).
[4] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Agricultural Impacts Key output from the SWAP model used in this analysis includes estimates of irrigated acres and gross revenue. After direct agricultural industry revenue was calculated by SWAP, the total indirect and induced income and direct, indirect, and induced employment and personal income were estimated using IMPLAN. The expenditures on goods and services required to support agricultural operations generate additional income and employment. Employment and personal income are also induced throughout the region as a result of consumer spending by those farm employees who are directly and indirectly affected by agricultural operations. Table 23-23 and Table 23-24 show the agricultural industry revenue, employment, and personal income that would be generated per year in the six-county area and the State under the action alternatives over the project's lifetime.

Table 23-23. Agricultural Industry Revenue, Employment, and Personal Income Generated in the Six-County Area by Action Alternative

Economic Impact	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Agricultural Industry Revenue (million $ per year)[1, 2]					
Direct	4.5	4.0	4.2	3.0	5.5
Indirect and induced	8.8	8.6	8.9	7.2	11.8
Total	13.3	12.6	13.1	10.2	17.3
Employment (jobs per year)[3]					
Direct	35	40	42	28	62
Indirect and induced	76	73	76	62	100
Total	110	113	118	89	162
Personal Income (million $ per year)					
Direct	1.2	0.9	0.9	0.7	1.1
Indirect and induced	3.1	3.0	3.1	2.5	4.1
Total	4.3	3.9	4.0	3.2	5.2

Notes:

IMPLAN modeling analysis is documented in the Modeling Appendix.

[1] Agriculture-related income is assumed to occur over the project's lifetime (i.e., 100 years).

[2] Agriculture-related income and personal income are presented in 2013 dollars.

[3] Jobs per year represent full-time, part-time, and temporary positions and would continue throughout the project's lifetime (i.e., 100 years).

Table 23-24. Agricultural Industry Revenue, Employment, and Personal Income Generated in the State by the Action Alternatives

Economic Effect	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5
Agricultural Industry Revenue (million $ per year)[1, 2]					
Direct	4.1	3.6	3.7	2.7	5.0
Indirect and induced	10.7	10.4	10.8	8.7	14.4
Total	14.8	13.9	14.5	11.4	19.4
Employment (jobs per year)[3]					
Direct	32	34	36	24	53
Indirect and induced	70	67	69	56	92
Total	102	101	106	80	145
Personal Income (million $ per year)					
Direct	1.1	0.7	0.7	0.6	0.9
Indirect and induced	3.6	3.5	3.6	2.9	4.8
Total	4.7	4.2	4.4	3.5	5.7

Notes:
IMPLAN modeling analysis is documented in the Modeling Appendix.
[1] Agriculture-related income is assumed to occur over the project's lifetime (i.e., 100 years).
[2] Agriculture-related income and personal income are presented in 2013 dollars.
[3] Jobs per year represent full-time, part-time, and temporary positions and would continue throughout the project's lifetime (i.e., 100 years).

Government and Fiscal Conditions

Fiscal impacts on local governments would occur from changes to property tax, sales tax, or assessment revenue resulting from implementing any of the action alternatives. The analysis discusses the loss of property tax revenue resulting from potential acquisition of existing privately held land to implement any of the action alternatives. The analysis also discusses potential changes in business incomes and sales tax revenue as a direct result of the estimated construction and operation expenditures and from changes in recreation-related expenditures and agricultural sales.

Because no quantitative analysis of the impact of implementing any of the action alternatives on local government and finance has been completed, this analysis provides a qualitative discussion of potential impacts. Areas of potential impacts were identified by comparing existing conditions and probable future conditions under each alternative. In many cases, the estimates completed as part of the IMPLAN and SWAP modeling served as the basis for impact estimates. These two models determine expected trends in employment, personal incomes, business incomes, and other data types to quantifiably estimate the impacts of implementing any of the action alternatives. Because these characteristics directly influence activities at the local level, they represent critical considerations in the analysis and conclusions presented in this section.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

Under NEPA, economic or social impacts must be discussed if they are interrelated to the natural or physical environmental impacts of a project (40 CFR 1508.14). Economic impacts discussed in this section are not considered physical impacts on the environment; however, an analysis of economic impacts can be used to judge the significance of other changes caused by them, such as changes in water supply or water quality. The significance of those associated environmental impacts is evaluated in each technical section of this Draft EIS. For this analysis, the magnitude of economic impacts resulting from implementing any of the action alternatives was identified and used to help characterize the associated socioeconomic, population, and housing impacts.

The following criteria were developed based on guidance provided by the State CEQA Guidelines and encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. Impacts of an alternative plan on socioeconomics, population, and housing would be significant if project implementation would do any of the following:

- Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)

- Displace substantial numbers of people or housing, necessitating the construction of replacement housing elsewhere

- Produce a substantial burden on the existing housing stock within the local community because of an increased housing demand created by nonlocal project employees
- Require sizeable numbers of new workers in a particular industrial sector from outside the local area during construction or operation
- Cause a substantial decrease in the number of opportunities for temporary or long-term direct, indirect, or induced employment
- Cause a substantial decrease in the number of opportunities for temporary or long-term increases in personal and/or disposable incomes
- Cause a substantial decrease in recreation visitation and spending during construction and operation
- Cause a substantial decrease in agricultural income (measured as agricultural industry revenue) from changes in surface water supply reliability
- Considerably decrease the incomes of businesses and local sales tax revenue

Topics Eliminated from Further Consideration

No topics related to socioeconomics, population, and housing that are included in the significance criteria listed above were eliminated from further consideration. Each of the topics associated with potential impacts in the primary study area are addressed in the Direct and Indirect Impacts section.

No construction-related, O&M-related, or recreation-related impacts would occur in the extended study area. Therefore, no socioeconomic, population, and housing impacts from these activities would occur in the extended study area, and these topics are not discussed further in this analysis.

Implementing any of the action alternatives would increase water available for delivery from Millerton Lake. Portions of this water would be conveyed directly to Friant Division water contractors or down the San Joaquin River and rediverted or exchanged for delivery to SOD CVP and SWP water contractors. The conveyance of these water supplies would not exceed channel capacity of the San Joaquin River and Delta

waterways and no change in existing use of adjacent lands in the affected counties would occur. The portion of the San Joaquin River extending from Friant Dam to the confluence with the Merced River is now subject to Restoration Flows, and these flows have not resulted in physical changes that substantially affect socioeconomic, population, and housing conditions. These areas are not discussed further in this analysis.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact SOC-1: Temporary Increases in Employment and Personal Income Resulting from Construction

Primary Study Area

No Action Alternative Under the No Action Alternative, implementation of the project and associated construction-related activities would not occur, and no construction workers would be needed. The economic trends of each county, however, would be expected to follow current trends and estimates described in the Affected Environment section. These trends indicate that the economies of the six-county area will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth will be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Alternatives Plans 1–3 and 5 Implementing Alternative Plan 1, 2, 3, or 5 would result in temporary increases in employment and personal income in the six-county area as a result of construction-related activities in the primary study area. Constructing the Temperance Flat RM 274 Dam, the powerhouse, the diversion works, the low-level intake structure, transmission facilities, and the new Wellbarn Road Boat Ramp and demolishing and relocating other recreational facilities would require an average of 450 new construction workers per year over the 8-year construction period (Table 23-20). The construction crew size includes general

construction labor, batch plant operators, project managers, on-site Reclamation staff, and truck drivers.

In addition to generating 450 construction jobs, implementing Alternative Plan 1, 2, 3, or 5 would generate 1,155 new indirect and induced jobs per year (Table 23-20). Indirect employment may be to support hiring in businesses that provide materials to the construction effort; in service-related industries that provide food, beverages, and other goods to construction workers; or in more technical industries, legal services, and other businesses. Induced employment would be jobs that are created in the region as a result of increased household spending by workers involved either directly or indirectly and not limited to construction-related activities.

Overall, the total 1,605 direct, indirect, and induced jobs represent a small increase in the total labor force in the six-county area, but the employment opportunities created by implementing Alternative Plan 1, 2, 3, or 5 represent a substantial contribution in these counties because of existing high unemployment rates Unemployment rates exceeded 15 percent in each county, with Merced County having the highest unemployment rate at 18.8 percent (Table 23-16). These new jobs are expected to provide temporary employment opportunities to many unemployed workers.

Constructing Alternative Plan1, 2, 3, or 5 would generate personal income through payment of wages to construction workers and employees in construction-related and service-oriented businesses, management earnings, contractor payments, and subsequent household and business spending in the regional economy. An estimated $109.4 million would be directly paid each year to the approximately 450 construction workers during the 8-year construction period. The additional 1,155 indirect and induced jobs would generate an additional estimated $54.7 million in personal income each year during the construction period. Taken together, it is expected that construction-related direct, indirect, and induced personal income resulting from implementing Alternative Plans 1, 2, 3, or 5 would be approximately $164.1 million per year within the six-county area.

Overall, constructing Alternative Plan 1, 2, 3, or 5 would generate 1,605 direct, indirect, and induced jobs and an estimated $164.1 million in personal income. These new jobs are expected to provide temporary, short-term employment opportunities to many unemployed workers, and spending of

personal income by these workers would result in new local economic activity in the six-county area.

This impact would be **less than significant and beneficial** under Alternative Plans 1, 2, 3, and 5. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 Implementing Alternative Plan 4 would result in temporary increases in employment and personal income in the six-county area as a result of construction-related activities in the primary study area. Construction of Alternative Plan 4 would generate an estimated 1,656 direct, indirect, and induced jobs; and personal income of approximately $169.8 million per year.

Construction, demolition, and relocation activities would require an average of 460 new workers per year over the 8-year construction period (Table 23-20). In addition to generating 460 construction jobs, implementing Alternative Plan 4 would generate 1,196 new indirect and induced jobs per year (Table 23-20).

Overall, the total 1,656 direct, indirect, and induced jobs represent a small increase in the total labor force in the six-county area, but the employment opportunities created by implementing Alternative Plan 4 represent a substantial contribution in these counties because of existing high unemployment rates.

An estimated $113.2 million would be directly paid each year to the approximately 460 construction workers during the 8-year construction period. The additional 1,155 indirect and induced jobs would generate an additional estimated $56.6 million in personal income each year during the construction period. Taken together, it is expected that construction-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 4 would be approximately $169.8 million per year within the six-county area. This represents approximately 0.5 percent of the estimated $32.6 billion in personal income in Fresno and Madera counties in 2010 (Table 23-6).

Overall, construction of Alternative Plan 4 would generate 1,656 direct, indirect, and induced jobs and an estimated $169.8 million in personal income. These new jobs are expected to provide temporary, short-term employment opportunities to many unemployed workers, and spending of

personal income by these workers would result in new local economic activity in the region.

This impact would be **less than significant and beneficial** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-2: Temporary Increases in Population and Housing Demand Resulting from Construction

Primary Study Area

No Action Alternative Under the No Action Alternative, construction-related activities would not occur. No construction workers would be needed, and the population and housing conditions would be expected to continue following current trends described in the Affected Environment section. These trends indicate that the economies of the six-county area will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth would be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Alternatives Plans 1–3 and 5 Implementing Alternative Plan 1, 2, 3 or 5 would result in temporary increases in population and housing demand in Fresno County and Madera County as a result of construction-related activities in the primary study area. As shown in Table 23-20, construction of Alternative Plan 1, 2, 3, or 5 would generate an estimated 1,605 direct, indirect, and induced jobs.

Because of the availability of the existing labor force and relatively high rate of unemployment within the six-county area, it is expected that an adequate number of new workers could be found within the local area (see the discussion of Impact SOC-1). Even if some workers were to come from outside the local area, sufficient housing capacity (e.g., rental housing and apartment vacancies) exists in the six-county area to house these workers. Vacancy rates in all six counties were generally higher than the State average (5.9 percent) and vacancy rates ranged from 6.0 percent in Kings County to 10.5 percent in Kern County (i.e., single-family attached homes, single-family detached homes, multi-family homes, and mobile homes) (Table 23-13). In addition, nonlocal workers may occupy transient housing, such as hotels and motels.

Campgrounds located in the vicinity of Millerton Lake, some of which would be open during construction, could provide additional transient housing (see Chapter 22, "Recreation"). Furthermore, if nonlocal construction workers were employed for the project, the temporary and short-term nature of the work supports the conclusion that these workers would not typically change residences if temporarily employed at the project construction site. Therefore, substantial impacts on population and housing in the primary study area are not expected.

Because workers serving the project could be expected to come primarily from nearby communities and cities in Fresno County and Madera County, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plans 1, 2, 3, and 5. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 Implementing Alternative Plan 4 would result in temporary increases in population and housing demand in Fresno and Madera counties as a result of construction-related activities in the primary study area. As shown in Table 23-20, construction of Alternative Plan 4 would generate an estimated 1,656 direct, indirect, and induced jobs.

Given the availability of the existing labor force and relatively high rate of unemployment within Fresno and Madera counties, it is expected that an adequate number of new workers could be found within the local area (see the discussion of Impact SOC-1). Even if some workers were to come from outside the local area, sufficient housing capacity exists in Fresno County and Madera County to house these workers. In addition, nonlocal workers may occupy transient housing, such as hotels and motels in Fresno and Madera counties. Campgrounds located in the vicinity of Millerton Lake, some of which would be open during construction, could provide additional transient housing (see Chapter 22, "Recreation"). Furthermore, if nonlocal construction workers were employed for the project, the temporary and short-term nature of the work supports the conclusion that these workers would not typically change residences if temporarily employed at the project construction site. Therefore, substantial impacts on population and housing in the primary study area are not expected.

Because workers serving the project could be expected to come primarily from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-3: Temporary Increases in Business Income and Local Sales Tax Revenue Resulting from Construction

Primary Study Area

No Action Alternative Under the No Action Alternative, the project would not be constructed; therefore, there would be no temporary increases in business incomes or local sales tax revenues from spending of personal income and construction-related expenditures in Fresno County and Madera County associated with the project. It is anticipated that business incomes and local sales tax revenues from spending of personal income would increase following current income trends described in the Affected Environment section. These trends indicate that the economies of the six counties will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth would be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Alternative Plans 1–3 and 5 Implementing Alternative Plan 1, 2, or 3 would be expected to generate an estimated $164.1 million in total personal income during the proposed 8-year construction period (see the discussion of SOC-1). In addition to this increase in personal incomes, most of the construction materials would be purchased within the six-county area, generating a substantial amount of sales and revenue for local businesses.

Construction expenditures would also represent net new spending to the six-county area. A large amount of construction material would be required to construct Alternative Plan 1, 2, 3, or 5. These purchases may include raw or refined materials, equipment required for the construction process, fuel for

vehicles and equipment, and other incidental materials and supplies. Of this material, it is expected that most would be procured from businesses within the six-county area.

Other direct construction expenditures consist of technical tasks required for project construction, such as engineering, design, and construction management; environmental mitigation costs; and land acquisition costs. Indirect expenditures would consist of spending on goods and services by industries that produce the items purchased as part of the construction, and induced expenditures would consist of spending by the households of workers involved either directly or indirectly in the construction process.

As a result of the large quantity of purchases expected, implementing Alternative Plan 1, 2, 3, or 5 would be expected to generate more than $419.1 million per year in sales and revenue for construction-related and service-oriented businesses that support the construction industry, with approximately $267.5 million in direct income and $151.6 in indirect and induced income. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways.

In addition to the business income that would be generated from spending of personal income and construction expenditures, the six counties would receive substantial local sales tax revenues on expenses related to taxable sales. Under California tax regulations, counties could receive sales tax revenues equal to 1 percent of total taxable sales spending for the entire project. The exact amount of local sales tax revenue increases has not yet been calculated; however, this additional spending would result in an appreciable increase in local sales tax revenues. Transient taxes, ranging from 4 to 15 percent, would be collected from the rental of rooms at lodging establishments, and also contribute to revenues in both counties.

This impact would be **less than significant and beneficial** under Alternative Plans 1, 2, 3, and 5. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 Implementing Alternative Plan 4 would be expected to generate an estimated $169.8 million in total personal income over the project's lifetime (see the discussion of Impact SOC-1). In addition to this increase in personal

incomes, most of the construction materials would be purchased within the six-county area, generating a substantial amount of sales and revenue for local businesses. Alternative Plan 4 would generate total personal expenditures of $169.8 million per year, and construction-related expenditures of $434.0 million per year.

As a result of the large quantity of purchases expected, implementing Alternative Plan 4 would be expected to generate more than $434.0 million per year in sales for construction-related and service-oriented businesses that support the construction industry, with approximately $277.0 million in direct income and $157.0 in indirect and induced income.

In addition to the business income that would be generated from spending of personal income and construction expenditures, the six-county area would receive substantial local sales tax revenues on expenses related to taxable sales. Under California tax regulations, the six counties could receive sales tax revenues equal to 1 percent of total taxable sales spending for the entire project. The exact amount of local sales tax revenue increases has not yet been calculated; however, this additional spending would result in an appreciable increase in local sales tax revenues. Transient taxes, ranging from 4 to 15 percent, would be collected from the rental of rooms at lodging establishments, and also contribute to revenues in both counties.

This impact would be **less than significant and beneficial** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-4: Increases in Employment and Personal Income Resulting from Operations and Maintenance

Primary Study Area

No Action Alternative Under the No Action Alternative, none of the action alternatives would be constructed. No O&M-related activities associated with the project would increase employment, and personal income and the labor force and personal income trends would be expected to follow the current estimates described in the Affected Environment section. These trends indicate that the economies the six-county region will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth would be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would result in increases in employment and personal income in Fresno and Madera counties as a result of O&M of the Temperance Flat RM 274 Dam, intake structure, powerhouse, valve house, and permanent access roads. O&M would generate an estimated 28 direct jobs and 10 indirect and induced jobs for a total of 38 new jobs (Table 23-21). It is expected that the workers serving the project would be expected to come from nearby communities and cities in Fresno County and Madera County. Overall, a total of 38 direct, indirect, and induced jobs would represent a small increase in the total labor force in Fresno and Madera counties. Given the large workforce in Fresno County and Madera County, it is anticipated that most of these new jobs would be filled from the existing workforce in the two counties.

O&M would generate personal income through payment of wages to employees and subsequent household and business spending in the regional economy. An estimated $1.9 million would be directly paid each year to the approximately 28 maintenance workers. The additional 10 indirect and induced jobs would generate an additional estimated $0.4 million in personal income. Taken together, it is expected that direct, indirect, and induced personal income resulting from implementing any of the action alternatives would be approximately $2.3 million per year over the project's lifetime. This represents less than 0.01 percent of the estimated $81.2 billion 2010 personal income in these counties (Table 23-6 and Table 23-15).

Overall, O&M of any of the action alternatives would generate 38 direct, indirect, and induced jobs and an estimated $2.3 million in personal income. These new jobs are expected to be filled from the local labor pool, and spending of personal income would result in local economic activity in Fresno County and Madera County. The increase in employment and personal income from O&M-related activities would be small in comparison to the regional economy.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-5: Increases in Spending, Employment, and Personal Income from Increased Recreational Visitation

Primary Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be constructed. However, projects to enhance and manage recreational resources, including those described in the Millerton Lake Resource Management Plan and General Plan, along with population growth in the region, would be expected to increase economic activity, including spending, employment, and personal income, in the Millerton Lake State Recreation Area.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would result in increases in recreation-related spending, employment, and personal income. New recreation participation in the region would be expected with creation of the Temperance Flat RM 274 Reservoir, and Millerton Lake recreational activities would benefit from higher and more constant lake levels during April, July, August, and September, when visitation could increase (see Chapter 22, "Recreation," for a detailed discussion of impacts associated with changes in recreation opportunities from implementing the action alternatives).

New recreation-related spending associated with increased recreation visitation under the action alternatives would generate $2.4 million under Alternative Plans 1, 2, and 3; $2.7 million under Alternative Plan 4; and $1.8 million under Alternative Plan 5 in direct, indirect, and induced income by spending of local and nonlocal visitors in food and convenience stores, eating and drinking establishments, gasoline and service stations, miscellaneous retail stores, and other establishments within Fresno and Madera counties. In turn, this spending by local and nonlocal visitors would directly generate an estimated 27 new jobs and six new indirect and induced jobs under Alternative Plans 1 and 2; 26 new jobs and six new indirect and induced jobs under Alternative Plan 3; 30 new jobs and seven new indirect and induced jobs under Alternative Plan 4; and 20 new jobs and five new indirect and induced jobs under Alternative Plan 5. These new jobs would generate an additional estimated $1.1 million (Alternative Plans 1, 2, and 3), $1.3 million (Alternative Plan 4), or $0.8

million (Alternative Plan 5) in personal income each year over the project's lifetime (Table 23-22).

Overall, increases in recreation visitation would generate spending by local and nonlocal visitors within Fresno County and Madera County, create new jobs, and generate personal income.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-6: Increases in Population and Housing Demand Resulting from Operations and Maintenance

Primary Study Area

No Action Alternative Because none of the action alternatives would be constructed under the No Action Alternative, no O&M-related activities associated with the project would increase population and housing demand. The population and housing trends would be expected to follow current estimates described in the Affected Environment section. These trends indicate that the economies of the six-county area will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth would be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would not result in increases in population and housing demand. O&M of the proposed Temperance Flat RM 274 Dam, intake structure, powerhouse, valve house, and permanent access roads would generate an estimated 38 direct, indirect, and induced jobs (see the discussion of Impact SOC-4), and new recreation visitation and spending associated with increased recreation visitation to Millerton Lake and the proposed Temperance Flat RM 274 Reservoir would generate between 25 and 37 direct, indirect, and induced jobs (see the discussion of Impact SOC-5).

Because the workers serving the project would be expected to come from nearby communities and cities in Fresno County and Madera County, it is anticipated that most of these new jobs would be filled by the existing workforce in the two counties. Even if some workers were to come from outside the

local area, sufficient housing capacity (e.g., rental housing and apartment vacancies) exists in the area to house these workers. Neither substantial population growth nor an increase in housing demand in the region would be anticipated with generation of these jobs. Therefore, the impact associated with increases in population and housing demand from O&M activities would be minimal.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-7: Increases in Business Income and Local Sales Tax Revenue Associated with O&M and Recreation Visitation

Primary Study Area

No Action Alternative Because none of the action alternatives would be constructed, implementing the No Action Alternative would not result in increases in business income and local sales tax revenue in Fresno and Madera counties from O&M-related activities and new spending associated with increased recreation visitation. The business income and sales tax revenue trends would be expected to follow current estimates described in the Affected Environment section. These trends indicate that the economies of the six-county area will continue to grow, increasing the local population, labor force, available jobs, personal income, housing, and revenues for local government services. It is anticipated that this growth would be consistent with the general plans of these counties.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives O&M-related activities associated with the action alternatives would generate an estimated $2.3 million in personal income, and new recreation-related jobs would generate an estimated $1.1 million (Alternative Plans 1, 2, and 3), $1.3 million (Alternative Plan 4), or $0.8 million (Alternative Plan 5) in personal income (see the discussions of Impacts SOC-4 and SOC-5). In total, implementing the action alternatives would result in an estimated $3.4-million (Alternative Plan 1, 2, or 3), $3.6-million (Alternative Plan 4), or $3.1-million (Alternative Plan 5) increase in personal income per year over the project's lifetime.

In addition to increases in personal income, O&M-related expenditures and spending associated with increased recreation visitation within Fresno County and Madera County would generate a substantial amount of revenue for local businesses. Direct expenditures for O&M are assumed to include the physical part components and other materials required for maintenance of new facilities. Indirect expenditures would consist of spending on goods and services by industries that produce items purchased as part of maintenance activities, and induced expenditures would consist of spending by the households of workers involved either directly or indirectly in maintenance. Implementing the action alternatives would be expected to generate more than $9.6 million per year in revenue for businesses in Fresno and Madera counties, with approximately $8.4 million in direct income and $1.2 million in indirect and induced income.

In addition, new recreation spending associated with increased recreation visitation would generate $2.4 million (Alternative Plans 1, 2, and 3), $2.7 million (Alternative Plan 4), or $1.8 million (Alternative Plan 5) in direct, indirect, and induced income. Increased revenues could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways. In addition to the business income that would be generated from spending of personal income and construction expenditures, Fresno and Madera counties would receive substantial local sales tax revenues on expenses related to taxable sales. Under California tax regulations, Fresno and Madera counties could receive sales tax revenues equal to 1 percent of total taxable sales spending. The exact amount of local sales tax revenue increases has not yet been calculated; however, this additional spending would result in an increase in local sales tax revenues.

This impact would be **less than significant and beneficial** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-8: Decreases in Property Tax Revenue from Acquisition of Privately Owned Land

Primary Study Area

No Action Alternative Because project implementation would not occur under the No Action Alternative, the permanent decrease in property tax revenue in Fresno County or Madera

County associated with acquiring privately owned land in the primary study area for project purposes would not occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would require acquiring approximately 170 acres of privately owned land in the primary study area in Fresno County and 110 acres of privately owned land in Madera County for project purposes.

If these properties are acquired in fee title, they would be removed from local tax rolls. The property tax and assessment revenue that could be lost as a result of property acquisition has not yet been calculated because the extent of fee title acquisition is not known at this time; however, the decreases in revenue would result in the loss of a portion of Fresno County tax revenues over the project's lifetime. The right to use other private lands needed for project purposes might be acquired through establishing rights-of-way or easements. The use of these mechanisms would not reduce property tax and assessment revenues to the counties.

More than $184 million in property tax revenue was generated in Fresno County and about $31.5 million was generated in Madera County during the 2009–2010 fiscal year (Table 23-11 and Table 23-12). Although a decrease in property tax revenue would occur with implementation of any of the action alternatives, the decrease would be small in comparison to the total property tax revenue generated in these counties. In addition, as discussed for Impact SOC-7, operations and maintenance activities and new spending associated with increased recreation visitation would generate business income and local sales tax revenue in Fresno County and Madera County that would offset reduced property tax revenues. Therefore, the reduction in tax revenues associated with the permanent acquisition of private property for the project would be minor.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas

Extended Study Area

No Action Alternative Under the No Action Alternative, Temperance Flat RM 274 Dam would not be constructed, and water supply and flood storage operations at Friant Dam would not change. Therefore, there would be no increase in surface water supply reliability from Millerton Lake. Agricultural production costs and income in the CVP and SWP water service areas would follow the current trends described in the Affected Environment section.

Many SOD CVP and SWP water users have been subjected to reduced water deliveries because of regulatory restrictions on CVP and SWP facility operations. In addition, local groundwater levels have declined, resulting in reduced groundwater supplies or increased extraction costs. These and other factors have adversely affected the agricultural economics of CVP and SWP water users, resulting in increased economic hardship and stress.

Without implementation of any of the action alternatives, the losses of agricultural economic activity, jobs, and tax revenues would continue. It is expected that as economic stress continues, there would be continued impact on agricultural economic activity, jobs, personal spending, and tax revenues.

This impact would be **significant** under the No Action Alternative.

Alternative Plan 1 Improved surface water reliability expected to result from implementing Alternative Plan 1 would result in less crop idling, thereby increasing agricultural production and net income. Within the CVP and SWP water service areas, the increased surface water reliability would provide the greatest economic benefits to agricultural water users in the six-county area. Other agricultural water users in the CVP and SWP water service areas would also benefit from increased surface water reliability; however, these economic impacts would be dispersed over the 36 counties that are served by the CVP and SWP and would be less discernible to a single jurisdiction. The additional agricultural industry revenue would result in direct, indirect, and induced economic benefits to the six-county area and the State. SWAP modeling indicates that implementing Alternative Plan 1 would increase the net agricultural industry revenue by approximately $4.5 million per

year in the six-county area and $4.1 million per year in the State over the project's lifetime. In 2010, the estimated crop value in the six-county area was approximately $22.5 billion and in the State as a whole was approximately $39.4 billion (Caltrans 2013c). This agricultural industry revenue from increased crop production would be small when compared to the overall agricultural industry revenue within the six-county area and the State.

To support the increased agricultural production expected from implementing Alternative Plan 1, additional agricultural workers would be needed. The increase in surface water supply reliability has the potential to result in less crop idling and greater agricultural production in the six-county area. This would enable existing employees to work for a longer period in the fields, while also increasing the total workers needed during the growing season. IMPLAN estimates that 35 agricultural workers would be needed to support additional crop production in the six-county area, and that 32 agricultural workers would be needed to support additional crop production in the State (Table 23-23 and Table 23-24).

An additional estimated $8.8 million and 76 new indirect and induced jobs would be generated in the six-county area, and $10.7 million and 70 new indirect and induced jobs would be generated in the State through purchases from businesses that support the agricultural industry, such as farm and equipment supply stores and from businesses that earn their income by selling, transporting, storing, marketing, and processing agricultural products (Table 23-23 and Table 23-24).

Overall, the total 110 direct, indirect, and induced jobs in the six-county area and the 102 indirect, and induced jobs in the State represent a small increase in the total labor force in the six-county region (approximately 1,260,000 employees in 2010) and State as a whole (18,316,000 employees in 2010), but the employment opportunities created by implementing Alternative Plan 1 represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 15 percent in each county, and the unemployment rate in the State exceeded 12 percent (Table 23-16). These new jobs are expected to provide employment opportunities to many unemployed workers.

Implementing Alternative Plan 1 would generate personal income through payment of wages to agricultural workers and

employees in agriculture-related businesses. An estimated $1.2 million would be directly paid each year to the approximately 35 agricultural workers in the six-county area over the project's lifetime. The additional 76 indirect and induced jobs would generate an additional estimated $3.1 million in personal income per year.

Within the State, an estimated $1.1 million would be directly paid to the approximately 32 agricultural workers, and the additional 70 jobs would generate an additional estimated $3.6 million in personal income per year over the project's lifetime. Taken together, it is expected that agriculture-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 1 would be approximately $4.3 million per year in the six-county area and $4.7 million per year in the State over the project's lifetime. This represents a small increase in the 2010 personal income ($48.6 billion) within the six-county area and the State ($1,558.7 billion) (Table 23-15).

Overall, implementing Alternative Plan 1 would generate $4.5 million in new agricultural industry revenue from increased crop production on existing agricultural lands in the six-county area; generate $8.8 million in indirect and induced income from agriculture-related spending; create 110 direct, indirect, and induced jobs; and generate an estimated $4.3 million in direct, indirect, and induced personal income. Within the CVP and State, implementing Alternative Plan 1 would generate $4.1 million in new agricultural industry revenue from increased crop production on existing agricultural lands; generate $10.7 million in indirect and induced income from agriculture-related spending; create 102 direct, indirect, and induced jobs; and generate an estimated $4.7 million in direct, indirect, and induced personal income.

The direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the six-county area and the State.

This impact would be **less than significant and beneficial** under Alternative Plan 1. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 2 The effects of improved water supply reliability in the CVP and SWP water service areas associated

with Alternative Plan 2 would be similar to but slightly less than those under Alternative Plan 1.

SWAP modeling indicates the net agricultural industry revenue would increase by approximately $4.0 million per year in the six-county area and $3.6 million per year in the State over the project's lifetime under Alternative Plan 2. This new agricultural industry revenue would be less than under Alternative Plan 1 ($4.5 million in the six-county area and $4.1 million in the State). In 2010, the estimated crop value in the six-county area was approximately $22.5 billion and in the State as a whole was approximately $39.4 billion. This agricultural industry revenue from increased crop production would be small when compared to the overall agricultural industry revenue within the six-county area and the State (Caltrans 2013c).

To support the increased agricultural production expected from implementing Alternative Plan 2, more agricultural workers would be needed. IMPLAN estimates that 40 agricultural workers would be needed to support additional crop production in the six-county area and that 34 agricultural workers would be needed to support additional crop production in the State. An additional $8.6 million in indirect and induced income and 73 new indirect and induced jobs in the six-county area and $10.4 million in indirect and induced income and 67 new indirect and induced jobs in the State would be generated from spending in agriculture-related and service-oriented businesses that support the agriculture industry (Table 23-23 and Table 23-24).

Overall, the total 113 and 101 direct, indirect, and induced jobs in the six-county area and the State, respectively, represent a small increase in the total labor force in the six-county region and State as a whole, but the employment opportunities created by implementing Alternative Plan 2 represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 15 percent in each county, and the unemployment rate in the State exceeded 12 percent (Table 23-16). These new jobs are expected to provide employment opportunities to many unemployed workers.

Implementing Alternative Plan 2 would generate personal income through payment of wages to agricultural workers and employees in agriculture-related businesses. An estimated $0.9 million would be directly paid each year to the approximately

40 agricultural workers in the six-county area over the project's lifetime. The additional 73 indirect and induced jobs would generate an additional estimated $3.0 million in personal income per year. Within the State an estimated $0.7 million would be directly paid to the approximately 34 agricultural workers, and the additional 67 jobs would generate an additional estimated $3.5 million in personal income per year over the project's lifetime.

Taken together, it is expected that agriculture-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 2 would be approximately $3.9 million per year within the six-county area and $4.2 million per year in the State over the project's lifetime. This represents a small increase in the 2010 personal income ($48.6 billion) within the six-county area and the State ($1,558.7 billion) (Table 23-15).

Overall, implementing Alternative Plan 2 would generate $4.0 million in new agricultural industry revenue from increased crop production on existing agricultural lands in the six-county area; generate $8.6 million in indirect and induced income from agriculture-related spending; create 113 direct, indirect; and induced jobs, and generate an estimated $3.9 million in direct, indirect, and induced personal income. Within the State, implementing Alternative Plan 2 would generate $3.6 million in new agricultural industry revenue from increased crop production on existing agricultural lands; generate $10.4 million in indirect and induced income from agriculture-related spending; create 101 direct, indirect, and induced jobs; and generate an estimated $4.2 million in direct, indirect, and induced personal income.

The direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the six-county area and in the State.

This impact would be **less than significant and beneficial** under Alternative Plan 2. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 3 The effects of improved water supply reliability in the CVP and SWP water service areas associated with Alternative Plan 3 would be similar to but slightly less than those under Alternative Plan 1 and greater than Alternative Plan 2.

SWAP modeling indicates the net agricultural industry revenue would increase by approximately $4.2 million per year in the six-county area and $3.7 million per year in the State over the project's lifetime under Alternative Plan 3. This new agricultural industry revenue would be less than under Alternative Plan 1 ($4.5 million in the six-county area and $4.1 million in the State). In 2010, the estimated crop value in the six-county area was approximately $22.5 billion and in the State as a whole was approximately $39.4 billion. This agricultural industry revenue from increased crop production would be small when compared to the overall agricultural industry revenue within the six-county area and the State (Caltrans 2013c).

To support the increased agricultural production expected from implementing Alternative Plan 3, more agricultural workers would be needed. IMPLAN estimates that 42 agricultural workers would be needed to support additional crop production in the six-county area and that 36 agricultural workers would be needed to support additional crop production in the State. An additional $8.9 million in indirect and induced income and 76 new indirect and induced jobs in the six-county area and $10.8 million in indirect and induced income and 69 new indirect and induced jobs in the State would be generated from spending in agriculture-related and service-oriented businesses that support the agriculture industry (Table 23-23 and Table 23-24).

Overall, the total 118 and 101 direct, indirect, and induced jobs in the six-county area and the State, respectively, represent a small increase in the total labor force in the six-county region and State as a whole, but the employment opportunities created by implementing Alternative Plan 3 represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 15 percent in each county, and the unemployment rate in the State exceeded 12 percent (Table 23-16. These new jobs are expected to provide employment opportunities to many unemployed workers.

Implementing Alternative Plan 3 would generate personal income through payment of wages to agricultural workers and employees in agriculture-related businesses. An estimated $0.9 million would be directly paid each year to the approximately 42 agricultural workers in the six-county area over the project's lifetime. The additional 76 indirect and induced jobs would generate an additional estimated $3.1 million in personal

income per year. Within the State an estimated $0.7 million would be directly paid to the approximately 36 agricultural workers, and the additional 69 jobs would generate an additional estimated $3.6 million in personal income per year over the project's lifetime.

Taken together, it is expected that agriculture-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 3 would be approximately $4.0 million per year within the six-county area and $4.4 million per year in the State over the project's lifetime. This represents a small increase in the 2010 personal income ($48.6 billion) within the six-county area and the State ($1,558.7 billion) (Table 23-15).

Overall, implementing Alternative Plan 3 would generate $4.2 million in new agricultural industry revenue from increased crop production on existing agricultural lands in the six-county area; generate $8.9 million in indirect and induced income from agriculture-related spending; create 118 direct, indirect; and induced jobs, and generate an estimated $4.0 million in direct, indirect, and induced personal income. Within the State, implementing Alternative Plan 3 would generate $3.7 million in new agricultural industry revenue from increased crop production on existing agricultural lands; generate $10.8 million in indirect and induced income from agriculture-related spending; create 106 direct, indirect, and induced jobs; and generate an estimated $4.4 million in direct, indirect, and induced personal income.

Total direct, indirect, and induced agriculture-related income ($13.1 million), employment (113 jobs), and personal income ($3.9 million) in the six-county area under Alternative Plan 3 would be less than under Alternative Plan 1 ($13.3 million in agriculture-related income, 110 jobs, and $4.3 million in personal income per year) and greater than Alternative Plan 2 ($12.6 million in agriculture-related income, 113 jobs, and $3.9 million in personal income).

The direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the six-county area and in the State.

This impact would be **less than significant and beneficial** under Alternative Plan 3. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 The effects of improved water supply reliability in the CVP and SWP water service areas associated with implementing Alternative Plan 4 would be similar to but slightly less than under Alternative Plan 1, 2, or 3. SWAP modeling indicates that implementing Alternative Plan 4 would increase the net agricultural industry revenue by approximately $3.0 million per year in the six-county area and $2.7 million per year in the State over the project's lifetime. In 2010, the estimated crop value in the six-county area was approximately $22.5 billion and in the State as a whole was approximately $39.4 billion.

To support the increased agricultural production expected from implementing Alternative Plan 4, additional agricultural workers would be needed. IMPLAN estimates that 28 agricultural workers would be needed to support additional crop production in the six-county area and that 24 agricultural workers would be needed to support additional crop production in the State. An additional $7.2 million in indirect and induced income and 62 new indirect and induced jobs in the six-county area and $8.7 million and 56 new indirect and induced jobs in the State would be generated from spending in agriculture-related and service-oriented businesses that support the agriculture industry (Table 23-23 and Table 23-24).

Overall, the total 89 and 80 direct, indirect, and induced jobs in the six-county area and the State, respectively, represent a small increase in the total labor force in the six-county region (approximately 1,135,500 employees in 2010) and State as a whole (16,051,500 employees in 2010), but the employment opportunities created by Alternative Plan 4 represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 15 percent in each county, and the unemployment rate in the State exceeded 12 percent (Table 23-16). These new jobs are expected to provide employment opportunities to many unemployed workers.

Implementing Alternative Plan 4 would generate personal income through payment of wages to agricultural workers and employees in agriculture-related businesses. An estimated $0.7 million would be paid annually to the approximately 28 agricultural workers in the six-county area over the project's lifetime. The additional 62 indirect and induced jobs would generate an additional estimated $2.5 million in personal income per year. Within the State, an estimated $0.6 million would be directly paid to the approximately 24 agricultural

workers, and the additional 56 jobs would generate an additional estimated $2.9 million in personal income per year over the project's lifetime.

Taken together, it is expected that agriculture-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 4 would be approximately $3.2 million per year within the six-county area and $3.5 million per year in the State over the project's lifetime. This represents a small increase in the 2010 personal income within the six-county area ($48.6 billion) and the State ($1,558.7 billion) (Table 23-6 and Table 23-15).

Overall, implementing Alternative Plan 4 would generate $3.0 million in new agricultural industry revenue from increased crop production on existing agricultural lands in the six-county area; generate $7.2 million in indirect and induced income from agriculture-related spending; create 89 direct, indirect, and induced jobs, and generate an estimated $3.2 million in direct, indirect, and induced personal income. Within the State, implementing Alternative Plan 4 would generate $2.7 million in new agricultural industry revenue from increased crop production on existing agricultural lands; generate $8.7 million in indirect and induced income from agriculture-related spending; create 80 direct, indirect, and induced jobs; and generate an estimated $3.5 million in direct, indirect, and induced personal income.

Total direct, indirect, and induced agriculture-related income ($10.2 million), employment (89 jobs), and personal income ($3.2 million) in the six-county area under Alternative Plan 4 would be less than under Alternative Plan 1 ($13.3 million in agriculture-related income, 110 jobs, and $4.3 million in personal income per year); and Alternative Plan 2 ($12.6 million in agriculture-related income, 113 jobs, and $3.9 million in personal income) and Alternative Plan 3 ($13.1 million in agriculture-related income, 118 jobs, and $4.0 million in personal income).

The direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the six-county area and in the State.

This impact would be **less than significant and beneficial** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 5 The effects of improved water supply reliability in the CVP and SWP water service areas associated with implementing Alternative Plan 5 would be greater than under Alternative Plan 1, 2, 3, or 4. SWAP modeling indicates that implementing Alternative Plan 5 would increase the net agricultural industry revenue by approximately $5.5 million per year in the six-county area and $5.0 million per year in the State over the project's lifetime. In 2010, the estimated crop value in the six-county area was approximately $22.5 billion and in the State as a whole was approximately $39.4 billion.

To support the increased agricultural production expected from implementing Alternative Plan 5, additional agricultural workers would be needed. IMPLAN estimates that 62 agricultural workers would be needed to support additional crop production in the six-county area and that 53 agricultural workers would be needed to support additional crop production in the State. An additional $11.8 million in indirect and induced income and 100 new indirect and induced jobs in the six-county area and $14.4 million and 92 new indirect and induced jobs in the State would be generated from spending in agriculture-related and service-oriented businesses that support the agriculture industry (Table 23-23 and Table 23-24).

Overall, the total 162 and 145 direct, indirect, and induced jobs in the six-county area and the State, respectively, represent a small increase in the total labor force in the six-county region (approximately 1,135,500 employees in 2010) and State as a whole (16,051,500 employees in 2010), but the employment opportunities created by Alternative Plan 5 represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 15 percent in each county, and the unemployment rate in the State exceeded 12 percent (Table 23-16). These new jobs are expected to provide employment opportunities to many unemployed workers.

Implementing Alternative Plan 5 would generate personal income through payment of wages to agricultural workers and employees in agriculture-related businesses. An estimated $1.1 million would be paid annually to the approximately 62 agricultural workers in the six-county area over the project's lifetime. The additional 100 indirect and induced jobs would generate an additional estimated $4.1 million in personal income per year. Within the State, an estimated $0.9 million would be directly paid to the approximately 53 agricultural workers, and the additional 92 jobs would generate an

additional estimated $4.8 million in personal income per year over the project's lifetime.

Taken together, it is expected that agriculture-related direct, indirect, and induced personal income resulting from implementing Alternative Plan 5 would be approximately $5.2 million per year within the six-county area and $5.7 million per year in the State over the project's lifetime. This represents a small increase in the 2010 personal income within the six-county area ($48.6 billion) and the State ($1,558.7 billion) (Table 23-6 and Table 23-15).

Overall, implementing Alternative Plan 5 would generate $5.5 million in new agricultural industry revenue from increased crop production on existing agricultural lands in the six-county area; generate $11.8 million in indirect and induced income from agriculture-related spending; create 162 direct, indirect, and induced jobs; and generate an estimated $5.2 million in direct, indirect, and induced personal income. Within the State, implementing Alternative Plan 4 would generate $5.0 million in new agricultural industry revenue from increased crop production on existing agricultural lands; generate $14.4 million in indirect and induced income from agriculture-related spending; create 145 direct, indirect, and induced jobs; and generate an estimated $5.7 million in direct, indirect, and induced personal income.

Total direct, indirect, and induced agriculture-related income ($17.3 million), employment (162 jobs), and personal income ($5.2 million) in the six-county area under Alternative Plan 5 would be greater than under Alternative Plan 1 ($13.3 million in agriculture-related income, 110 jobs, and $4.3 million in personal income per year); and Alternative Plan 2 ($12.6 million in agriculture-related income, 113 jobs, and $3.9 million in personal income); Alternative Plan 3 ($13.1 million in agriculture-related income, 118 jobs, and $4.0 million in personal income); and Alternative Plan 4 ($10.2 million in agriculture-related income, 89 jobs, and $3.2 million in personal income per year).

The direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the six-county area and in the State.

This impact would be **less than significant and beneficial** under Alternative Plan 5. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-10: Increases in Population and Housing Demand Within the CVP and SWP Water Service Areas

Extended Study Area

No Action Alternative Under the No Action Alternative, there would be no increase in surface water supply reliability from Temperance Flat RM 274 Reservoir and Millerton Lake. Crop idling in the CVP and SWP water service areas and agricultural production would be similar to existing conditions. No direct, indirect, or induced employment would occur from the project, and the population and housing conditions would be expected to follow the current trends described in the Affected Environment section.

This impact would be **less than significant** under the No Action Alternative.

Alternative Plan 1 Implementing Alternative Plan 1 would generate an estimated 110 direct, indirect, and induced jobs in the six-county area. Even if some workers were to come from outside this area, sufficient housing capacity (e.g., rental housing and apartment vacancies) exists in the six-county area to house them. Vacancy rates in the six-county region were generally higher than the State average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region are not expected.

Within the State, implementing Alternative Plan 1 would generate an estimated 102 direct, indirect, and induced jobs. These jobs would be dispersed over a broader geographical area and not concentrated in any single county. Therefore, this increase in jobs would have essentially no impact on population and housing in the State.

Because workers serving the project could be expected to come from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in

housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 1. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 2 Implementing Alternative Plan 2 would generate an estimated 113 direct, indirect, and induced jobs in the six-county area, which would be three more jobs than generated under Alternative Plan 1. Even if some workers were to come from outside this area, sufficient housing capacity exists in the six-county area to house them. Vacancy rates in the six-county region were generally higher than the State average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region are not expected.

Within the State, implementing Alternative Plan 2 would generate an estimated 101 direct, indirect, and induced jobs, which would be one fewer jobs than would be generated under Alternative Plan 1. These jobs would be dispersed over a greater geographical area and not concentrated in any one county. Therefore, this increase in jobs would have essentially no impact on population and housing in the State.

Because workers serving the project could be expected to come from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 2. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 3 Implementing Alternative Plan 3 would generate an estimated 118 direct, indirect, and induced jobs in the six-county area, which would be eight more jobs than generated under Alternative Plan 1 and five more jobs than generated under Alternative Plan 2. Even if some workers were to come from outside this area, sufficient housing capacity exists in the six-county area to house them. Vacancy rates in

the six-county region were generally higher than the State average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region are not expected.

Within the State, implementing Alternative Plan 3 would generate an estimated 106 direct, indirect, and induced jobs, which would be four more jobs than would be generated under Alternative Plan 1 and five more jobs than generated under Alternative Plan 2. These jobs would be dispersed over a greater geographical area and not concentrated in any one county. Therefore, this increase in jobs would have essentially no impact on population and housing in the State.

Because workers serving the project could be expected to come from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 3. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 Implementing Alternative Plan 4 would generate an estimated 89 direct, indirect, and induced jobs six-county area, which would be approximately 21 fewer jobs than would be generated under Alternative Plan 1, 24 fewer jobs than generated under Alternative 2, and 29 fewer jobs than would be generated under Alternative Plan 3. Even if some workers were to come from outside this area, sufficient housing capacity exists in the six-county area to house them. Vacancy rates in the six-county region were generally higher than the State average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region are not expected.

Within the State, implementing Alternative Plan 4 would generate an estimated 80 direct, indirect, and induced jobs,

which would be 22 fewer jobs than would be generated under Alternative Plan 1, 21 fewer jobs than generated under Alternative Plan 2, and 26 fewer jobs than would be generated under Alternative Plan 3. These jobs would be dispersed over a greater geographical area and not concentrated in any one county. Therefore, this increase in jobs would have essentially no impact on population and housing in the six-county area or the State.

Because workers serving the project could be expected to come from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 5 Implementing Alternative Plan 5 would generate an estimated 162 direct, indirect, and induced jobs six-county area. This would be approximately 52 more jobs than would be generated under Alternative Plan 1, 49 more jobs than generated under Alternative 2, 44 more jobs than would be generated under Alternative Plan 3, and 73 more jobs than generated under Alternative 4. Even if some workers were to come from outside this area, sufficient housing capacity exists in the six-county area to house them. Vacancy rates in the six-county region were generally higher than the State average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region are not expected.

Within the State, implementing Alternative Plan 5 would generate an estimated 145 direct, indirect, and induced jobs. This would be 43 more jobs than would be generated under Alternative Plan 1, 44 more jobs than generated under Alternative Plan 2, 39 more jobs than would be generated under Alternative Plan 3, and 65 more jobs than generated under Alternative Plan 4. These jobs would be dispersed over a greater geographical area and not concentrated in any one county. Therefore, this increase in jobs would have essentially

no impact on population and housing in the six-county area or the State.

Because workers serving the project could be expected to come from nearby communities and cities in the six-county area, neither substantial population growth nor an increase in housing demand in the region is anticipated following generation of these jobs.

This impact would be **less than significant** under Alternative Plan 5. Mitigation for this impact is not needed and thus not proposed.

Impact SOC-11: Increases in Business Income and Local Sales Tax Revenue Within the CVP and SWP Water Service Areas

Extended Study Area

No Action Alternative As discussed under Impact SOC-9, reduced groundwater supplies or increased extraction costs have adversely affected the agricultural economics of CVP and SWP water users, resulting in increased economic hardship and stress.

Without implementation of any of the action alternatives, the losses of agricultural economic activity and personal income would continue, resulting in the loss of business incomes or local tax revenues.

This impact would be **significant** under the No Action Alternative.

Alternative Plan 1 Implementing Alternative Plan 1 would be expected to generate an estimated $4.3 million in total personal income per year in the six-county area and $4.7 million in personal income per year in the State over the project's lifetime. In addition to this increase in personal income, implementing Alternative Plan 1 would be expected to generate approximately $13.3 million per year in the six-county area and $14.8 million per year in the State from new agricultural income related to increased crop production on existing agricultural lands and increased agriculture-related spending. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways.

In addition to this increase in business income, the six-county area and the State would receive substantial local sales tax revenues on increased expenses related to taxable sales. Under California tax regulations these counties could receive sales tax revenues equal to 1 percent of total taxable sales spending.

This impact would be **less than significant and beneficial** under Alternative Plan 1. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 2 Implementing Alternative Plan 2 would be expected to generate an estimated $3.9 million in total personal income per year in the six-county area and $4.2 million in personal income in the State over the project's lifetime. In addition to this increase in personal income, implementing Alternative Plan 2 would be expected to generate approximately $12.6 million per year in the six-county area and $13.9 million per year in the State from new agricultural income related to increased crop production on existing agricultural lands and increased agriculture-related spending. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways.

In addition to this increase in business income, the six-county area and the State would receive substantial local sales tax revenues on increased expenses related to taxable sales. Under California tax regulations these counties could receive sales tax revenues equal to 1 percent of total taxable sales spending.

This impact would be **less than significant and beneficial** under Alternative Plan 2. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 3 Implementing Alternative Plan 3 would be expected to generate an estimated $4.0 million in total personal income per year in the six-county area and $4.4 million in personal income in the State over the project's lifetime. In addition to this increase in personal income, implementing Alternative Plan 3 would be expected to generate approximately $13.1 million per year in the six-county area and $14.5 million per year in the State from new agricultural income related to increased crop production on existing agricultural lands and increased agriculture-related spending. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into

increased salaries and wages for employees, or used in other ways.

In addition to this increase in business income, the six-county area and the State would receive substantial local sales tax revenues on increased expenses related to taxable sales. Under California tax regulations, these counties could receive sales tax revenues equal to 1 percent of total taxable sales spending.

This impact would be **less than significant and beneficial** under Alternative Plan 3. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 4 Implementing Alternative Plan 4 would be expected to generate an estimated $3.2 million in total personal income per year in the six-county area and $3.5 million in personal income per year in the State over the project's lifetime. In addition to this increase in personal income, implementing Alternative Plan 4 would be expected to generate approximately $10.2 million per year in the six-county area and $11.4 million per year in the State from new agricultural income related to increased crop production on existing agricultural lands and increased agriculture-related spending. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways.

In addition to this increase in business income, the six-county area and the State would receive substantial local sales tax revenues on increased expenses related to taxable sales. Under California tax regulations these counties could receive sales tax revenues equal to 1 percent of total taxable sales spending.

This impact would be **less than significant and beneficial** under Alternative Plan 4. Mitigation for this impact is not needed and thus not proposed.

Alternative Plan 5 Implementing Alternative Plan 5 would be expected to generate an estimated $5.2 million in total personal income per year in the six-county area and $5.7 million in personal income per year in the State over the project's lifetime. In addition to this increase in personal income, implementing Alternative Plan 4 would be expected to generate approximately $17.3 million per year in the six-county area and $19.4 million per year in the State from new agricultural income related to increased crop production on existing

agricultural lands and increased agriculture-related spending. Increased sales could be reinvested in existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways.

In addition to this increase in business income, the six-county area and the State would receive substantial local sales tax revenues on increased expenses related to taxable sales. Under California tax regulations, these counties could receive sales tax revenues equal to 1 percent of total taxable sales spending.

This impact would be **less than significant and beneficial** under Alternative Plan 5. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

No mitigation measures are required for Action Alternatives 1-5 because impact conclusions are either no impact, less than significant, or less than significant and beneficial within the primary study area and extended study area.

Chapter 24
Transportation, Circulation, and Infrastructure

This chapter describes the affected environment for transportation, circulation, and associated infrastructure, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The affected environment for transportation, circulation, and infrastructure includes discussion of existing traffic conditions and the roadways, bicycle facilities, public transit opportunities, railroads, water navigation opportunities, and airports primarily within the primary study area.

Primary Study Area

Roadways

Roadways in the primary study area are described as highways, arterials, collectors, and local roads, according to Fresno County and Madera County definitions (Fresno County 2000, Madera County 1995), and functional classifications are set by Caltrans and the FHWA. Key roadways in the primary study area that are likely to be affected by project-related traffic are listed below and shown in Figure 24-1.

SR 99 varies between a four-lane and six-lane highway and is located west of the primary study area. SR 99 joins Interstate 5 (I-5) south of the City of Bakersfield and continues north into Madera County. Freeway interchanges near the primary study area include those at SR 41, Herndon Avenue, and 4th Street.

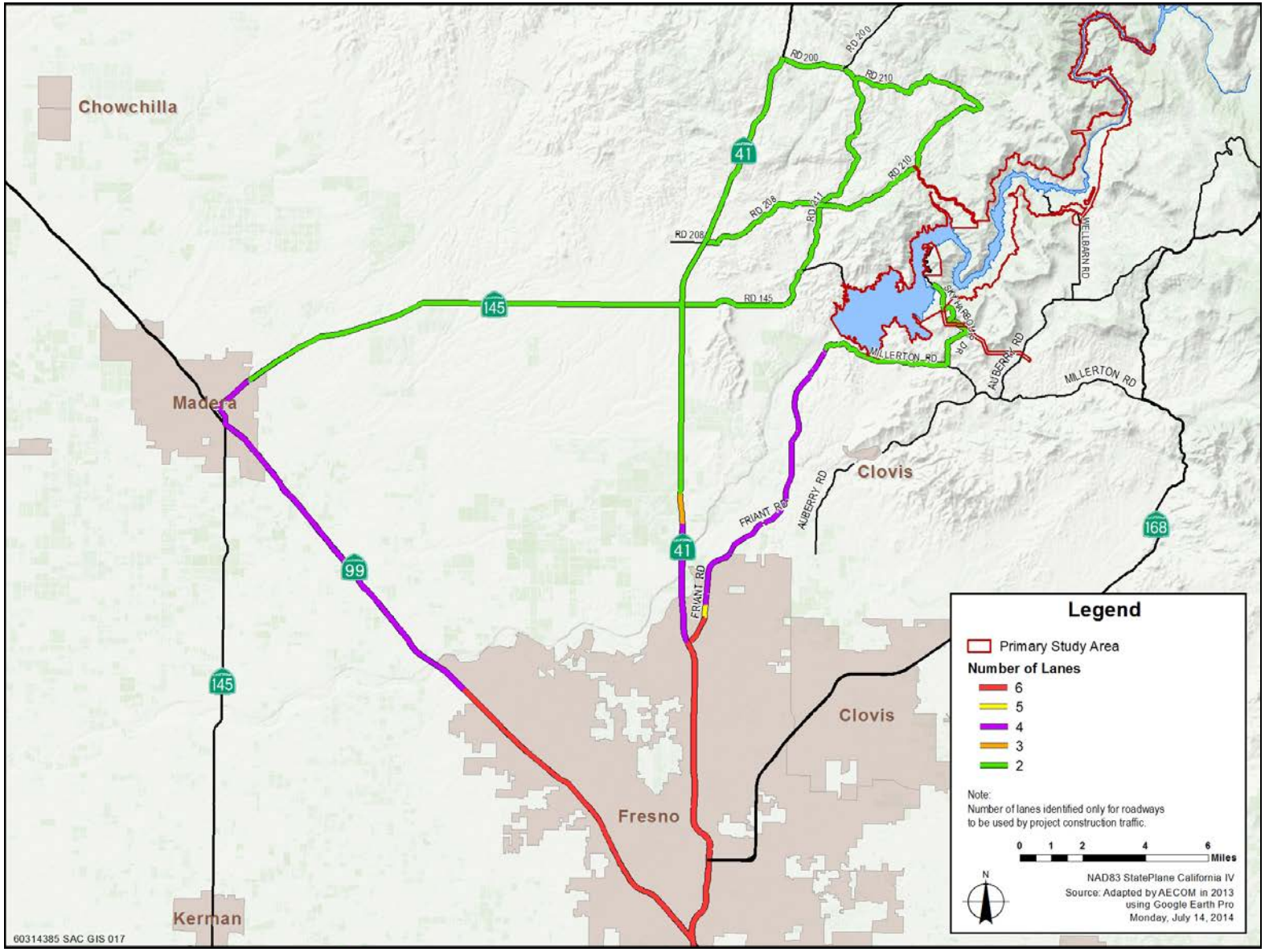

Figure 24-1. Construction Traffic Routes in the Vicinity of the Primary Study Area

SR 41 is a two-lane highway in Madera County and varies between a four- and six-lane highway in Fresno County. It is located west of the primary study area. SR 41 joins SR 99 within the City of Fresno and continues north into Madera County. Roadways that could be accessed from SR 41 toward the primary study area include Friant Road, Road 145, and North Fork Road.

SR 145 begins in Fresno County at I-5 and ends at SR 41 in Madera County. East of SR 41, SR 145 becomes Road 145. Road 145 leads to recreational facilities in the Millerton Lake SRA. SR 145 has two lanes with paved shoulders near SR 41.

Friant Road begins in the City of Fresno and continues north into Fresno County, connecting Millerton Road in the north to SR 41 in the south. Friant Road varies between two and six lanes wide. Within the City of Fresno, Friant Road is a divided roadway that varies between four and six lanes and has a curb, gutter, and sidewalk along both sides of the roadway. North of the City of Fresno, Friant Road has two lanes with soft shoulders between Copper Avenue and Willow Avenue. Between Willow Avenue and Lost Lake Road, it is a four-lane divided road, and between Lost Lake Road and North Fork Road, it is a two-lane rural roadway.

Millerton Road is located south of Millerton Lake and connects the community of Friant with Auberry Road. Millerton Road has two lanes with soft shoulders. The posted speed limit along the roadway is 50 miles per hour (mph). Parking is not allowed along the roadway. Millerton Road would provide access to the transmission line corridor proposed in the southwestern portion of the primary study area.

Sky Harbour Road begins at Millerton Road and continues north to the South Finegold picnic area within the Millerton Lake SRA. It has two lanes with no shoulders. Sky Harbour Road would provide access to the potential haul routes used during construction of the project.

Auberry Road begins in Fresno County at Copper Avenue and continues into the community of Auberry. It is generally a two-lane road with soft shoulders. The speed limit along the roadway is 50 mph, and parking is not allowed on either side of the roadway.

North Fork Road runs between SR 41 and Road 222 within Madera County. It is also known as Road 200. North Fork Road is a two-lane roadway with paved shoulders.

Road 206 extends between Road 145 and Friant Road. It leads to recreational facilities in the Millerton Lake SRA. Road 206 has two lanes with soft shoulders.

Road 208 extends between SR 145 and Road 210. It is also known as Wide Awake Ranch Road west of SR 41. Road 208 is a two-lane roadway with no shoulders.

Road 210 extends between Road 211 and North Fork Road. It has two lanes with no shoulders. Portions of Road 210, east of Road 216 are unpaved. Road 210 would provide access to the potential haul routes used during project construction.

Wellbarn Road extends from Auberry Road and provides access to Temperance Flat. It is a two-lane roadway with soft shoulders. Wellbarn Road would provide access to to new recreational features and to the relocated transmission line corridor proposed in the northeast portion of the primary study area.

Powerhouse Road extends from Auberry Road in Fresno County to Road 222 in Madera County. It connects Madera County with Fresno County via a bridge across Kerckhoff Lake. Powerhouse Road has two lanes with soft shoulders.

In addition, other roads within the primary study area are located on land owned by BLM. Some of these roads are designated as motorized routes, such as Smalley Road, and others are designated as nonmotorized routes. Specific roads located on lands managed by BLM are depicted in travel management maps prepared as part of ongoing BLM land management activities (BLM 2011). No special restrictions have been assigned to these roads as part of current resource management plans.

Operation of the roadway system is typically described in terms of level of service (LOS). LOS is a quantitative indication of the level of delay and congestion experienced by motorists. LOS is designated by the letters “A” through “F,” with “A” corresponding to the lowest level of congestion and “F” corresponding to the highest level of congestion.

The LOS methodology used to analyze the operational conditions of the roadway segments involves examining the

average daily traffic volumes as compared to the daily traffic volume capacity of the roadway facility. Capacity is the volume of traffic that the segment can accommodate in a day and remain at an acceptable LOS. The ratio of the volume to the capacity (volume/capacity) is an indicator of traffic conditions, speeds, and driver maneuverability.

Levels of service are typically defined as follows:

- **LOS A** represents free flow. Individual users are virtually unaffected by others in the traffic stream. The volume/capacity ratio is 0 to 0.60.

- **LOS B** represents stable flow, but the presence of other users in the traffic stream begins to be noticeable. The volume/capacity ratio is 0.61 to 0.70.

- **LOS C** represents stable flow, but the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The volume/capacity ratio is 0.71 to 0.80.

- **LOS D** represents high-density, stable flow. The volume/capacity ratio is 0.81 to 0.90.

- **LOS E** represents operating conditions at or near the capacity level. The volume/capacity ratio is 0.91 to 1.00.

- **LOS F** represents forced or breakdown flow. The volume/capacity ratio is greater than 1.00.

Table 24-1 summarizes the operational assessment of regional and local roadways. It includes only those roadway segments for which roadway volume count data were available.

All roadways currently operate acceptably based on Caltrans, Madera County, and Fresno County LOS standards.

Table 24-1. Existing Traffic Operations

Roadway	Location	LOS Standard	Average Daily Traffic Volume	Roadway Capacity	Volume-to-Capacity Ratio	Existing LOS
SR 99	North of Jenson Avenue	D	99,000	117,500	0.84	D
SR 41	South of Friant Road	D	62,000	117,500	0.53	A
	North of Friant Road	D	42,000	117,500	0.36	A
SR 145	West of SR 41	D	5,300	18,000	0.29	A
Millerton Road	North Fork Road to Brighton Crest Road	C	8,600	14,600	0.59	A
	Brighton Crest Road to Sky Harbor Road	C	8,600	14,600	0.59	A
	Sky Harbor Road to Table Mountain Road	C	7,400	14,600	0.51	A
	Table Mountain Road to Auberry Road	C	4,300	14,600	0.29	A
Friant Road	Willow Avenue to Lost Lake Road	C	9,600	30,900	0.31	A
	Lost Lake Road to North Fork Road	C	9,600	14,600	0.66	A
Road 206	Road 145 to Friant Road	D	3,460	13,000	0.27	A
North Fork Road	East of SR 41	D	2,970	13,000	0.23	A
Copper Avenue	West of Auberry Road	C	5,600	14,600	0.38	A
Auberry Road	East of Morgan Canyon Road	C	9,400	14,600	0.64	A
	Morgan Canyon Road to Wellbarn Road	C	4,000	14,600	0.27	A
	Wellbarn Road to Millerton Road E.	C	3,800	14,600	0.26	A
	Millerton Road E. to Millerton Road W.	C	4,400	14,600	0.30	A
	Millerton Road W. to Copper Avenue	C	5,400	14,600	0.37	A
Wellbarn Road	North of Auberry Road	C	162	5,000 [1]	0.03	A
Smalley Road	West of Powerhouse Road	C	210	5,000 [1]	0.04	A
Powerhouse Road	West of Auberry Road	C	480	5,000 [1]	0.10	A

Sources: ICF International 2010; Caltrans 2012a; Madera County Transportation Commission 2010, 2012

Notes:
[1] Roadway capacity for rural roadway is conservatively estimated to be 5,000 vehicles per day.

Key:
E = East
LOS = level of service
SR = State Route
W = West

Bicycle Facilities

Both the motorized and nonmotorized routes on BLM lands provide opportunities for bicyclists. Mountain biking is a targeted activity on the nonmotorized routes (BLM 2012).

Bikeways in the primary study area are classified as Class I (bike paths), Class II (bike lanes), and Class III (bike routes). Bikeway classifications are defined as follows:

- **Class I (Bike Paths)** – Facilities located in a separate right-of-way for the exclusive use of bicycles and pedestrians, with minimal cross flow by motor vehicles

- **Class II (Bike Lanes)** – Marked lanes on roadways for exclusive use by bicyclists

- **Class III (Bike Routes)** – Roadways in which bicyclists and motorists share the travel lane

The rural bikeways system map contained within the *2011 Regional Transportation Plan* (Council of Fresno County Governments 2010) depicts planned trails and bikeways within the primary study area, which include Friant Road, Millerton Road, and Auberry Road. The San Joaquin River Trail and the Lewis S. Eaton Trail are existing Class I bike paths within the primary study area.

Public Transit

Public transit in the vicinity of the primary study area is limited. Madera County operates the Madera County Connection, a general public, intercity fixed-route system. The Madera route operates Monday through Friday from 5:51 a.m. to 8:09 p.m. within eastern Madera County and has stops at Northfork, Bass Lake, Oakhurst, Coarsegold, Yosemite Lakes, Ranchos, and Children's Hospital (Madera County Transportation Commission 2014). Auberry Transit is a demand-responsive van service affiliated with Fresno County Rural Transit Agency that caters to patrons with disabilities. It offers rides on Tuesdays only by reservation from the Auberry area to the Fresno-Clovis metropolitan area. In addition, local intercommunity service is offered Monday through Friday between the foothill communities and Indian rancherias of Big Sandy and Cold Springs (Fresno County Rural Transit Agency 2013).

Railroads

Within Madera and Fresno counties, freight railroad service is provided by the Burlington Northern Santa Fe (BNSF), Union Pacific (UP), and San Joaquin Valley Railroads (Genessee & Wyoming Inc. 2014). Passenger rail service is provided by Amtrak and operates on the BNSF line with stops in the Cities of Madera and Fresno. The rail line closest to the primary study area boundary is approximately 10 miles away. Both BNSF and UP maintain railyards in the City of Fresno for shipping freight and materials.

Water Navigation

The Millerton Lake SRA provides for recreational activities along Millerton Lake. Water navigation is limited to recreational activities, such as boating and kayaking. There are six boat ramps at Millerton Lake: five located on the south side of the lake and one on the north.

Airports

Airports and airstrips in the region and their distance from the primary study area are listed in Table 24-2.

Table 24-2. Airports and Airstrips in the Vicinity of the Primary Study Area

Name	Approximate Distance and Direction from Primary Study Area
Arnold Ranch Airport	6 miles southwest
Fresno Yosemite International Airport	12 miles south
Sierra Skypark Airport	16 miles southwest
Fresno Chandler Executive Airport	18 miles south
Madera Municipal Airport	20 miles west
Sallaberry Ranch Airstrip	23 miles northwest

Extended Study Area

Many roadways cross the San Joaquin River in the extended study area between Friant Dam and the Merced River confluence. Many of these crossings include a bridge. However, Road 13 crosses the river without a bridge. Road 13 has two lanes with soft shoulders. North of the San Joaquin River, Road 13 is also known as Chowchilla Canal Road. South of the San Joaquin River, Road 13 is also known as San Mateo Road.

A number of local rural roads parallel portions of the section of the San Joaquin River extending from the Merced River to the Delta, located just north of SR 132 (Maze Road). Highways

and roads with bridge crossings of the San Joaquin River include Hills Ferry Road at the Merced River confluence in Merced County, and Crows Landing Road, West Main Avenue, West Grayson Road, and SR 132, all in Stanislaus County.

The Delta region is served by several major freeways. I-5 and SR 99 run north-south and I-80 and U.S. Highway 50 run east-west through Sacramento. Other highways extend from the cities of Sacramento and Stockton to small cities and towns in the region. Local roads in the Delta are often narrow and winding; during peak travel times, traffic in this area often includes slow, oversized farm equipment.

Portions of the CVP and SWP water service areas are crossed by several large interstate and State highways. U.S. Highway 101 extends from San Luis Obispo south to Los Angeles, and I-5 runs north-south through the Central Valley to Los Angeles and on to San Diego. An extensive, intricate freeway system serves the Los Angeles area. I-10 runs east from Los Angeles to Arizona, and I-8 runs east-west from San Diego to Arizona.

The lower San Joaquin River and Delta support recreational and private boating, which is discussed in Chapter 22, “Recreation.”

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on transportation, circulation, and infrastructure that could result from implementing any alternative. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on transportation, circulation, and infrastructure. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on transportation, circulation, and infrastructure and associated mitigation measures are summarized in Table 24-3.

Table 24-3. Summary of Impacts and Mitigation Measures for Transportation, Circulation, and Infrastructure

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
TRN-1: Reduce Level of Service for Designated Roads	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
TRN-2: Increase Traffic Hazards on Local Roads	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-2: Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
TRN-3: Interfere With Emergency Access	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-3: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 24-3. Summary of Impacts and Mitigation Measures for Transportation, Circulation, and Infrastructure (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation	Level of Significance After Mitigation
TRN-4: Decrease Performance of Bicycle or Pedestrian Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	TRN-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact
LTS = less than significant
PS = potentially significant

Methods and Assumptions

The primary impact of implementing any action alternative would be associated with introducing construction-related traffic to local roadways. In addition, long-term operation of any alternative would generate vehicular trips associated with operation of the new recreational facilities upstream from RM 274. Operation of any action alternative would not result in additional land use development and therefore would not lead to an increase in trips that would be related to such development. The number of vehicular trips associated with operation and maintenance activities of the project features would be small and less than significant and is not addressed in this discussion. Therefore, this analysis addresses construction- and recreation-related traffic impacts.

Available literature, including documents published by Federal, State, county, and city agencies that document traffic conditions and infrastructure, were reviewed for this analysis.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and action alternatives. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project and a reasonable range of alternatives, if required. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on transportation, circulation, and infrastructure would be significant under CEQA if project implementation would do any of the following:

- Conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into

account all modes of transportation, including mass transit and nonmotorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit

- Conflict with an applicable congestion management program, including but not limited to LOS standards and travel demand measures or other standards established by the county congestion management agency for designated roads or highways
- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks
- Substantially increase hazards because of a design feature or incompatible uses
- Result in inadequate emergency access or
- Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities

Topics Eliminated from Further Consideration

Implementing any action alternative would not affect existing air traffic patterns. The airport nearest to the primary study area is the Arnold Ranch Airport, which is located approximately 6 miles southwest of the site. Therefore, this issue is not discussed further in this analysis.

None of the action alternatives involve construction of a facility that would conflict with adopted policies, plans, or programs supporting alternative transportation. Therefore, this issue is not discussed further in this analysis.

Implementing any action alternative could affect traffic operations, transportation facilities, and associated infrastructure during the modification or construction of facilities. Impacts related to San Joaquin River water flow would occur only from Friant Dam to the Delta, and conveyance of these water supplies would not exceed channel capacity of the river or Delta waterways. Within minimal change to San Joaquin River and Delta instream flows, only minor increases in boating use would be expected to occur on

the San Joaquin River, and no changes would occur in boating use in the Delta; consequently, neither is discussed further. Thus, no impacts on current traffic operations, existing transportation facilities, or associated infrastructure would occur in these areas. Therefore, none of the action alternatives would impact transportation resources found in and adjacent to the San Joaquin River or Delta.

Changes to water conveyance to the CVP and SWP water service areas would not exceed historical maximum deliveries and would not result in a change in land use or cropping patterns, or result in other physical changes to the environment. The existing transportation network is sufficient to accommodate anticipated traffic increases associated with the implementation of the action alternatives, without substantially worsening traffic operations. Therefore, none of the action alternatives would impact transportation resources found in the CVP or SWP water service areas. The resources found in these areas are not discussed further in this analysis.

Direct and Indirect Effects

This section describes the environmental consequences of implementing any alternative. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact TRN-1: Reduce Level of Service for Designated Roads

Primary Study Area

No Action Alternative No project-related construction activities would occur and new recreation opportunities would not be introduced under the No Action Alternative. Although planned land uses in the vicinity of the primary study area call for continued agricultural and open space uses, some future population growth may occur near the primary study area, potentially increasing local traffic volumes along designated roads and highways in the primary study area. Planned land use is addressed in Chapter 17, “Land Use Planning and Agricultural Resources.” As shown in Table 24-1, local roadways in the primary study area operate at LOS A and have capacity sufficient to accommodate increased traffic volumes that could occur in association with planned population growth and land development.

There would be **no impact** under the No Action Alternative.

Action Alternatives Impacts on traffic volumes would be associated with constructing the project features, and with increased recreational visitation to Millerton Lake and the proposed Temperance Flat RM 274 Reservoir.

Implementing any action alternative would involve the construction and operation of numerous project features. The construction of these project features, which would occur over a period of 10 years, would increase the traffic volumes along designated haul routes within the primary study area during this period; however, construction traffic is considered temporary and would cease at the end of construction. Construction-related impacts on traffic would be limited to travel on existing freeways and local roadways to and from the project site and/or the staging yard related to the construction workers' commute, movement of equipment, and material delivery. Assessment of the impact that project construction traffic could have on local and regional roads included review of existing daily traffic volumes and consideration of both the addition of project construction traffic to existing daily traffic levels and the capacity of the road to handle the additional traffic.

The total number of daily trips related to the construction workers' commute, movement of equipment, and material delivery that would be added to area roadways over the entire 10-year construction period would range between 689,924 and 752,421 under Alternative Plan 4, varying according to the three quarries, batch plant, and haul road options. The total number of daily trips added to area roadways for Alternative Plans 1, 2, 3, or 5 over the entire 10-year construction period would be slightly less than for Alternative Plan 4; fewer trips would be required to construct the fixed LLIS associated with Alternative Plans 1, 2, 3, and 5 than the SLIS under Alternative 4. Because the number of truck trips under each action alternative is approximate, for a conservative analysis, construction trips associated with Alternative Plan 4 were used in this analysis to represent all five alternatives.

This analysis focuses on the number of trips added to area roadways during a single day when multiple phases of construction activities are occurring at the same time. Because construction days in August and September of the seventh year of construction would yield the most daily construction trips, August 26, of the seventh year, was chosen as a representative

day for the traffic impact analysis. Based on the anticipated construction phasing for that day, the maximum total number of vehicle trips from construction workers that would be added to area roadways would be 340 for quarry, batch plant, and haul road Options A and B, and 396 for Option C. The maximum number of truck trips attributable to material delivery and disposal that would be required on that single day would be 133 for each quarry, batch plant, and haul road option.

To properly assess the impacts of truck trips generated by the project, a heavy-vehicle factor known as a passenger car equivalent (PCE) value is applied to the project truck traffic. This heavy-vehicle factor is used to account for the additional space occupied, reduced speed, and reduced maneuverability associated with these vehicles as compared to standard automobiles. A PCE value of 2.0 was applied to the construction delivery/waste truck trip generation estimates as recommended by the *Highway Capacity Manual 2000* (Transportation Research Board 2000). Therefore, disposal of construction waste and material delivery would add approximately 266 passenger car equivalents to area roadways on the most congested construction day (i.e., most construction days will experience fewer added vehicles).

In total, all construction-related traffic would add approximately 606 total passenger car equivalents to area roadways on the most congested construction day for quarry, batch plant, and haul road Options A and B. For Option C, construction-related traffic would add approximately 662 total passenger car equivalents to area roadways on the most congested construction day. These daily trips would take place on designated haul routes located on the local and regional roadways discussed earlier.

Tables 24-4, 24-5, and 24-6 summarize LOS results when construction traffic is added to existing roadway traffic volumes. All roadways shown in Tables 24-4, 24-5, and 24-6 would continue to operate acceptably with the addition of project construction traffic according to Fresno County, Madera County, and Caltrans policies and standards.

Table 24-4. Effect of Project Construction Traffic Operations – Alternative Plan 4, Quarry, Batch Plant, and Haul Road Option A

Roadway[1]	Location	LOS Standard	Average Daily Traffic Volume	Daily Construc-tion Traffic Added	Existing + Daily Construction Traffic Volume	Roadway Capacity	Volume-to-Capacity Ratio	Existing LOS	Construc-tion-Related LOS
SR 99	North of Jenson Avenue	D	99,000	560	99,560	117,500	0.85	D	D
SR 41	South of Friant Road	D	62,000	495	62,495	117,500	0.53	A	A
	North of Friant Road	D	42,000	254	42,254	117,500	0.36	A	A
SR 145	West of SR 41	D	5,300	0	5,300	18,000	0.29	A	A
Millerton Road	North Fork Road to Brighton Crest Road	C	8,600	241	8,841	14,600	0.61	A	B
	Brighton Crest Road to Sky Harbor Road	C	8,600	241	8,841	14,600	0.61	A	B
	Sky Harbor Road to Table Mountain Road	C	7,400	0	7,400	14,600	0.51	A	A
	Table Mountain Road to Auberry Road	C	4,300	0	4,300	14,600	0.29	A	A
Friant Road	Willow Avenue to Lost Lake Road	C	9,600	241	9,841	30,900	0.32	A	A
	Lost Lake Road to North Fork Road	C	9,600	241	9,841	14,600	0.67	A	A
Road 206	Road 145 to Friant Road	D	3,460	0	3,460	13,000	0.27	A	A
North Fork Road	East of SR 41	D	2,970	254	3,224	13,000	0.25	A	A
Copper Avenue	West of Auberry Road	C	5,600	44	5,644	14,600	0.39	A	A
Auberry Road	East of Morgan Canyon Road	C	9,400	17	9,417	14,600	0.65	A	B
	Morgan Canyon Road to Wellbarn Road	C	4,000	56	4,056	14,600	0.28	A	A
	Wellbarn Road to Millerton Road E.	C	3,800	44	3,844	14,600	0.26	A	A
	Millerton Road E. to Millerton Road W.	C	4,400	44	4,444	14,600	0.30	A	A
	Millerton Road W. to Copper Avenue	C	5,400	44	5,444	14,600	0.37	A	A
Wellbarn Road	North of Auberry Road	C	162	92	254	5,000	0.05	A	A
Smalley Road	West of Powerhouse Road	C	210	19	229	5,000	0.05	A	A
Powerhouse Road	West of Auberry Road	C	480	19	499	5,000	0.10	A	A

Sources: ICF International 2010; Caltrans 2012a; Madera County Transportation Commission 2010, 2012

Note:

[1] Additional roadway segments, for which roadway volume count data were not available, are discussed qualitatively in the text

Key:

E = East

LOS = level of service

SR = State Route

W= West

Table 24-5. Effect of Project Construction Traffic Operations – Alternative Plan 4, Quarry, Batch Plant, and Haul Road Option B

Roadway[1]	Location	LOS Standard	Average Daily Traffic Volume	Daily Construction Traffic Added	Existing + Daily Construction Traffic Volume	Roadway Capacity	Volume-to-Capacity Ratio	Existing LOS	Construction-Related LOS
SR 99	North of Jenson Avenue	D	99,000	560	99,560	117,500	0.85	D	D
SR 41	South of Friant Road	D	62,000	495	62,495	117,500	0.53	A	A
	North of Friant Road	D	42,000	0	42,000	117,500	0.36	A	A
SR 145	West of SR 41	D	5,300	0	5,300	18,000	0.29	A	A
Millerton Road	North Fork Road to Brighton Crest Road	C	8,600	495	9,095	14,600	0.62	A	B
	Brighton Crest Road to Sky Harbor Road	C	8,600	495	9,095	14,600	0.62	A	B
	Sky Harbor Road to Table Mountain Road	C	7,400	0	7,400	14,600	0.51	A	A
	Table Mountain Road to Auberry Road	C	4,300	0	4,300	14,600	0.29	A	A
Friant Road	Willow Avenue to Lost Lake Road	C	9,600	495	10,095	30,900	0.33	A	A
	Lost Lake Road to North Fork Road	C	9,600	495	10,095	14,600	0.69	A	A
Road 206	Road 145 to Friant Road	D	3,460	0	3,460	13,000	0.27	A	A
North Fork Road	East of SR 41	D	2,970	0	2,970	13,000	0.23	A	A
Copper Avenue	West of Auberry Road	C	5,600	44	5,644	14,600	0.39	A	A
Auberry Road	East of Morgan Canyon Road	C	9,400	17	9,417	14,600	0.65	A	B
	Morgan Canyon Road to Wellbarn Road	C	4,000	56	4,056	14,600	0.28	A	A
	Wellbarn Road to Millerton Road E.	C	3,800	44	3,844	14,600	0.26	A	A
	Millerton Road E. to Millerton Road W.	C	4,400	44	4,444	14,600	0.30	A	A
	Millerton Road W. to Copper Avenue	C	5,400	44	5,444	14,600	0.37	A	A
Wellbarn Road	North of Auberry Road	C	162	92	254	5,000	0.05	A	A
Smalley Road	West of Powerhouse Road	C	210	19	229	5,000	0.05	A	A
Powerhouse Road	West of Auberry Road	C	480	19	499	5,000	0.10	A	A

Sources: ICF International 2010; Caltrans 2012a; Madera County Transportation Commission 2010, 2012

Note:

[1] Additional roadway segments, for which roadway volume count data were not available, are discussed qualitatively in the text

Key:

E = East
LOS = level of service
SR = State Route
W= West

Table 24-6. Effect of Project Construction Traffic Operations – Alternative Plan 4, Quarry, Batch Plant, and Haul Road Option C

Roadway[1]	Location	LOS Standard	Average Daily Traffic Volume	Daily Construction Traffic Added	Existing + Daily Construction Traffic Volume	Roadway Capacity	Volume-to-Capacity Ratio	Existing LOS	Construction-Related LOS
SR 99	North of Jenson Avenue	D	99,000	616	99,616	117,500	0.85	D	D
SR 41	South of Friant Road	D	62,000	551	62,551	117,500	0.53	A	A
	North of Friant Road	D	42,000	0	42,000	117,500	0.36	A	A
SR 145	West of SR 41	D	5,300	0	5,300	18,000	0.29	A	A
Millerton Road	North Fork Road to Brighton Crest Road	C	8,600	551	9,151	14,600	0.63	A	B
	Brighton Crest Road to Sky Harbor Road	C	8,600	551	9,151	14,600	0.63	A	B
	Sky Harbor Road to Table Mountain Road	C	7,400	0	7,400	14,600	0.51	A	A
	Table Mountain Road to Auberry Road	C	4,300	0	4,300	14,600	0.29	A	A
Friant Road	Willow Avenue to Lost Lake Road	C	9,600	551	10,151	30,900	0.33	A	A
	Lost Lake Road to North Fork Road	C	9,600	551	10,151	14,600	0.70	A	A
Road 206	Road 145 to Friant Road	D	3,460	0	3,460	13,000	0.27	A	A
North Fork Road	East of SR 41	D	2,970	0	2,970	13,000	0.23	A	A
Copper Avenue	West of Auberry Road	C	5,600	44	5,644	14,600	0.39	A	A
Auberry Road	East of Morgan Canyon Road	C	9,400	17	9,417	14,600	0.65	A	B
	Morgan Canyon Road to Wellbarn Road	C	4,000	56	4,056	14,600	0.28	A	A
	Wellbarn Road to Millerton Road E.	C	3,800	44	3,844	14,600	0.26	A	A
	Millerton Road E. to Millerton Road W.	C	4,400	44	4,444	14,600	0.30	A	A
	Millerton Road W. to Copper Avenue	C	5,400	44	5,444	14,600	0.37	A	A
Wellbarn Road	North of Auberry Road	C	162	92	254	5,000	0.05	A	A
Smalley Road	West of Powerhouse Road	C	210	19	229	5,000	0.05	A	A
Powerhouse Road	West of Auberry Road	C	480	19	499	5,000	0.10	A	A

Sources: ICF International 2010; Caltrans 2012a; Madera County Transportation Commission 2010, 2012

Note:

[1] Additional roadway segments, for which roadway volume count data were not available, are discussed qualitatively in the text

Key:

E = East

LOS = level of service

SR = State Route

W= West

Project construction traffic would also be added to the following roadway segments, not shown in Tables 24-4, 24-5, and 24-6:

- North Friant Road between SR 41 and Rice Road
- North Friant Road between Rice Road and Copper Avenue
- North Friant Road between Copper Avenue and Willow Avenue
- Auberry Road between Powerhouse Road and SJ&E Road
- Auberry Road between SJ&E Road and Morgan Canyon Road
- County Road 200
- County Road 210
- County Road 211

These roadway segments are not included in Tables 24-4, 24-5, and 24-6 because no existing daily roadway volumes were available for these roadway segments, precluding a quantitative analysis. However, based on the existing traffic volumes and levels of service on adjacent roadway segments along Friant Road, Auberry Road, SR 145, and Road 206 documented in Tables 24-4, 24-5, and 24-6, it is anticipated that the additional roadway segments identified above would have similar traffic volumes and levels of service. Additionally, based on the expected distribution of construction traffic and assignment of construction trips to the roadway network, it is anticipated that the roadway segments listed above would also operate at LOS A under existing conditions and all action alternatives.

It should also be noted that temporary lane closures may be implemented during project construction. However, the roadway segment LOS findings in Tables 24-4, 24-5, and 24-6 conclude that the existing roadway network has sufficient capacity to accommodate diverted vehicles associated with temporary roadway closures.

In the long term, increased recreational opportunities and visitors at Millerton Lake and the proposed Temperance Flat

RM 274 Reservoir would result in additional traffic on area roadways. After project construction, traffic would increase from water-oriented recreationists' use of the Temperance Flat RM 274 Reservoir and because of a sustained water surface elevation at Millerton Lake. The potential annual increase in visitation at Millerton Lake is estimated to be 34,000 visitors, and approximately 82,000–96,000 additional visitors at the proposed Temperance Flat RM 274 Reservoir would be expected. July is the peak month during the recreation season for visitation, and accounts for 28 percent of visitation for the year (Reclamation 2014). Thus, in July, an additional approximately 9,520 visitors and 26,880 visitors would undertake recreational activities at Millerton Lake and Temperance Flat RM 274 Reservoir, respectively.

Assuming that most visits occur during the 8 weekend days in July and that the average vehicle occupancy rate is five persons, an additional approximately 238 vehicle trips per day would be added to area roadways because of improved conditions at Millerton Lake. An additional 672 vehicle trips per day would be added to area roadways because of recreational activities at the new Temperance Flat RM 274 Reservoir. Visitors to both facilities would come primarily from the Fresno metropolitan area. Visitors accessing Millerton Lake would use area roadways such as Friant Road and Millerton Road, whereas visitors to the Temperance Flat RM 274 Reservoir would use local roadways such as Copper Avenue, Auberry Road, and Wellbarn Road.

Table 24-7 provides a summary of the LOS results when long-term recreational traffic from the action alternatives is added to existing roadway traffic volumes. As shown in Table 24-7, all roadways would continue to operate at an acceptable LOS with the addition of project-related recreational traffic according to Fresno County, Madera County, and Caltrans policies and standards.

This impact would be **less than significant** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Table 24-7. Effect of Project Recreational Traffic Operations on Local Roadways

Roadway	Location	LOS Standard	Average Daily Traffic Volume	Daily Recreational Traffic Added	Existing + Daily Recreational Traffic Volume	Roadway Capacity	Volume-to-Capacity Ratio	Existing LOS	Project-Related LOS
SR 99	North of Jenson Avenue	D	99,000	0	99,000	117,500	0.85	D	D
SR 41	South of Friant Road	D	62,000	0	62,000	117,500	0.53	A	A
SR 145	West of SR 41	D	5,300	0	5,300	18,000	0.29	A	A
Millerton Road	North Fork Road to Brighton Crest Road	C	8,600	238	9,076	14,600	0.62	A	B
	Brighton Crest Road to Sky Harbor Road	C	8,600	0	8,600	14,600	0.59	A	A
	Sky Harbor Road to Table Mountain Road	C	7,400	0	7,400	14,600	0.51	A	A
	Table Mountain Road to Auberry Road	C	4,300	0	4,300	14,600	0.29	A	A
Friant Road	Willow Avenue to Lost Lake Road	C	9,600	238	10,076	30,900	0.33	A	A
	Lost Lake Road to North Fork Road	C	9,600	238	10,076	14,600	0.69	A	B
Road 206	Road 145 to Friant Road	D	3,460	0	3,460	13,000	0.27	A	A
North Fork Road	East of SR 41	D	2,970	0	2,970	13,000	0.23	A	A
Auberry Road	East of Morgan Canyon Road	C	9,400	0	9,400	14,600	0.64	A	B
	Morgan Canyon Road to Wellbarn Road	C	4,000	0	4,000	14,600	0.27	A	A
	Wellbarn Road to Millerton Road E.	C	3,800	672	5,144	14,600	0.35	A	A
	Millerton Road E. to Millerton Road W.	C	4,400	672	5,744	14,600	0.39	A	A
	Millerton Road W. to Copper Avenue	C	5,400	672	6,744	14,600	0.46	A	A
Wellbarn Road	North of Auberry Road	C	162	448	610	5,000	0.12	A	A
Smalley Road	West of Powerhouse Road	C	210	224	434	5,000	0.09	A	A
Powerhouse Road	West of Auberry Road	C	480	224	704	5,000	0.14	A	A

Sources: ICF International 2010; Caltrans 2012a; Madera County Transportation Commission 2010, 2012
Key:
E = East
LOS = level of service
SR = State Route
W= West

Impact TRN-2: Increase Traffic Hazards on Local Roads

Primary Study Area

No Action Alternative No project-related construction or operations and maintenance activities would occur under the No Action Alternative. Although planned land uses in the vicinity of the primary study area call for continued agricultural and open space uses, some future population growth may occur near the primary study area, potentially increasing local traffic volumes along designated roads and highways in the primary study area. As presented in Table 24-1, local roadways in the primary study area operate at LOS A and have capacity sufficient to accommodate increased traffic volumes that could occur in association with foreseeable future population growth and land development. There would be no new hazards to local roadways created from a project design feature.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, the maneuvering of project construction vehicles and equipment among the general-purpose traffic on local roads, many of which are two-lane winding roads, could cause safety hazards. Trucks and heavy equipment used during project construction would interact with vehicle movements on existing roadways.

Traffic safety hazards could occur as a result of (1) the introduction of trucks and other construction-related vehicles that could affect the minimal stopping sight distance, (2) conflicts where road width is narrowed or a roadway is closed during construction activities, or (3) increased truck traffic in general (and trucks' slower speed and wider turning radii) during construction.

In addition to these potential hazards, the use of large trucks to transport equipment and material to and from the project site could affect road conditions on the haul routes by increasing the rate of road wear. The degree to which this impact would occur depends on the design (pavement type and thickness) and the existing condition of the road. Major arterials and collectors are designed to accommodate a mix of vehicle types, including heavy trucks. The potential impacts are expected to be negligible on those roads. However, lower capacity roadways could be substantially affected by construction equipment traveling on them.

Because of the temporary disruption to traffic flow, roadway wear and tear, the removal or reduction of lanes, minimal stopping sight distance, and the local increase in traffic congestion, drivers would potentially be presented with increased traffic hazards during construction.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact TRN-3: Interfere with Emergency Access

Primary Study Area
No Action Alternative No project-related construction activities would occur under the No Action Alternative. Although planned land uses in the vicinity of the primary study area call for continued agricultural and open space uses, some future population growth may occur near the primary study area, potentially increasing local traffic volumes along designated roads and highways in the primary study area. Thus, there is a potential for roadways to be obstructed and for response times for emergency vehicles to increase; however, because traffic movement would remain in a free-flowing condition, the ability of local agencies to respond to an emergency is not expected to be impaired.

There would be **no impact** under the No Action Alternative.

Action Alternatives Under the action alternatives, emergency access to the primary study area could be affected by construction of the project features. Construction-related traffic could delay emergency vehicles, and lane or road closures or roadway detours could obstruct the movement of emergency vehicles. Thus, construction activities could impair the ability of local agencies to respond to an emergency.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact TRN-4: Decrease Performance of Bicycle or Pedestrian Facilities

Primary Study Area
No Action Alternative No project-related construction activities would occur under the No Action Alternative. Although planned land uses in the vicinity of the primary study area call for continued agricultural and open space uses, some

future population growth may occur, potentially increasing local traffic volumes along designated roads and highways in the primary study area and potentially increasing the number of bicyclists and pedestrians. However, such increases are not expected to cause a decrease in the performance or safety of bicycle or pedestrian facilities.

There would be **no impact** under the No Action Alternative.

Action Alternatives Temporary lane closures may be needed when installing the transmission line, included in all action alternatives, where new power lines would cross over existing roads. The transmission line in the southwestern portion of the primary study area would cross Sky Harbour Road and Auberry Road. In addition, large construction vehicles traveling along local roadways to and from the project site could obstruct bicycle or pedestrian facilities. Temporary road closures or obstructions in the roadway could decrease the performance or safety of bicycle or pedestrian facilities.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Mitigation Measures

This section discusses the mitigation measure for the potentially significant impacts described in the Direct and Indirect Impacts section, as presented in Table 24-3.

No mitigation is required for Impact TRN-1 within the primary study area or for Impacts TRN-1 through TRN-4 within the extended study area because there would be no impact or the impact would be less than significant for all action alternatives. The following mitigation is required for Impacts TRN-2, TRN-3, and TRN-4 in the primary study area for all action alternatives.

Mitigation Measure TRN-2: Implement a Traffic Management Plan

Before construction begins, Reclamation, its contractors, and/or its construction partners will prepare and implement a traffic management plan (TMP) to reduce construction-related traffic impacts on the roadways at or near the work site, as well as to reduce potential traffic safety hazards and ensure adequate access for emergency responders. Reclamation and/or its contractor will coordinate development and implementation of this plan with jurisdictional agencies (e.g., Fresno County),

as appropriate. The TMP will achieve the following performance criteria:

- Maintain traffic flows on affected streets.
- Maintain the maximum amount of travel lane capacity during nonconstruction periods.
- Maintain alternating one-way traffic flow past construction zones.
- Minimize traffic disturbances adjacent to schools and commercial areas.
- Provide appropriate and safe detour routes if closure of a roadway is required.
- Minimize disruption of access to driveways and adjacent land uses.

Measures incorporated into the TMP to achieve the performance criteria may include but would not be limited to the following measures:

- Outline the use of multiple routes to and from construction locations to minimize the daily amount of traffic on individual roadways.
- Identify specific construction methods for affected streets and provide flagger control at sensitive sites to manage traffic control and flows. If visibility is poor at any intersection, highly visible signs will be posted at all approaches to the intersection, stating that construction activity is taking place and that drivers should be aware of construction vehicles traveling on roads in the area.
- Require construction workers to park personal vehicles at the approved staging area and take only the necessary vehicles to the work sites.
- Require that affected roadway rights-of-way be repaired and restored to their original condition after construction is completed.
- Identify detours for bicycles and pedestrians, where applicable, in all areas where pedestrian and bicycle

access and circulation during project construction cannot be safely maintained.

- Include plans to coordinate all construction activities with emergency service providers in the area. Emergency service providers will be notified of the timing, location, and duration of construction activities.
- Limit construction work zone widths.
- Coordinate with local schools and businesses regarding construction activities and transportation routes to identify specific time of day, season, or other circumstances that would warrant special management.
- Post notices of upcoming construction activities to allow motorists to select alternative routes ahead of time.
- Provide appropriate warning signage and lighting for construction zones.
- Identify detour routes, and install signage that warns of road closures and detour routes.

Implementing Mitigation Measure TRN-2 would reduce the potentially significant impact associated with traffic hazards (Impact TRN-2) to a **less-than-significant** level.

Mitigation Measure TRN-3: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan

Implementing Mitigation Measure TRN-3 would reduce the potentially significant impact associated with emergency access (Impact TRN-3) to a **less-than-significant** level.

Mitigation Measure TRN-4: Implement Mitigation Measure TRN-2, Implement a Traffic Management Plan

Implementing Mitigation Measure TRN-4 would reduce the potentially significant impact associated with the safety of alternative modes of transportation (Impact TRN-4) to a **less-than-significant** level.

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Chapter 25
Utilities and Service Systems

This chapter describes the affected environment for utilities and service systems, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. The discussion of utilities and service systems focuses primarily on the primary study area (area of project features, Temperance Flat Reservoir Area, and Millerton Lake downstream from RM 274). Many utilities and service systems are discussed to some degree in other chapters. Water supply systems and infrastructure (namely, the CVP and SWP facilities) are discussed in Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations." Hydropower facilities and power generation rates are discussed in Chapter 20, "Power and Energy." Impacts on law enforcement, fire protection, and emergency response providers are discussed in this chapter and also in Chapter 24, "Transportation, Circulation, and Infrastructure."

The potential for growth inducement impacts on utilities and service systems in the primary and extended study areas is addressed in Chapter 28, "Other NEPA and CEQA Considerations."

Affected Environment

The affected environment for utilities and service systems includes discussion of water supply, wastewater infrastructure, stormwater drainage infrastructure, solid waste management, electrical service and infrastructure, telecommunications, fire protection services, and law enforcement protection and emergency services.

No natural gas service is provided and no schools are located in the primary study area; therefore, these topics are not addressed further in this Draft EIS.

Primary Study Area

Water Supply

Area of Project Features The only water supply facilities in the area of project features are located in the vicinity of the transmission line corridor.

Community Service Area (CSA) 34 provides water supply and infrastructure in the vicinity of the transmission line corridor. CSA 34 will eventually provide water service to approximately 3,500 residential units in its 3,281-acre service area located north and south of Millerton Road, north of Auberry Road, and east of Sky Harbour Road. District infrastructure includes pumps that draw water from Millerton Lake, a raw water transmission line, a water treatment plant storage tank, and a distribution system (Fresno LAFCO 2007). CSA 34 has an agreement with the county to provide up to 1,390 acre-feet per year of the county's existing 3,000 acre-feet per year CVP contract entitlement. Currently, CSA 34 services 86 residential lots in the Brighton Crest subdivision located northwest of Millerton Road and north of Auberry Road (Fresno County 2011).

Temperance Flat Reservoir Area The San Joaquin River Gorge Area includes a single well installed in 2005 for the purpose of providing potable water for the BLM administrative site, educational facilities, and the public campgrounds. Water is tested quarterly and the system is operated and maintained by a partnership with the Sierra National Forest. Two 8,000 gallon water tanks were installed to handle the increasing recreational use demands and to provide water for fire suppression activities as needed.

Millerton Lake Downstream from RM 274 Both surface water from Millerton Lake and groundwater are used for the residential and commercial water supply in Millerton Lake downstream from RM 274. Many of the water systems are private and use private groundwater wells, although some are community-wide systems (Reclamation and State Parks 2010). The following discussion describes water supplies and infrastructure in the Millerton Lake SRA and in residential areas along the shoreline of Millerton Lake.

Millerton Lake State Recreation Area The water supply for the North and South Shore areas in the Millerton Lake SRA is regulated under contracts with Reclamation and Fresno County Waterworks Districts (WWD) 18 and 38. The agreement with

Reclamation limits water withdrawal from Millerton Lake to 21 acre-feet per year (Reclamation and State Parks 2010). This includes water used on the North Shore and water purchased from the WWD 18 on the South Shore.

Potable water supply for the South Shore area of the Millerton Lake SRA is purchased from WWD 18, which serves 425 acres located at the base of Friant Dam and Millerton Lake. Treated water from the WWD 18 is pumped to water storage tanks located near the Ranger Station in the Millerton Lake SRA, and potable water is then distributed to the recreation areas on the South Shore (Reclamation and State Parks 2010).

In the North Shore area of the Millerton Lake SRA, campgrounds and day-use areas are served by two water treatment plants, which are located at the Rocky Point and Meadows recreation areas. Under an agreement with Reclamation, water is pumped directly from the lake to these water treatment plants. After treatment, the water is pumped to two 55,000-gallon concrete storage tanks located at Mono (which stores water from Rocky Point treatment plant) and Meadows (which stores water from Meadows treatment plant) and distributed to the campsites and day-use areas. Potable water at South Finegold day-use area is purchased and delivered from WWD 38; however, water is piped directly to the day-use area rather than being stored in an intermediate tank (Reclamation and State Parks 2010).

Residential Uses Along the Millerton Lake Shoreline Water service is provided to residential subdivisions along the shoreline of Millerton Lake by WWD 38 in Fresno County and Maintenance District 1, Hidden Lakes, in Madera County. WWD 38 encompasses 154 acres and provides water supplies and infrastructure to the Sky Harbor subdivision (also known as the Millerton Lake Park Estates) located 6 miles north of the intersection of Sky Harbour Road and Millerton Road in Fresno County. The district owns one groundwater production well, a storage tank system, and fire suppression hydrants (Fresno LAFCO 2011). WWD 38 has 59 residential water service connections, and no new service connections have occurred in the past 2 years.

Maintenance District 1, Hidden Lakes, provides water supplies and infrastructure to the Hidden View Estates subdivision located on the northwestern shoreline of Millerton Lake in Madera County. Raw water is obtained from Millerton Lake through an underwater intake structure and pumped to a small

water treatment plant. Two pumps at the water treatment plant convey treated water to a 135,000-gallon storage tank. Treated water is then distributed by gravity flow to residences. The district currently has 46 water service connections (Madera County 2013).

Wastewater Infrastructure

Area of Project Features The only sewer service or infrastructure in the area of project features is located in the vicinity of the transmission line corridor.

CSA 34 collects, treats, and disposes of wastewater in the Brighton Crest residential subdivision located northwest of Millerton Road and north of Auberry Road in the vicinity of the proposed transmission line corridor. CSA 34 uses a pretreatment system at each residential lot before wastewater is conveyed to an on-site package wastewater treatment plant (Fresno LAFCO 2007).

Temperance Flat Reservoir Area No major sewer service or infrastructure is located in the Temperance Flat Reservoir Area.

Millerton Lake Downstream from RM 274 Most of the area surrounding Millerton Lake SRA is currently served by private septic systems rather than community wastewater treatment facilities. These systems consist of septic systems, vault toilets, and chemical toilets. Individual leach fields generally provide wastewater disposal; however, several septic systems on the south shore of Millerton Lake convey sewage to an evaporative pond on the south side of Millerton Road (Reclamation and State Parks 2010).

As discussed above, WWD 38 provides sewer service to the Sky Harbor subdivision (also known as the Millerton Lake Park Estates) in Fresno County. Forty-seven parcels are connected to the system (Fresno LAFCO 2011). In addition, the South Finegold day-use area is connected to WWD 38 sewer facilities (Reclamation and State Parks 2010). Treated wastewater is disposed of via extended aeration or spray fields.

Stormwater Drainage Infrastructure

Area of Project Features No stormwater drainage infrastructure has been installed in the area of project features. Surface water runoff from the area of project features directly enters the San Joaquin River in the reservoir pool of Millerton Lake.

Temperance Flat Reservoir Area No stormwater drainage infrastructure has been installed in the Temperance Flat Reservoir Area. Runoff in the Temperance Flat Reservoir Area directly enters the San Joaquin River, which flows into Millerton Lake. Numerous creeks and small local tributaries located in the reservoir area also flow into Millerton Lake.

Millerton Lake Downstream from RM 274 No stormwater drainage infrastructure has been installed in the Millerton Lake downstream from RM 274. Stormwater runoff in the Millerton Lake SRA and residential areas along the shoreline of the lake flows into Millerton Lake.

In the vicinity of the proposed transmission line corridor, stormwater runoff is discharged to seasonal drainages, which flow into Millerton Lake.

Solid Waste Management

Area of Project Features Solid waste services in the area of project features are managed by the Fresno County Resources Division and the Madera County Resource Management Agency. This discussion identifies the general characteristics of solid waste management and disposal facilities.

Fresno County Solid waste disposal in Fresno County is managed by the Fresno County Resources Division. The county owns and operates the American Avenue Landfill. The American Avenue Landfill is 440 acres in size, with a permitted disposal area of 361 acres. The landfill is classified as a Class II and Class III landfill and accepts asbestos and general residential, commercial, and industrial refuse for disposal, including municipal solid waste, construction and demolition debris, agricultural debris, and other nonhazardous designated debris.

The American Avenue Landfill is permitted to accept a maximum of 2,200 tons per day (tpd) of solid waste. The site has a permitted maximum capacity of approximately 3.3 million cubic yards and a remaining capacity of 2.9 million cubic yards. The closure date of the American Avenue Landfill is anticipated to be approximately 2031 (CalRecycle 2013a).

Fresno County's construction and demolition debris disposal ban ordinance (Title 8, Chapter 8.25) bans the disposal of construction and demolition debris at the American Avenue Landfill except for individual loads consisting of 3 cubic yards or less; mixed loads where construction and demolition debris

represents less than 20 percent of the load; disaster debris; loads without adequate local market infrastructure; and loads containing nonfriable asbestos that meet county guidelines. Contractors are required to dispose of construction-related debris at recycling facilities such as the Cedar Avenue Recycling/Transfer Station, Kroeker, Inc., the Rice Road Transfer Station (Allied Waste), Sunset Waste, Waste Management, and West Coast Waste in the City of Fresno; Mid-Valley Disposal, Inc., in Kerman; and Pena's Disposal, Inc., in Cutler (Fresno County 2007).

Madera County Solid waste disposal in Madera County is managed by the Madera County Resource Management Agency. The county owns and operates the Fairmead Sanitary Landfill. Fairmead Sanitary Landfill is a total of 121 acres in size, with a permitted disposal area of 77 acres. Fairmead Sanitary Landfill is classified as a Class III municipal solid waste landfill facility and is permitted to accept general residential, commercial, and industrial refuse for disposal, including municipal solid waste, construction and demolition debris, green materials, agricultural debris, and other nonhazardous designated debris (CalRecycle 2013b).

The Fairmead Sanitary Landfill is permitted to accept a maximum of 1,100 tpd of solid waste. The site has a permitted maximum capacity of approximately 9.4 million cubic yards and a remaining capacity of 5.5 million cubic yards. The closure date of the Fairmead Sanitary Landfill is anticipated to be approximately 2028 (CalRecycle 2013b).

The county does not have a postconstruction or residential recycling program but does remove some postconstruction wastes out of the waste stream in the Mammoth Material Recovery Facility.

Temperance Flat Reservoir Area No solid waste collection and disposal service is provided in the Temperance Flat Reservoir Area.

Millerton Lake Downstream from RM 274 Solid waste collection and disposal services provided to the Millerton Lake downstream from RM 274 area are provided by the Fresno County Resources Division and the Madera County Resource Management Agency. These service providers are identified in the preceding discussion.

Electrical Service and Infrastructure

Area of Project Features The only electrical service or infrastructure in the area of project features is located in the vicinity of the transmission line corridor. The PG&E provides electrical service to residences along Sky Harbour Road, Winchell Cove Road, Millerton Road, and Auberry Road; the Eagle Springs Golf Course and Country Club; and the Table Mountain Rancheria casino through underground electrical distribution lines.

Temperance Flat Reservoir Area In the Temperance Flat Reservoir Area, three 115-kV PG&E transmission lines connect the turbine generators at the Kerckhoff and Kerckhoff No. 2 Powerhouses to the regional and statewide electrical grid. East of the Temperance Flat Reservoir Area, a high-voltage PG&E electrical transmission corridor runs in a north to south direction.

Millerton Lake Downstream from RM 274 Electrical service to the Millerton Lake downstream from RM 274 area is provided by PG&E. Aboveground electrical transmission lines run from the electrical grid to electrical utility boxes in the recreation areas around Millerton Lake. The electrical transmission lines from the utility boxes connect to underground electrical distribution lines that serve the administrative buildings, maintenance facilities, and Millerton Courthouse in the South Shore area. Aboveground distribution lines provide electricity to water pumps that supply water to the recreation areas around Millerton Lake. Additional aboveground electrical distribution lines are located along the Millerton Lake boat ramp and Winchell Cove boat ramp (Reclamation and State Parks 2010).

PG&E provides electrical service to residences along Millerton Road, the Sky Harbor subdivision, and Hidden View Estates through underground transmission lines. Electricity to groundwater well pumps associated with residences along Millerton Road is provided by aboveground distribution lines.

Telecommunications

Area of Project Features No telephone service or infrastructure is located in the area of project features.

Temperance Flat Reservoir Area No telephone service or infrastructure is located in the Temperance Flat Reservoir Area.

Millerton Lake Downstream from RM 274 Ponderosa Telephone provides telephone service to the areas of Millerton Lake downstream from RM 274 and in the vicinity of the proposed transmission line corridor. All telephone lines are underground (Reclamation and State Parks 2010). A microwave tower is located near the South Shore administrative offices and provides communication related to dam operations with Reclamation.

Ponderosa Telephone is located in the community of O'Neals, approximately 25 miles northeast of the City of Fresno. The Ponderosa Telephone service area encompasses approximately 3,000 square miles from the southern California to the central California high Sierra and serves approximately 10,000 subscriber lines in rural communities. In the Millerton Lake area, Ponderosa Telephone serves the communities of O'Neil and North Fork in Madera County and Shaver Lake, Auberry, and Friant in Fresno County (Ponderosa Telephone 2011).

Fire Protection Services

Area of Project Features Fire protection services in the area of project features are provided by the Fresno County Fire Protection District and the Madera County Fire Department. The following discussion identifies the general characteristics of fire protection facilities and services.

Fresno County Fire Protection District The Fresno County Fire Protection District encompasses approximately 2,655 square miles and serves a population of more than 220,000 citizens. It is bounded on the east by the Sierra Nevada and on the west by the Coast Ranges. The district provides fire protection services to the communities of Calwa, Easton, Malaga, Del Rey, Caruthers, San Joaquin, Tranquility, Prather, Friant, Tollhouse, Wonder Valley, Cantua Creek, Three Rocks, Five Points, Centerville, Tivy Valley, and Sand Creek and to the Cities of San Joaquin, Parlier, Mendota, and Huron (Fresno County Fire Protection District 2013a).

The daily emergency response staffing for the entire fire district is 48 personnel. This staffing includes six battalion chiefs, 13 two or three-person engine companies, one three-person truck company, one medium rescue unit, water tenders, and patrols housed in 13 full-time fire stations. The district provides a full range of emergency responses services including, but not limited to, structural fire suppression, wildland fire suppression, response to hazardous materials incidents, Urban Search and Rescue, water rescue, vehicle

extrication, technical rescue, and basic life support medical services. The district emergency response personnel respond to over 14,700 incidents annually (Fresno County Fire Protection District 2013b).

The Fresno County Fire Protection District, in cooperation with the California Department of Forestry and Fire Protection (CAL FIRE), provides all risk emergency services from 13 district-staffed fire stations and five district-paid call firefighter stations. The nearest Fresno County Fire Protection District facility in the primary study area is the Millerton Station 72, located at 4091 East Millerton Road in Friant (Fresno County Fire Protection District 2013a, 2013b).

Madera County Fire Department The Madera County Fire Department provides fire protection services to unincorporated areas of Madera County. The district comprises 17 fire stations; a fleet of 56 apparatus and support vehicles; and a personnel staff that includes 32 career fire suppression personnel, 175 paid call firefighters, and seven support personnel (Madera County Fire Department 2013).

The department is administered, and career suppression personnel are provided, through a contract with CAL FIRE. The department assists with providing fire protection to the City of Madera through a mutual aid agreement and has a cooperative agreement with Central California Women's Facility for fire protection services in the north end of Madera County (Madera County Fire Department 2013).

Madera County fire stations are staffed 24 hours a day by a full-time career fire captain or fire apparatus engineer and are augmented by paid call firefighters. The nearest Madera County Fire Protection District facility in the primary study area is the O'Neals Volunteer Fire Station 17, located at Road 201 in O'Neals.

Temperance Flat Reservoir Area Fire protection services in the Temperance Flat Reservoir Area are provided by the Fresno County Fire Protection District and the Madera County Fire Department. These service providers are discussed above.

Millerton Lake Downstream from RM 274 Fire protection services in the Millerton Lake downstream from RM 274 area are provided by the Fresno County Fire Protection District and the Madera County Fire Department. These service providers are discussed above.

Law Enforcement Protection and Emergency Services

Area of Project Features Law enforcement and emergency services in the area of project features are provided by the Fresno County Sheriff's Department, the Madera County Sheriff's Department, and the California Highway Patrol (CHP). The following discussion identifies the general characteristics of law enforcement facilities and services.

Fresno County Sheriff's Department The Fresno County Sheriff's Department provides law enforcement service to the unincorporated areas of the county and to the Cities of Coalinga, Huron, San Joaquin, Kerman, Mendota, and Firebaugh. It is also the contract law enforcement agency for the Cities of San Joaquin and Mendota. Specialized members of the sheriff's department also serve on units, including the Air Support Unit, Off-Road Safety Team, Forensics Laboratory, Boating Enforcement Unit, SWAT Unit, Dive Team, and Search and Rescue Unit (Fresno County Sheriff's Department 2013).

The department provides service to four geographic areas and maintains four stations and two substations. The primary study area is located in Area 4, which includes the eastern mountain region of Fresno County and covers approximately 2,734 square miles. Area 4's northeastern substation located on Auberry Road is nearest to Millerton Lake. Currently, this substation is only used by deputies to meet and serve the public on an occasional basis due to ongoing budget restraints (Fresno County Sheriff's Department 2013).

In addition, the Fresno County Sheriff's Department coordinates emergency evacuation routes and programs for residents and businesses in Fresno County. Large-scale emergency services are handled by the department in cooperation with the FEMA; USFS; the State emergency response network run by the California Office of Emergency Services (OES); CAL FIRE; the CHP; and local fire departments, hospitals, and ambulance services.

Madera County Sheriff's Department Law enforcement in unincorporated areas of Madera County is provided by the Madera County Sheriff's Department. The department is divided into three distinct divisions (Valley Division, Mountain Division, and Administrative Division) Specialized members of the sheriff's department also serve on additional units, including the Agricultural Crimes Unit, Off-Highway Vehicle Unit, SWAT Team, Dive Team, and Search and Rescue Team

(Madera County Sheriff's Department 2013). The nearest facility to the primary study area is located at 14143 Road 28 in the City of Madera.

In addition, the Madera County Sheriff's Department is responsible for coordinating emergency services in Madera County. Area-wide emergency services are handled by the department in cooperation with FEMA; USFS; the State emergency response network run by the OES; CAL FIRE; the CHP; and local fire departments, hospitals, and ambulance services.

California Highway Patrol The CHP provides traffic regulation enforcement, emergency management, and vice assistance on State highways, all Federal interstate highways, and other major roadways in Fresno and Madera Counties. The primary study area is located in the Central Division, which oversees 275 miles of the Interstate 5 corridor and 224 miles of State Route 99 and provides ground and air support for emergencies in its division personnel (CHP 2013).

The CHP Central Division has 15 area offices, six resident posts, two commercial inspection facilities, 667 uniformed officers, and 226 nonuniformed personnel (CHP 2013).

Temperance Flat Reservoir Area Law enforcement protection and emergency services in the Temperance Flat Reservoir Area are provided by the Fresno County Sheriff's Department, the Madera County Sheriff's Department, and the CHP. These service providers are discussed above.

Millerton Lake Downstream from RM 274 Law enforcement protection and emergency services in the Millerton Lake downstream from RM 274 area are provided by the Fresno County Sheriff's Department, the Madera County Sheriff's Department, and the CHP. These service providers are discussed above.

Extended Study Area

In the portion of the extended study area extending from Friant Dam to the Delta, project operations would modify conditions in the San Joaquin River and improve water supply reliability to areas that receive CVP water supplies. These changes in operations would not result in an increased demand for utilities and service systems; therefore, the geographic regions in this portion of the extended study area are not discussed further in this section.

Effects on public parks and recreational facilities are discussed in Chapter 22, “Recreation.”

Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on utilities and service systems. It then discusses the impacts of the alternatives and proposes mitigation where appropriate. The potential impacts on utilities and service systems and associated mitigation measures are summarized in Table 25-1.

Table 25-1. Summary of Impacts and Mitigation Measures for Utilities and Service Systems

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
UTL-1: Result in Exceeding Wastewater Treatment Requirements or Requiring New or Expanded Wastewater Treatment Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	PS	UTL-1: Prepare and Implement a Wastewater Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
UTL-2: Result in Exceeding Stormwater Drainage Infrastructure Capacity or Requiring New or Expanded Stormwater Drainage Facilities	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 25-1. Summary of Impacts and Mitigation Measures for Utilities and Service Systems (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
UTL-3: Increase in Solid Waste Generation That Exceeds Permitted Landfill Capacity	Primary Study Area	No Action Alternative	LTS	None Required	LTS
		Alternative Plan 1	PS	UTL-3: Prepare and Implement a Solid Waste Management Plan	LTS
		Alternative Plan 2	PS		LTS
		Alternative Plan 3	PS		LTS
		Alternative Plan 4	PS		LTS
		Alternative Plan 5	PS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
UTL-4: Damage to or Disruption of Utility or Service Systems	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	LTS		LTS
		Alternative Plan 2	LTS		LTS
		Alternative Plan 3	LTS		LTS
		Alternative Plan 4	LTS		LTS
		Alternative Plan 5	LTS		LTS
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
LTS = less than significant
NI = no impact
PS = potentially significant

Methods and Assumptions

Evaluation of potential utility and services system impacts was based on a review of planning documents pertaining to the primary and extended study areas, including the BLM RMP, the Millerton Lake RMP, the general plans for Fresno and Madera counties, and other documents obtained for addressing other local service system purveyors.

Impacts are evaluated in relation to changes in levels of service or increased demand for utilities and service systems associated with the alternatives and the actions needed to provide the services that could potentially lead to physical environmental impacts. Impacts on water supply services to Millerton Lake and vicinity were evaluated based on construction and operational activities that would result from project implementation. A long-term impact would result if project operation would create a substantial disruption or reduction in the distribution or quantity of water supply.

Impacts on utilities and service systems were evaluated based on the duration and extent to which such services would be affected, as well as the ability of the service provider to continue to provide a level of service that could meet the needs of the public. The evaluation compares the duration of the impact with the service provided, taking into account the ability of the provider to maintain necessary services through alternative means.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and other alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project. A “[s]ignificant effect on the environment” means “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project” (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4[a]).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines and

consideration of the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on utilities and service systems would be significant if project implementation would do any of the following:

- Exceed water supplies available to service the project from existing entitlements and resources such that new or expanded entitlements would be needed
- Exceed wastewater treatment requirements of the Central Valley Water Board
- Exceed stormwater drainage infrastructure capacity such that new or expanded infrastructure would be needed
- Fail to comply with published local, State, or Federal statutes, regulations, or standards relating to solid waste
- Exceed permitted landfill capacity with waste generated by the project
- Degrade the level of service of a public utility or service system
- Require relocating utility infrastructure
- Require substantial improvements to the infrastructure or level of staffing of a utility or service system to maintain its existing level of service
- Require or result in the construction of new water treatment, wastewater treatment, or stormwater drainage facilities, or the expansion of such existing facilities, the construction of which could cause significant environmental impacts
- Disrupt utilities service to create a public health hazard or extended service disruption

Topics Eliminated from Further Discussion

As discussed at the beginning of this chapter, water supply and infrastructure are discussed in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations.” Also, no natural gas service is provided and no schools are located in the primary study area. Based on the review of proposed construction methods, described in Chapter 2, “Alternatives,” it

was determined that implementing any of the action alternatives would not affect existing water supply utilities or distribution system in the primary study area or vicinity. Therefore, these issues are not discussed further in this analysis.

Implementing any of the action alternatives would increase the amount of water available for delivery from Millerton Lake. Portions of this water would be conveyed directly to Friant Division water contractors or down the San Joaquin River and rediverted or exchanged for delivery to SOD CVP and SWP water contractors. About 30to 60 percent of the water made available for delivery would be conveyed directly to Friant Division water contractors, depending on the alternative plan implemented. From 28 TAF to 37 TAF would be discharged to the San Joaquin River for conveyance to SOD CVP and SWP water contractors. The conveyance of these water supplies would not exceed channel capacity of the San Joaquin River or Delta waterways. No change in existing use of adjacent lands would occur. Additional flows on the San Joaquin River and the Delta would not affect utilities and service systems because additional flows would not create additional wastewater, increase water demand, or require additional stormwater drainage facilities. Therefore, none of the five action alternatives would have an impact on utilities and service systems found in the San Joaquin River or Delta.

As described in Chapter 14, “Hydrology – Surface Water Supplies and Facilities Operations,” of this Draft EIS, implementing any of the action alternatives would increase water reliability for the Friant Division contractors and SOD CVP and SWP water contractors during most water-year types. A net change in systemwide water deliveries would average about 61to 76 TAF, depending on the alternative plan implemented. Up to 152 TAF would be delivered with less available for delivery in most years. The increased water supplies would equal less than 2 percent of total CVP and SWP average annual SOD water deliveries. The delivery of this additional water would not exceed historic maximum deliveries or existing contracted water volumes, result in placing new land into agricultural production, change cropping patterns, or result in other physical changes to the environment. Additional deliveries to the CVP and SWP service areas would not affect utilities and service systems (i.e., law enforcement, emergency response services, electrical service, and telecommunications) because the additional deliveries would not generate additional wastewater, increase water demand, or require additional

stormwater drainage facilities. Therefore, none of the five action alternatives would have an impact on this resource found in the CVP or SWP service areas. Utilities and service systems found in these areas are not discussed further in this analysis.

Direct and Indirect Impacts

This section describes the environmental consequences of implementing any of the alternatives.

Impact UTL-1: Result in Exceeding Wastewater Treatment Requirements or Requiring New or Expanded Wastewater Treatment Facilities

Primary Study Area

No Action Alternative Trends indicate that Fresno and Madera Counties will continue to grow, increasing the local population, housing, and demand for local utilities and services under the No Action Alternative. This growth would be consistent with the general plans of Fresno and Madera Counties. Existing regional wastewater treatment facilities have sufficient capacity to meet service area demands. Without construction of the new Temperance Flat RM 274 Reservoir, no new facilities would be constructed and no existing facilities would be expanded, altered, or demolished. No changes to wastewater treatment volumes or facilities would occur. Therefore, **no impact** would occur.

Action Alternatives As previously discussed in the "Affected Environment" section of this chapter, the only sewer service or infrastructure is located in the vicinity of the proposed transmission line corridor. This facility would not be affected with implementation of any of the action alternatives.

Construction of project facilities under the action alternatives, such as the dam, powerhouse and transmission facilities, and access roads would not result in the need for new or expanded wastewater facilities because these would be temporary construction projects and not development projects that would require stable, long-term services. Wastewater disposal services would be provided for construction crews where wastewater would be collected and transported to a suitable treatment facility for disposal.

Elements of the action alternatives that would generate wastewater during future operations and maintenance activities are the recreational facilities whose wastewater service

requirements would be met by pumping and hauling wastes to a suitable disposal facility. Increased recreational use of Millerton Lake and the proposed Temperance Flat RM 274 Reservoir could increase visitation to the two facilities by about 100,000 visitors annually. This increase in recreational use would generate wastewater that would need to be collected, conveyed, and treated at sufficient capacity to manage peak use periods. Under the action alternatives, relocated wastewater facilities associated with new or relocated facilities, such as recreational facilities and maintenance buildings, would be designed and constructed to satisfy the conditions of sewage disposal permits issued by Fresno County or Madera County, as applicable.

The action alternatives include a quarry where aggregate for construction can be excavated and hauled to the proposed onsite batch plant where the aggregate would be combined with various other ingredients to form the concrete used for construction of the dam and other project facilities.

Operation of the aggregate quarry and batch plant would generate wastewater from workers as well as wastewater from equipment operations. Given the distance from existing wastewater infrastructure, the quarry and batch plant would use on-site wastewater treatment and disposal. Wastewater discharge is regulated by the Regional Boards, and wastewater discharges would be required to comply with Regional Board requirements.

The increase in wastewater generated during construction and after construction by future recreational users might exceed the ability of existing community wastewater treatment facilities to adequately treat and dispose of wastewater or result in a direct discharge to surface waters in the primary study area.

This impact would be **potentially significant** impact. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact UTL-2: Result in Exceeding Stormwater Drainage Infrastructure Capacity or Requiring New or Expanded Stormwater Drainage Facilities

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities

would be expanded, altered, or demolished. No changes to stormwater drainage infrastructure or capacity would occur.

There would be **no impact** under the No Action Alternative.

Action Alternatives As discussed in the "Affected Environment," section, there is no stormwater drainage infrastructure in the primary study area, and stormwater runoff is discharged to seasonal drainages and flows into the San Joaquin River at Millerton Lake. No stormwater drainage infrastructure is proposed under any of the action alternatives.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed, and thus not proposed.

Impact UTL-3: Increase in Solid Waste Generation That Exceeds Permitted Landfill Capacity

Primary Study Area

No Action Alternative Trends indicate that Fresno and Madera Counties will continue to grow, increasing the local population, housing, and demand for local utilities and services under the No Action Alternative. This growth would be consistent with the general plans of Fresno and Madera Counties. Existing and future populations will produce solid wastes that will reduce available capacity of existing solid waste disposal facilities. The ongoing and future generation of solid waste would be consistent with growth expressed in the Fresno and Madera County General Plans. When existing solid waste landfill capacity is reached, additional facilities will need to be developed to receive the volume of wastes generated in the landfill service areas.

This impact would be **less than significant** under the No Action Alternative.

Action Alternatives Implementing any of the action alternatives would generate solid waste, including construction debris from the demolition of existing buildings and future dam construction activities, packaging for materials used in the construction of the Temperance Flat RM 274 Reservoir, and other wastes generated by construction crews, and consumptive use of materials during construction of the reservoir. If not disposed of on-site, waste debris from tree removal within the reservoir inundation area may also occur.

The potential volume of solid waste that might be generated during construction is not known. However, potentially, the

volume of waste could substantially reduce the capacity of existing solid waste disposal facilities that serve this source. A substantial reduction of solid waste disposal capacity could have repercussions on the ability and cost to the local community to manage the existing solid waste disposal system.

Engineering plans include a waste disposal site for the permanent disposal of waste rock from diversion tunnel and powerhouse excavation. This area is approximately 21.5 acres in size and is located approximately 3,200 feet southwest of the proposed powerhouse within the existing inundation area of Millerton Lake. Cofferdam materials would be disposed of within the quarry site or elsewhere within the primary study area. Trees removed from the inundation area might be burned or otherwise disposed of within the project site. Additional waste material generated during the construction process would be disposed of on the project site to the extent feasible.

Construction-related debris would be disposed of at waste or recycling facilities in Fresno, Kerman, or Cutler or hauled to other locations, depending on terms with the disposal contractor. Because the volume of solid waste that would be transported to these facilities is not known, the potential exists for the generation of solid waste to result in adverse impacts on the permitted capacity of existing recycling or landfill facilities.

This impact would be **potentially significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact UTL-4: Damage to or Disruption of Utility or Service Systems

Primary Study Area

No Action Alternative Under the No Action Alternative, no new facilities would be constructed, and no existing facilities would be expanded, altered, or demolished. There would be **no impact** under the No Action Alternative.

Action Alternatives The action alternatives include relocating PG&E electric power transmission lines. The transmission lines currently connect the generators at the Kerckhoff and Kerckhoff No. 2 powerhouses with the electrical grid. The existing transmission lines would be removed and reconstructed outside of the reservoir inundation area. New

transmission lines would also be installed to connect the new powerhouse located on Millerton Lake.

The disruption to electrical utilities related to the removal and relocation of the transmission lines would not affect individual utility customers because these existing transmission lines are primary power lines that interconnect the PG&E hydroelectric facilities with the grid and do not convey or deliver retail power supplies. The temporary disruption would result in a temporary reduction of available power to PG&E.

This impact would be **less than significant** under the action alternatives.

Mitigation Measures

This section discusses mitigation measures for each potentially significant impact described in the "Direct and Indirect Impacts" section, as presented in Table 25-1.

No mitigation is required for Impacts UTL-2 and UTL-4 within the primary study area or for Impacts UTL-1 through UTL-4 within the extended study area because there would be no impact or the impact would be less than significant for all action alternatives. Mitigation is required for Impacts UTL-1 and UTL-3 in the primary study area for all action alternatives.

Mitigation Measure UTL-1: Prepare and Implement a Wastewater Management Plan

As part of final design, Reclamation will prepare and implement a wastewater management plan to determine the volume and quality of wastewater to be generated on-site from both domestic and process sources. The plan shall define what portion of wastewater is to be disposed of on-site, the type of treatment to be employed, and the quality of wastewater that would be discharged to local surface water bodies. For wastewater to be treated off-site, the plan shall identify the volume and quality of wastewater to be collected, transported, and disposed of at a suitable existing wastewater treatment facility. A commitment to serve the needed wastewater transport and treatment services from the transporter and treatment facility owner shall be obtained before construction is initiated.

The plan shall also address the long-term collection, transportation, and disposal of wastewater to be generated by future recreation users. This portion of the plan shall be prepared in coordination with the California Department of

Parks and Recreation for services to be provided in the Millerton Lake SRA. Coordination with the established administrative authority over the Temperance Flat RM 274 Reservoir recreation facilities shall be completed as part of preparing and implementing this plan. The plan shall define how wastewater generated by recreational users would be collected, transported, and disposed of.

Implementing Mitigation Measure UTL-1 would reduce the potentially significant impact associated with wastewater treatment (Impact UTL-1) to a **less-than-significant** level.

Mitigation Measure UTL-3: Prepare and Implement a Solid Waste Management Plan

Before construction activities are initiated, Reclamation will prepare a solid waste management plan to:

- Provide an estimate of the volume of solid waste that would require off-site disposal
- Identify appropriate recycling or disposal facilities in accordance with applicable Federal, State, and local regulations regarding solid waste disposal
- Identify facilities with adequate capacity to accommodate the project's construction waste
- Obtain a commitment to serve the wastewater and solid water transport and disposal needs of the project from the appropriate transport and facility owner
- Identify the mechanism and responsibility to separate and manage solid waste suitable for on-site versus off-site disposal

Implementing Mitigation Measure UTL-3 would reduce the potentially significant impact associated with solid waste facilities (Impact UTL-3) to a **less-than-significant** level.

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Chapter 26
Visual Resources

This chapter describes the affected environment setting for visual resources, as well as potential environmental consequences and associated mitigation measures, as they pertain to implementing the alternatives. This chapter presents information on the primary study area (area of project features, the Temperance Flat Reservoir Area, and Millerton Lake below RM 274). It also discusses the extended study area (San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas).

Affected Environment

The project area for visual resources encompasses the landscapes directly affected by the action alternatives and the surrounding areas that would be within view of project facilities. This section includes discussion of the physical environment, viewsheds, and aesthetic qualities in the primary and extended study areas that could be affected by implementation of the alternatives.

Primary Study Area

Key Observation Points in Primary Study Area

Nine key observation points (KOP) were chosen to illustrate elements of the primary study area landscape that reflect the existing scenic quality (Figure 26-1). KOPs were chosen at key access points to represent the various types of users, emphasizing viewpoints that are typical of the different users.

Several KOPs were chosen from areas primarily traversed by recreational users, including motorists, hikers, campground users, and watercraft users. KOPs 1, 2, and 3 were chosen along the SJRG from local roadways leading to campgrounds and river access facilities. KOP 9 was taken directly from the San Joaquin River Trail and represents a typical hiker view of the SJRG. KOPs 5 and 6 were taken directly from recreational facilities along Millerton Lake, including the Meadows campground and boat dock as well as Millerton Courthouse.

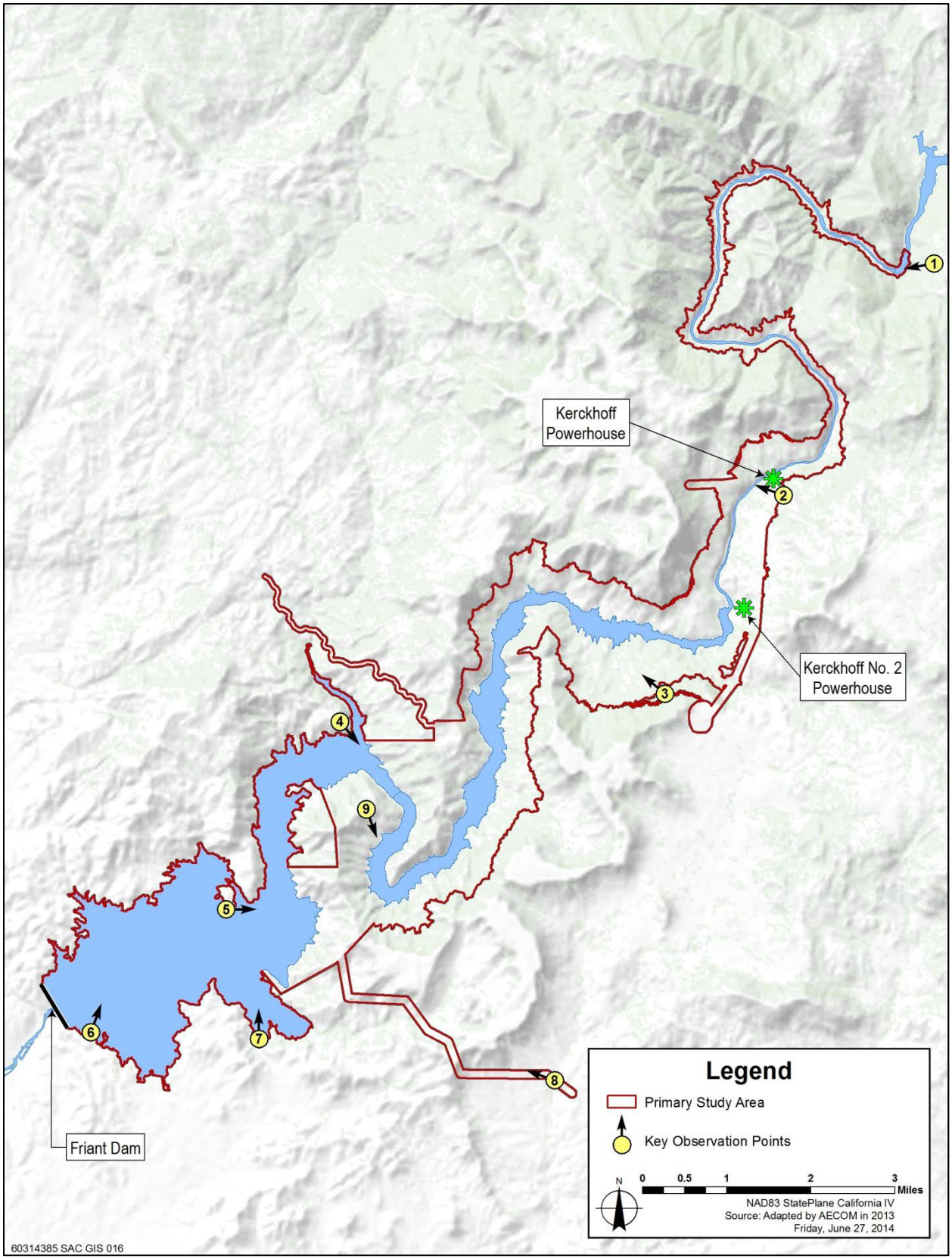

Figure 26-1. Key Observation Points in the Primary Study Area

Homeowners also make up a portion of viewers in the area, represented by KOPs 4 and 7. KOP 8 represents the views of other motorists, residents, and nearby workers near Auberry Road and other local roads.

The following discussion addresses each of these KOPs. Representative photographs from these KOPs are presented in Figure 26-2 through Figure 26-10.

KOP 1—View from Power House Road near Kerckhoff Dam KOP 1 provides a typical motorist view near Kerckhoff Dam. Views in this area also include rafters/kayakers or persons accessing the river (Figure 26-2). The landforms in this area are dominated by steep slopes leading to a narrow gorge with the flowing river. There are few visible human-made alterations in this area and no trails. Although this is a special area and is eligible and suitable to be designated as a wild/scenic river under the Wild and Scenic Rivers Act, few people have access to this area. Whitewater rafting and kayaking are possible only when releases from Kerckhoff Dam create instream flows sufficient to allow watercraft passage. The dominant landscape is the exposed river channel leading uphill to steep gorge slopes. Views are limited by dense vegetation and tree canopy and steep hill slopes.

KOP 2—View from Squaw Leap/Smalley Road This area is accessible to a variety of users, especially recreationists and campers, both on foot and in automobiles (Figure 26-3). Viewers at this location see several human-made facilities, including a transmission line and power house facilities. Nearby features include a footbridge to the west, paved roads, and a few buildings. Viewers looking west may see the footbridge crossing the San Joaquin River, and rolling foothill terrain covered with oak savanna and grasslands, leading to a rocky and steep gorge with the river below.

KOP 3—View from Wellbarn Road Viewers use this road to access the Temperance Flat Boat-in Campground (Figure 26-4). The views along portions of this roadway are limited or obstructed because of the density of oak trees. This area is composed of motorists and other users of Wellbarn Road, which provides access to hiking and camping on the San Joaquin River Trail. A few buildings are located at lower elevations along the river. Within the Millerton Lake inundation area, the maximum water elevation mark can be seen along the gorge bottom, contrasting with upland vegetation.

Figure 26-2. KOP 1: View from Power House Road near Kerckhoff Dam

Figure 26-3. KOP 2: View from Squaw Leap/Smalley Road

Figure 26-4. KOP 3: View from Wellbarn Road

KOP 4—View from Residences on Ralston Ridge Water dominates the view looking east from Ralston Ridge (Figure 26-5). The lake spreads out to the north and south of the vista and is bordered on all sides with rolling hillsides. The Millerton Lake maximum water level mark is an obvious visual feature showing contrast with upland vegetation. This and other views of Millerton Lake change in response to the volume of water stored in the reservoir. As the lake fills, the contrasting exposed ground surface diminishes until the lake is at maximum pool. This dynamic visual feature can also be seen from KOPs 5 to 7. Residents are the most common viewers in this area.

KOP 5—View from Campground and Boat Ramp
Campers, anglers, and others visiting the boat ramp near the Meadows campground area look east across the lake to foothills (Figure 26-6). To the northeast, there is a prominent excavation in the hillside where a road was established along the hillsides to a few homes overlooking the lake. The Millerton Lake maximum water level mark is also obvious from this KOP.

Figure 26-5. KOP 4: View from Residences on Ralston Ridge

Figure 26-6. KOP 5: View from Campground and Boat Ramp

KOP 6—View from Millerton Courthouse Viewers at the Millerton Courthouse stand on a rise overlooking a small marina to the north in the lake below (Figure 26-7). Beyond the marina, the lake dominates the view with rolling hillsides beyond. The view from this KOP primarily includes rock outcrops that are exposed during Millerton Lake drawdown. As the lake fills, these features are inundated.

KOP 7—View from Residences near Winchell Cove Road Views from Winchell Cove Road encompass views across the lake to the north (Figure 26-8). From this point, a viewer can make out some of the human-made elements in the distance mentioned in the description of KOP 5, including the boat ramp. To the northeast, a viewer can see a building across Winchell Bay. The exposed ground surface within the reservoir inundation zone clearly contrasts with the upland vegetation.

KOP 8—View from Auberry Road Motorists along Auberry Road can look northwest over a graded road cut to rolling hills with scattered oak trees in the distance (Figure 26-9). To the north and south, scattered rural residences can be seen in the grassy landscape.

KOP 9—View from Pincushion Mountain At one of the highest elevations in the area, hikers on the San Joaquin River Trail on Pincushion Mountain can see the bend in the lake where the lake begins to narrow and follow upstream to the SJRG (Figure 26-10). This KOP provides the perspective available to many public hikers of the area immediately upstream from RM 274.

San Joaquin River Gorge Special Recreation Management Area

BLM established a Visual Resource Management (VRM) system to evaluate scenic values and establish management objectives for those values. The inventory system involves identifying the visual resources of an area and assigning them to inventory classes using the BLM visual resource inventory process. BLM delineated the SJRG SRMA portion of the primary study area and designated it as Scenic Quality Rating Unit (SQRU) 01, as described in the *Draft Bakersfield Resource Management Plan & Environmental Impact Statement* (BLM 2011). SQRU 01 is rated as a Class II visual resource, indicating that the visual resource is of high value (Class I representing the highest value) (BLM 1986).

Figure 26-7. KOP 6: View from Millerton Courthouse

Figure 26-8. KOP 7: View from Residences near Winchell Cove Road

Figure 26-9. KOP 8: View from Residences near Winchell Cove Road

Figure 26-10. KOP 9: View from Residences near Winchell Cove Road

This rating takes into account the distance zone, sensitivity quality rating, and sensitivity level of the SQRU. SQRU 01 was classified as consistent with the Foreground-Middle

Ground Distance Zone, meaning that much of the primary study area is visible to viewers from various viewpoints or roadways. This area received a rating of moderate sensitivity because of its frequent recreational use, and it was designated a scenic quality rating of “A” in recognition of its high scenic quality.

In assigning the scenic quality rating, BLM considered several factors, including the sensitivity of viewers to the visual landscape and the qualities of the landscape being assessed. When considered together, they are used to assign a numeric scenic quality rating.

The following tables show the rating of sensitivity level for SQRU 01 (Table 26-1) and describe the visual elements (Table 26-2) contributing to the scenic quality rating as presented in Table 26-3. These ratings are subjective, depending on the reviewer; however, the BLM VRM system attempts to normalize potential bias by asking reviewers to consider the same types of elements in every analysis.

As shown in Table 26-1, SQRU 01 is considered to be moderately sensitive because it includes the SJRG as a special area that experiences a high amount of public use. Because users consist primarily of recreationists, they are considered to be moderately sensitive to landscape change. In addition, public interest in the area is considered moderate. Using these ratings, BLM has found SQRU 01 to have an overall rating of moderate sensitivity.

Table 26-1. Sensitivity Level Rating Sheet for SQRU 01

Type of User	Amount of Use	Public Interest	Adjacent Land Uses	Special Areas	Other Factors	Overall Rating	Explanation
Moderate	High	Moderate	Low	High	—	Moderate	Unit is frequently used for recreation.

Source: BLM 2011

Table 26-2 presents a description of the scenic qualities of SQRU 01 recognized by BLM. Although the descriptions apply to BLM-owned land in SJRG, the scenic quality elements described are similar to those of lands located farther

downstream that are not owned by BLM. The physiographic (or physical geography) similarity within the unit is the basis for why the entire area was designated as a single SQRU.

Table 26-2. Scenic Quality Field Inventory for SQRU 01

	Landform/Water	Vegetation	Structure
Form	Wide v-shaped gorge topped with rolling hills. River drains gorge bottom past boulders. Rock outcrops along gorge sides. Dramatic relief.	Relatively even and uniform on gorge sides and top. Absent close to river.	Flat and paved road. Two flat and paved parking lots. Boxy hydroelectric facility. Flat dirt trails.
Line	Diagonal, meandering gorge sides down to narrow river. Slightly diagonal hills atop gorge. Irregular path of gorge. Slightly diagonal and meandering river.	Diagonal along gorge sides and slightly diagonal atop gorge.	Winding road. Horizontal parking lots. Horizontal and vertical hydroelectric facility. Winding trails.
Color	Tan, gray, and rust rock outcrop. Dark blue and white water.	Light green to dark green. Seasonal variations.	Gray road and parking lots. Tan hydroelectric facility. Tan trails.
Texture	Moderately smooth gorge sides and top. Smooth rock along gorge bottom. Moderately smooth river.	Moderately smooth.	Smooth road and parking lots. Stiff hydroelectric facility. Smooth trails.

Source: BLM 2011

Table 26-3 presents ratings (ranging from 0 to 5, where 0 represents a weak contribution and 5 represents a strong contribution) of the scenic quality elements identified in Table 26-2, indicating the level at which they contribute to the overall scenic quality. As rated, the SJRG landform is distinctive and has the highest rating, and existing cultural modifications are not considered to be contributing factors. The other scenic quality elements that contribute to the overall rating are vegetative cover, presence of water, color of the landscape, and the relative scarcity or uniqueness of the landscape. An SQRU that receives a rating higher than 19 under the BLM VRM system is considered to have high scenic value.

Table 26-3. Scenic Quality Rating Summary for SQRU 01

Landform	Vegetation	Water	Color	Adjacent Scenery	Scarcity	Cultural Modifications	Total Score	Scenic Quality Rating	Explanation
5	4	3	4	3	4	0	23	A	Unit has varying topography, vegetation, and a river. The gorge offers dramatic views. There is minimal disturbance.

Source: BLM 2011

The BLM inventory class provides a basis for considering visual values in the resource management planning process. Visual resource management classes are established through the RMP process for all BLM-administered lands. During the RMP process, the class boundaries are adjusted as necessary to reflect the resource allocation decisions made in the RMP.

The BLM inventory classes have established baseline objectives where the Class I objective is most stringent and Class IV objective accommodates require major landscape modifications. SQRU 01, as established in the visual resources inventory, is assigned VRI Class II, corresponding to the Class II Objective (BLM 2011) as described below:

- **Class I Objective** preserves the character of the landscape. It provides for natural ecological changes but does not preclude limited management activity. The level of change to the characteristic landscape should be low and must not attract attention.

- **Class II Objective** retains the character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

- **Class III Objective** partially retains the character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view

of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

- **Class IV Objective** provides for management activities that require major modifications of the landscape's character. This level of change can be high. The management activities may dominate the view and be the major focus of viewer attention; however, every attempt should be made to minimize their impact through careful location, minimal disturbance, and repetition of the basic elements.

BLM further establishes its visual resource management objectives for the SJRG SRMA within three resource management zones (RMZ), including the Pa'San RMZ, Wu Ki'Oh RMZ, and Tahoot RMZ. In its analysis of recreation and visitor services, BLM identifies the implementation planning framework for the RMZs including the administration of visual resource management. As such, the SJRG SRMA is managed at multiple objective levels, with Pa'San RMZ at VRM Class I, Wu Ku'Oh RMZ at Class II, and Tahoot at Class IV.

Through the resource management planning process, BLM completed a preliminary suitability determination and suggested that the portion of San Joaquin River from Kerckhoff Dam to Kerckhoff Powerhouse is eligible and suitable for inclusion in the NWSRS. Eligibility is based on whether a river segment is both free flowing and possesses at least one ORV, which could be a scenic, recreational, geologic, fish, wildlife, cultural, historic, or other value. In the case of this segment of the San Joaquin River, the scenic quality rating of "A" contributed to the finding that the segment is eligible to be included in the NWSRS. Other qualities contributing to the segment's eligibility included wildlife and cultural ORVs.

Extended Study Area

Visual resources are described below for the San Joaquin River from Friant Dam to the confluence with the Merced River, the San Joaquin River from the Merced River to the Delta, the Delta, and the CVP and SWP water service areas. Overall visual quality was assessed qualitatively with landscapes described as high, moderate, or low, using the following qualitative terms:

- **Vividness** describes the presence of distinctive landscape features, such as topographic relief, geologic

formations, color, or patterns that combine to form a striking or memorable visual pattern.

- **Intactness** describes the integrity of a landscape and the degree to which it is free from incongruous or out-of-place features that detract from the visual pattern.

- **Unity** describes the appearance of the landscape as a whole and the degree to which the visual elements maintain a coherent visual pattern.

San Joaquin River from Friant Dam to the Merced River

Visual resources along the San Joaquin River from Friant Dam to the Merced River are described in the following sections. This discussion is based on information presented in the SJRRP PEIS/R (SJRRP 2012).

The portion of the extended study area extending from Friant Dam to the confluence with the Merced River is now subject to changed instream flows associated with implementing the SJRRP. Restoration Flows could modify environmental conditions in the river channel and bypasses. These instream flows would not result in a physical change in this river reach that would substantially affect visual resources because, as concluded in the SJRRP PEIS/R (SJRRP 2012), the increase in flow volumes and water velocities between Friant Dam and the confluence with the Merced River would alter the distribution of soil deposits and vegetative composition found in portions of the affected reaches, which could enhance the scenic value of this portion of the river and adjacent lands by increasing visual diversity and complexity. The effect from release of Interim Flows in this portion of the extended study area is not discussed further in this section. The visual context of Reaches 1 through 5 of the San Joaquin River from Friant Dam to the Merced River are described below. A map of the river reaches and flood bypass system is provided in Chapter 5, "Biological Resources – Fisheries and Aquatic Resources."

Reach 1 Observers in or adjacent to the river in Reach 1 see a river channel and adjacent vegetated banks and bluffs with views having moderate vividness; however, the concrete structures of Friant Dam and associated diversion structures and canals, buildings, parking lots, and a fish hatchery visible above the river at the upper end of Reach 1A reduce the intactness and unity of views. Downstream from Friant Dam, views are of naturally vegetated open space interspersed with golf courses, instream and offstream gravel operations,

orchards, and row crops. Intactness of the views ranges from low in areas of gravel mining operations to moderate in areas where the riparian corridor and adjacent lands are relatively undisturbed. Unity of the views ranges from low in areas where adjacent land uses produce sharp visual contrasts (disturbed lands adjacent to natural areas) to moderate where land uses have softer edges (riparian corridor adjacent to natural lands or parklands). The overall visual quality in Reach 1A is low to moderate.

Observers adjacent to the river in Reach 1B experience views with low vividness because of the lack of distinctive landscape features and the disturbed riparian corridor. Intactness of the views is somewhat reduced by the limited riparian vegetation coverage, disturbance resulting from gravel mining operations, and the contrasting managed agricultural landscape; intactness is low to moderate. Overall unity is low to moderate. The overall visual quality in Reach 1B is low.

Reach 2 The topography in Reach 2 is characterized by a sandy, meandering channel and adjacent land cover is primarily agricultural. Observers adjacent to the river in Reach 2 experience views with low vividness because this reach lacks distinctive landscape features, including Mendota Pool. Features of Mendota Pool include several pumps and canals to divert flows for meeting demands. Other features of this reach include the San Mateo Road crossing and the Chowchilla Bypass Bifurcation Structure, which is a major intrusive element. Therefore, intactness of this reach is considered low to moderate. Unity is low to moderate also because of intrusion of artificial structures and the contrast between the managed agricultural landscape and the meandering, sparsely vegetated stream channel in this reach. The overall visual quality in this reach is low.

Reach 3 The topography in Reach 3 is characterized by a sandy, meandering channel. This reach conveys perennial flows of Delta water released from the Mendota Pool to Sack Dam, where flows are diverted to the Arroyo Canal. The channel meanders approximately 23 miles through a predominantly agricultural area except where the city of Firebaugh borders the river’s west bank for 3 miles. One bridge crosses the river in this reach. A narrow, nearly continuous band of riparian vegetation consisting primarily of cottonwood riparian forest is present on at least one side of the channel, and diversion structures are common in this reach.

Observers adjacent to the river in Reach 3 experience views with low vividness because of a lack of distinctive landscape features. Intactness of the views is low to moderate because of the presence of dams, diversion structures, and urban development, which intrude on views of the river corridor and adjacent agricultural landscape. Overall, the unity of the views is low in the vicinity of the diversion structures and moderate where the distinctive riparian corridor meanders through the more managed agricultural landscape. The overall visual quality in this reach is moderate.

Reach 4 Observers adjacent to the river in Reach 4A experience views with low vividness because of the lack of distinctive landscape features. Intactness of the views in this reach is low because of the presence of intruding artificial structures and the degraded condition of the riparian corridor. Unity is low because of the sharp contrast between the riparian area and the adjacent managed agricultural landscape. The overall visual quality in this subreach is low.

Observers adjacent to the river in Reach 4B1 experience views with low vividness because of the lack of distinctive landscape features. Intactness of the views is generally low (along the altered riparian area) to moderate (across adjoining agricultural land cover). Unity is low because of the sharp contrast between the vegetation-choked river channel and the adjacent managed agricultural landscape. The overall visual quality in this subreach is low.

Observers adjacent to the river in Reach 4B2 experience views with moderate vividness because of the wider floodplain with surrounding natural vegetation, and intactness is moderate because of the limited number of artificial structures that intrude on the views. Unity is moderate also because of the wider riparian corridor and adjacent areas of natural habitat. The overall visual quality in this subreach is moderate.

Reach 5 Observers adjacent to the river in Reach 5 experience views with moderate vividness because of the views of the wider floodplain, with meandering riparian corridors and expanses of surrounding natural vegetation. Intactness of the views is moderate because of the uninterrupted expanses of natural habitat and the limited number of artificial structures that intrude on the views. Unity of the views is moderate because the natural features of the landscape lack abrupt contrasts or changes. The overall visual quality in this reach is moderate.

San Joaquin River from the Merced River to the Delta

The Merced River joins the San Joaquin River in Mariposa County and continues north through Stanislaus and San Joaquin counties into the Delta. Among the most notable visual resources is the San Joaquin River NWR, which is composed of 7,000 acres of habitat, including riparian woodland, wetland, and grassland. Most of the river flows through quiet agricultural bottomlands and avoids most cities and urban areas. For this reason, most viewers are motorists traveling along highway crossings or local roads.

Observers adjacent to the San Joaquin River in this portion of the study area experience views with moderate vividness because of the wider floodplain with its meandering riparian corridors. Intactness of the views is moderate because of the limited number of artificial structures that intrude on the views. Unity of the views is moderate because the natural features of the landscape lack abrupt contrasts or changes. The overall visual quality in this reach is moderate.

Delta

The Delta landscape can be divided into four main landscape categories: agricultural areas, waterways, developed areas, and undeveloped open space. Each of these categories has distinctive visual and scenic attributes that contribute to the dominant visual character of the Delta landscape. This area hosts a variety of land cover and vegetative communities: open water, riparian forest, wetlands and aquatic vegetation, agriculture, grasslands, and urban development. Within each category, specialized dominant features in the visual landscape combine to define more distinct landscape types that share similar visual elements.

The Delta consists of largely undeveloped islands and low-lying tracts of land surrounded by waterways and levees. In addition to the natural waterways, the area contains a variety of water development facilities, such as levees, aqueducts, and intake structures. The construction of levees in the late 1800s and early 1900s resulted in the conversion of wetlands, riparian corridors, and open water to agricultural lands characterized by elevated and vegetated levees surrounding low-lying areas of farmland.

Lands contributing to the visual resources in the Delta include SRAs, wildlife refuges and preserves, marinas and shoreline recreational facilities, the Diablo Range, and the Vaca Mountains. Although the Delta is largely an agricultural area,

human-made structures of aesthetic value, such as bridges and historical homes and town sites, are located along the roadways.

SR 160, a two-lane, State-designated scenic highway, travels primarily along the tops of levees through the central and northern areas of the Delta and provides elevated views of various land uses and landscape types.

The attributes of the Delta landscape change over the course of a year in response to seasonal changes and weather. Vegetation, agricultural crops, and land use patterns vary according to the time of year and farming activities. For instance, a particular field may be fallow through winter and early spring but exhibit substantial vegetative growth through summer. Often stubble or crop remnant can be seen in fall after harvest.

Buildings associated with farms and duck clubs in areas that receive flooding are commonly raised structures that can withstand flooding. These structures are scattered throughout the Delta. The visual character of the Delta landscape is an appealing and sharp contrast against the Sacramento metropolitan region. Views are moderately high in vividness. The artificial intrusions associated with development, agriculture, and infrastructure are low but present, resulting in moderate intactness. The visual quality of the area is also moderately high.

CVP and SWP Water Service Areas

The CVP and SWP deliver water supplies to a variety of agricultural and municipal/industrial land uses south of the Delta. Agricultural lands in the western and middle San Joaquin Valley occupy typically flat open space with views extending to distant land features. Because of the extensive agricultural production, landscapes are often visually limited with visual variety provided by changes in color associated with agricultural crop types.

The Friant Division water service area is located in the eastern portion of the San Joaquin Valley, near the interface between the valley floor and adjacent foothills. In portions of this water service area, the landscape provides greater visual variety because of the more complex visual features influenced by topography, presence of natural vegetation, agricultural crop type, and presence of upland areas to the east.

Municipal and industrial land uses vary widely in appearance, topography, and landscape features. Urban areas are dominated by human-made features consisting of buildings, residences, transportation systems, and other infrastructure. Rural and less urbanized landscapes are composed of varying degrees of human-made features and natural vegetation and cover. These landscapes also vary depending on the proximity of topographic relief, whether the landscapes are located in inland areas or near the coast, whether vegetative canopies are present.

Environmental Consequences and Mitigation Measures

This section describes potential environmental consequences on visual resources that could result from implementing any of the alternatives. It also describes the methods of environmental evaluation, assumptions, and specific criteria that were used to determine the significance of impacts on visual resources. It then discusses the potential impacts and proposes mitigation where appropriate. The potential impacts on visual resources and associated mitigation measures are summarized in Table 26-4.

Methods and Assumptions

Analysis of potential impacts on visual resources is based on guidance developed by BLM. All assessments are qualitative, evaluating potential impacts of the alternatives on the viewshed in relation to local visual character.

Table 26-4. Summary of Impacts and Mitigation Measures for Visual Resources

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
VIS-1: Consistency With Applicable Plans	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	None Available	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
VIS-2: Degradation and/or Obstruction of a Scenic View	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	VIS-2: Minimize Construction-Related Visual Impact on Scenic Views from KOPs	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Table 26-4. Summary of Impacts and Mitigation Measures for Visual Resources (contd.)

Impact	Study Area	Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance After Mitigation
VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	S	VIS-3: Minimize or Avoid Visual Impact of Daytime Glare and Nighttime Lighting	SU
		Alternative Plan 2	S		SU
		Alternative Plan 3	S		SU
		Alternative Plan 4	S		SU
		Alternative Plan 5	S		SU
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
VIS-4: Impacts on a Designated Scenic Highway	Primary Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI
	Extended Study Area	No Action Alternative	NI	None Required	NI
		Alternative Plan 1	NI		NI
		Alternative Plan 2	NI		NI
		Alternative Plan 3	NI		NI
		Alternative Plan 4	NI		NI
		Alternative Plan 5	NI		NI

Key:
NI = no impact
S = significant
SU = significant and unavoidable

A field assessment of the primary study area was conducted to identify areas of visual sensitivity and scenic resources and to assess the character and quality of the visual resources present. Because no changes are anticipated to the aesthetic values of the extended study area, no field assessment was performed. The following analysis emphasizes the potential relationship between the alternatives and sensitive viewers associated with recreational areas, roadways, and commercial and residential development. KOPs were identified, and photograph points were established. The assessment of visual quality presented in this Draft EIS is based on the quality of the scenic resources and the visual sensitivity of the most likely viewer group at a particular KOP. Assessment methods were applied to the alternatives using the following steps:

- **Identify visually sensitive areas** – Areas rated highest for sensitivity are those with views seen by people driving to or from recreational activities or along routes designated as scenic corridors. Stationary views from relatively moderate- to high-use recreational areas and commercial/residential areas are also considered to be sensitive.

- **Define the landscape character** – "Landscape character" refers to the visual and cultural image of a geographic area. It is composed of the combination of physical, biological, and cultural attributes that make each landscape identifiable or unique. Landscape character embodies distinct landscape attributes that exist throughout the area.

- **Identify visually sensitive observation points** – Analysis of the impacts on visual resources from implementing any alternative should consider both construction and postconstruction views. This step identifies visually sensitive observation points in the primary study area. Identification of visually sensitive observation points allows a comparison of existing views and potential visual impacts resulting from implementing any alternative.

- **Identify visually affected KOPs** – Based on the location and distance of potential visual impact areas from the visually sensitive observation points, only a portion of the observation points may be significantly affected. Areas in the foreground-middleground zone are usually less than 3 to 5 miles away and are readily

visible from observation points. Areas farther away, but less than 15 miles away, are in the background. Areas that are not immediately visible or farther than 15 or so miles away are in the seldom-seen zone.

- **Classify scenic quality rating** – Scenic quality ratings are used to categorize visual features as follows: A, distinctive; B, typical; and C, indistinctive.

Criteria for Determining Significance of Impacts

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental impacts that would be caused by, or result from, implementing the No Action Alternative and the range of action alternatives. Under NEPA, the severity and context of an impact must be characterized. An environmental document prepared to comply with CEQA must identify the potentially significant environmental impacts of a proposed project and a reasonable range of alternatives, if required. A "[s]ignificant effect on the environment" means "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental impacts (State CEQA Guidelines, Section 15126.4(a)).

The criteria used to determine the significance of impacts for this analysis are based primarily on the State CEQA Guidelines and other associated criteria, including regulatory agency standards. Federal criteria and NEPA guidance were also considered. The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental impacts as required under NEPA. Impacts of an alternative on visual resources would be significant if project implementation would result in any of the following effects:

- Have a substantial adverse impact on a scenic vista
- Substantially damage scenic resources, including trees, rock outcroppings, and historic buildings adjacent to a State scenic highway
- Substantially degrade the existing visual character or quality of the project site and its surroundings

- Create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the project area

Additional criteria considered in the analysis include land management standards as described in associated planning documents developed by the Bakersfield BLM regional office. The Bakersfield RMP outlines the visual resource management standards for BLM land in the region (BLM 2012). Because the Bakersfield RMP determined the primary study area to have a scenic quality rating of A, the area is considered to be moderately sensitive, and management of this area is held to a standard of Visual Resource Class III. This designation requires existing management to partially retain existing landscape character. The level of allowable change to the characteristic landscape should be moderate, and management activities may attract attention but should not dominate a casual observer's view. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Project-related activities that would result in a greater-than-moderate change to the character of the landscape, attract attention and dominate the view of the casual observer, or diverge from the basic elements found in the predominant natural features of the characteristic landscape would result in inconsistency with BLM resource management objectives designated for Bakersfield BLM SQRU 01 and the SJRG SRMA.

In addition, the primary study area is located along a segment of the San Joaquin River that has been determined to be suitable as an addition to the NWSRS with a recommended classification of wild/scenic. If a waterway is determined to be eligible/suitable for official designation, land management must be taken to protect the free-flowing condition and the ORVs qualifying its eligibility. Because this waterway has segments eligible as either wild or scenic, any impacts on the free-flowing nature of these segments, any impacts on the ORVs in each segment, or watershed development greater than that associated with scenic- or wild-designated river segments could affect NWSRS eligibility, suitability, or classification (wild, scenic, or recreational).

Topics Eliminated from Further Consideration

No topics related to visual resources that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

None of the landscapes and visual resource features in the extended study area would be affected by construction or operation activities associated with implementing the action alternatives. Changes to water conveyance to the CVP and SWP water service areas would not exceed historic maximum deliveries and would not result in a change in land use or cropping patterns or affect the visual quality of these areas. Therefore, none of the action alternatives would have an impact on visual resources found in the San Joaquin River, Delta, or the CVP or SWP water service areas. The visual resources found in these areas are therefore not discussed further in this analysis.

Direct and Indirect Effects

The following section describes the potential environmental consequences of the alternatives. Where the action alternatives would have identical or nearly identical impacts regardless of which action alternative is implemented, the action alternatives are described together. Where impacts would differ, the action alternatives are described separately.

Impact VIS-1: Consistency with Applicable Plans

Primary Study Area

No Action Alternative No project-related construction or operation activities would occur under the No Action Alternative. It is expected that there would be no inconsistencies with the Bakersfield RMP or other local plans from other projects that would be expected to occur under the No Action Alternative.

There would be **no impact** under the No Action Alternative.

Alternative Plans 1-4 Despite development that has occurred in the area, (Friant Dam, scattered residences, and recreational facilities) the primary study area retains a high quality visual landscape. Applicable visual resources guidelines for planning BLM actions are primarily sourced from the Bakersfield Proposed RMP for SJRG SRMA (2012). In the Proposed RMP, the primary study area was identified as having Class II visual resources, highlighting the regional high scenic values. The SJRG SRMA further specifies that the gorge area has diverse

management requirements, from low values in the Tahoot RMZ at VRM Class IV, to high values in the Pa' San RMZ at VRM Class I. Implementing Alternative Plans 1-4 would involve constructing and operating numerous structural elements that would permanently add human-made features to the landscape that would contrast with existing natural features and modify the viewshed's character. This would result in a moderate to high change to the characteristic landscape which would result in inconsistency with visual resource objectives designated for the primary study area.

Implementing Alternative Plans 1-4 would involve constructing and operating numerous structural elements that would permanently add human-made features to the landscape that would contrast with existing natural features and modify the viewshed's character. Under Alternative Plans 1-4, the majority of physical structures and landscape modifications affect viewsheds in the Kerckhoff Reservoir and SJRG area. Scenic values in the Millerton Lake area, characterized by KOPs 5, 6, and 7 would remain largely unchanged. Similarly, views from nearby travelers as represented by KOP 8 would not be affected as a result of the action alternatives. For the purposes of visual resources analysis, this discussion focuses on impacts to the SJRG and Kerckhoff Reservoir area as represented by KOPs 1-4 and KOP 9.

The Temperance Flat RM 274 Dam, diversion works and intake structure, powerhouse and transmission facilities, valve house, waste area, and quarry, batch plant, and haul road options A, B, or C would modify the existing visual character of the area by introducing substantial areas of ground disturbance, concrete structures, and a new reservoir. The dam structure would result in a permanent impoundment that would disrupt the natural visual character of the SJRG. The installation of associated structures and permanent access roads would also introduce conflicting color, form, and texture into the landscape. The changes associated with the action alternatives would attract attention and dominate the view of the natural landscape when observed from KOPs.

Operation of the reservoir would result in a substantial change to the upstream shoreline. Existing operation of Millerton Lake allows for a maximum water elevation of 580 feet, and typical seasonal water availability results in elevations between 480 feet and 560 feet. The Temperance Flat RM 274 Reservoir would have a maximum water elevation of 985 feet, a 405-foot increase above the established maximum elevation. Complete

or partial vegetation clearing would occur within some portions this inundation zone. This change would result in a more expansive shoreline and increased visual dominance of the reservoir water body. Furthermore, during periods of drawdown, the reservoir waterline could be reduced to as low as elevation 690. During these periods, a large area of bare soil would be exposed to viewers, creating the bathtub ring effect typical of many water storage facilities. This effect occurs in the existing landscape to a limited extent with Millerton Lake operations. However, implementing the Temperance Flat RM 274 Dam would greatly increase the size of the unvegetated ground, and the operations would expose a zone of approximately 290 feet in height. To illustrate this effect, Figure 26-11 depicts a view from Wellbarn Road, looking northwest at the SJRG. Figure 26-12 and Figure 26-13 show high- and low-water conditions, respectively, that would occur as a result of the proposed dam operations. This bathtub ring effect would draw an observer's attention and would widen the altered impact of unvegetated, bare soil to the landscape.

Figure 26-11. Existing View from Wellbarn Road (KOP 3)

Figure 26-12. Visual Simulation of the Reservoir (High Water) from Wellbarn Road (KOP 3)

Figure 26-13. Visual Simulation of the Reservoir (Low Water) from Wellbarn Road (KOP 3) – Alternative Plans 1-4

Quarry, batch plant, and haul road options A, B, or C would provide aggregate for the main dam and cofferdams during

construction. Each site would be approximately 92 acres in size. Pending geotechnical investigation, one of the three quarry, batch plant, and haul road options would be constructed under the action alternatives. The selected quarry option would be excavated to elevation 600 feet yielding an estimated 10 million cubic yards. For quarry, batch plant, and haul road options A, B, and C, the quarry would be sited at or below the proposed inundation elevation 985 feet. As previously discussed, complete or partial vegetation clearance within some of the inundation zone is already proposed under the action alternatives. The remaining quarry excavation would be hidden underwater during high-water conditions or would appear similar to the surrounding bare soil "bathtub ring" during periods of drawdown. Grading of the quarry, batch plant, and haul road areas would overlap with the reservoir construction areas and would not substantially contribute to changes in the visual character of the landscape.

Temporary project-related construction activities would result in grading and vegetation clearance surrounding the Temperance Flat RM 274 Dam site; staging area; quarry, batch plant, and haul road options; and other nearby sites. To the extent feasible, some of these areas would be revegetated, or plant colonization would be allowed to occur naturally. These disturbed areas may take years to redevelop plant cover and would not necessarily return to a forested or other condition similar to that of the existing landscape. This would result in a temporary but long-term impact on the visual character of the area that would be highly perceptible to viewers, including nearby residents and recreationists.

This impact would be **significant** under Alternative Plans 1-4. No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Alternative Plan 5 This impact would be similar to Alternative Plans 1-4. Implementing Alternative Plan 5 would involve constructing and operating numerous structural elements that would permanently add human-made features to the landscape that would contrast with existing natural features and modify the viewshed's character. This would result in a moderate to high change to the characteristic landscape which would result in inconsistency with visual resource objectives designated for the primary study area. All of the proposed

project components would be the same as Alternative Plans 1to 4 with exception to the operation of the Temperance Flat RM 274 Dam. As such, this discussion focuses on the dam operation unique to Alternative Plan 5.

Similar to Alternative Plans 1-4, operation of the proposed Temperance Flat RM 274 Reservoir would result in a substantial change to the upstream shoreline. Existing operation of Millerton Lake allows for a maximum water elevation of 580 feet, and typical seasonal water elevations between 480 feet and 560 feet. The Temperance Flat RM 274 Reservoir would have a maximum water elevation of 985 feet, a 405-foot increase above the established maximum elevation. This change would result in a more expansive shoreline and increased visual dominance of the reservoir water body.

As a result of dam operations unique to Alternative Plan 5, during periods of drawdown the reservoir waterline could be reduced further than Alternative Plans 1-4 to as low as elevation 603. During these periods, a large area of bare soil would be exposed to viewers, creating the bathtub ring effect typical of many water storage facilities. This effect occurs in the existing landscape to a limited extent with Millerton Lake operations. However, implementing Alternative Plan 5 would greatly increase the size of the bare ground, and the operations would expose a zone of approximately 382 feet in height. To illustrate this effect, Figure 26-11 depicts a view from Wellbarn Road, looking northwest at the SJRG. Figure 26-12 and Figure 26-14 show high- and low-water conditions, respectively, that would occur as a result of the proposed dam operations. This bathtub ring effect would draw an observer's attention and would widen the altered impact of unvegetated, bare soil to the landscape.

This impact would be **significant** under Alternative Plan 5.

No feasible avoidance or minimization measures are available to reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level.

Figure 26-14. Visual Simulation of the Reservoir (Low Water) from Wellbarn Road (KOP 3) – Alternative Plan 5

Impact VIS-2: Degradation and/or Obstruction of a Scenic View

Primary Study Area

No Action Alternative No designated scenic vistas are located in the primary study area. Under the No Action Alternative, the existing scenic views would not be degraded or obstructed because the project would not be constructed. The visual setting would remain the same as under existing conditions.

There would be **no impact** under the No Action Alternative.

Alternative Plans 1-4 As described in the discussion of Impact VIS-1, Alternative Plans 1-4 would introduce a new dam, associated infrastructure, power facilities, and reservoir operations, resulting in a bathtub ring effect. Introduction of these new features would alter and degrade the character of the natural landscape. Existing scenic views of areas where infrastructure would be built or relocated could be obstructed or degraded. Views from some KOPs would be degraded or obstructed during construction. Throughout the primary study area, vegetation retention or removal activities would also degrade scenic views.

Figure 26-11 presents a view of the existing SJRG from Wellbarn Road. The view from this KOP would be affected by the establishment of Temperance Flat RM 274 Reservoir, its operations, and associated construction activities. The existing site exhibits relatively undisturbed forested hills with a sinuous riverbed below. Figure 26-12 and Figure 26-13 depict visual simulations representative of the proposed reservoir during high-water and low-water conditions, respectively. As shown, the dominant presence of high water would draw attention and reduce the amount of upland vegetation present in the viewshed. The establishment of the reservoir would change the scenic characteristic from a flowing riverbed to a larger, more static body of water. During periods of reservoir drawdown, a wide bathtub ring effect would be present as a result of reservoir operation and management activities. This bare soil is less visually complex than the combination of water and upland vegetation and as such would reduce the natural character of the landscape.

Figure 26-15 depicts a view of the existing San Joaquin River from residences and roads on Ralston Ridge. The existing site exhibits forested ridges and hillsides where the San Joaquin River widens and enters the main body of Millerton Lake. The existing Millerton Lake operation results in a variable bathtub ring effect, as indicated by a ring of bare soil and rocks. The view from this KOP would be affected by introducing Temperance Flat RM 274 Dam, its operations, and construction activities. Figure 26-16 depicts a visual simulation representative of the proposed Temperance Flat RM 274 Dam site. The dam introduces a dominant human-made element into the existing viewshed. Views to locations upriver of the dam would be obstructed. Construction activities in and around the dam site would also result in removal of vegetation and introduce a presence of construction equipment and nighttime lighting that would degrade the quality of the view from this KOP during this period.

This impact would be **significant** under Alternative Plans 1-4. Mitigation for this impact is proposed below in the Mitigation Measures section.

Figure 26-15. Existing View from Residences on Ralston Ridge (KOP 4)

Figure 26-16. Visual Simulation of the Dam from Residences on Ralston Ridge (KOP 4)

Alternative Plan 5 This impact would be similar to Alternative Plans 1-4. As described in the discussion of Impact VIS-1, Alternative Plan 5 would introduce a new dam, associated infrastructure, power facilities, and reservoir operations, resulting in a bathtub ring effect. Introduction of these new features would alter and degrade the character of the natural landscape. Existing scenic views of areas where infrastructure would be built or relocated could be obstructed or degraded. Views from some KOPs would be degraded or obstructed during construction. Throughout the primary study area, vegetation retention or removal activities would also degrade scenic views. All of the proposed project components would be the same as Alternative Plans 1-4 with the exception of operations of Temperance Flat RM 274 Reservoir and Millerton Lake. As such, this discussion focuses on the reservoir operations unique to Alternative Plan 5.

Figure 26-11 presents a view of the existing SJRG from Wellbarn Road. The view from this KOP would be affected by the establishment of Temperance Flat RM 274 Reservoir, its operations, and associated construction activities. The existing site exhibits relatively undisturbed forested hills with a sinuous riverbed below. Similar to Alternative Plans 1-4, Figure 26-12 depicts visual simulations representative of the proposed reservoir during high-water conditions. As shown, the dominant presence of high water would draw attention and reduce the amount of upland vegetation present in the viewshed. The establishment of the reservoir would change the scenic characteristic from a flowing riverbed to a larger, more static body of water.

Figure 26-14 depicts a visual simulation representative of the proposed reservoir during low-water conditions unique to Alternative Plan 5. During periods of reservoir drawdown, a bathtub ring effect—wider than that of Alternative Plans 1-4—would be present as a result of reservoir operation and management activities. This bare soil is less visually complex than the combination of water and upland vegetation and as such would reduce the natural character of the landscape.

This impact would be **significant** under Alternative Plan 5. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting

Primary Study Area

No Action Alternative Under the No Action Alternative, daytime glare and/or nighttime lighting would not increase because Temperance Flat RM 274 Dam would not be constructed. The visual setting would remain the same as under existing conditions.

There would be **no impact** under the No Action Alternative.

Action Alternatives The increased area of light-colored soil around the Temperance Flat RM 274 Reservoir shoreline that would be exposed during periods of drawdown and, conversely, the increased area of water surface associated with high water would increase the potential for daytime glare. New infrastructure, such as the powerhouse, transmission facilities, and quarry, batch plant, and haul road options, and new access roads, would also create new sources of reflective daytime glare. In addition, construction equipment could be a temporary source of reflective daytime glare. Construction activities at night requiring the use of vehicle and perimeter lighting, particularly in the vicinity of Temperance Flat RM 274 Dam, would be necessary for several years. New sources of permanent nighttime lighting would be required for some locations, such as relocated recreational facilities, new roads, and power facilities.

This impact would be **significant** under the action alternatives. Mitigation for this impact is proposed below in the Mitigation Measures section.

Impact VIS-4: Impacts on a Designated Scenic Highway

Primary Study Area

No Action Alternative Under the No Action Alternative, there would not be any inconsistencies with Federal and State scenic byway requirements because Temperance Flat RM 274 Dam would not be constructed. The visual setting would remain the same as under existing conditions.

There would be **no impact** under the No Action Alternative.

Action Alternatives No Federal or State scenic highways are designated in the primary study area. There are a few designated State scenic highways in the area surrounding the primary study area. Several eligible highways in the region

have not yet been designated. The nearest scenic highway, SR 168, is eligible for designation; however, as discussed in the Regulatory Setting section of this chapter, travelers cannot see the primary study area while on this road. No other officially designated or eligible scenic highways are located near the primary study area.

There would be **no impact** under the action alternatives. Mitigation for this impact is not needed and thus not proposed.

Mitigation Measures

This section discusses mitigation measures for each significant impact described in the Direct and Indirect Impacts section, as presented in Table 26-4.

No mitigation is required for Impact VIS-4 within the primary study area because there would be no impact for all action alternatives. Impacts VIS-1 through VIS-4 would not occur in the extended study area.

Impacts VIS-1, VIS-2, and VIS-3 would be significant within the primary study area. No feasible mitigation measures are available at the time of preparation of this Draft EIS to reduce Impact VIS-1 to less-than-significant levels. Therefore, Impact VIS-1 (within the primary study area) would be **significant and unavoidable**. The following mitigation is required for Impacts VIS-2 and VIS-3 in the primary study area for all action alternatives.

Mitigation Measure VIS-2: Minimize Construction-Related Visual Impact on Scenic Views from KOPs Reclamation will implement the following actions to minimize potential impacts on visual resources during project construction:

- Store construction equipment in the designated contractor staging area when it is not in use (e.g., after hours or when not required for the day's construction activities).

- Ensure, when practicable, that construction materials that will remain permanently on-site are consistent in color, texture, and pattern with the surrounding environment.

Implementing this mitigation measure would reduce the visual impacts of the project related to the degradation and/or obstruction of a scenic view, but it would not necessarily

reduce them to a less-than-significant level. There are no additional feasible mitigation measures that could be implemented to further reduce the visual impact of construction of the large-scale facilities associated with the action alternatives in a relatively natural environment. Impact VIS-2, therefore, would be **significant and unavoidable** under the action alternatives.

Mitigation Measure VIS-3: Minimize or Avoid Visual Impact of Daytime Glare and Nighttime Lighting
Reclamation will implement the following actions to minimize or avoid potential impacts on visual resources from daytime glare and nighttime lighting as a result of permanent lighting or construction equipment and staging:

- Avoid constant nighttime lighting and overly bright lighting to the extent possible. The location of lighting will correspond to the anticipated use and should not exceed the amount of light actually required by users.

- Screen lights and direct them away from residences to the highest degree possible, and minimize to the highest degree possible the amount of nighttime light used. Lighting fixtures will include shielding to minimize off-site light spill and glare. In addition, the following measures will apply:

  – The spacing of luminaire lamps (or comparable vandal-resistant lighting) shall be the maximum allowable for traffic safety.

  – Luminaires (or comparable vandal-resistant lighting) shall be cutoff-type fixtures that cast low-angle illumination to minimize incidental spillover of light onto adjacent private properties and undeveloped open space. Fixtures that project upward or horizontally will not be used.

  – Luminaire lamps (or comparable vandal-resistant lighting) shall be used to provide good color rendering and natural light qualities.

Implementing this mitigation measure would reduce the visual impacts of the project related to the generation of increased daytime glare and/or nighttime lighting, but it would not necessarily reduce them to a less-than-significant level. There are no additional feasible mitigation measures that could be

implemented to further reduce this impact. Impact VIS-3, therefore, would be **significant and unavoidable** under the action alternatives.

Chapter 27
Cumulative Effects

This chapter provides an analysis of overall cumulative effects of the alternatives. Cumulative effects are determined by analyzing the potential for impacts of an alternative to combine with the impacts of other past, present, and reasonably foreseeable future projects to produce project-related impacts. This analysis follows applicable guidance provided by CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005).

Definitions of Cumulative Effects

The CEQ regulations that implement NEPA provisions define a cumulative effect as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7).

Cumulative impacts can result from individually minor but collectively significant actions over time, and they differ from indirect impacts (40 CFR 1508.8). They are caused by the incremental increase in total environmental effects that occurs when the evaluated project is added to other past, present, and reasonably foreseeable future actions. Cumulative effects can thus originate from causes that are unrelated to the project being evaluated, and the analysis of cumulative effects looks at the life cycle of the effects. These effects can be either adverse or beneficial.

Cumulative impacts are defined in the State CEQA Guidelines (14 CCR Section 15355) as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." A cumulative impact occurs from "the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from

individually minor but collectively significant projects taking place over a period of time" (14 CCR Section 15355(b)).

Consistent with the State CEQA Guidelines (14 CCR Section 15130(a)), the discussion of cumulative impacts focuses on significant and potentially significant cumulative impacts. The State CEQA Guidelines (14 CCR Section 15130(b)) state that:

> *The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by the standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact.*

Relationship to CALFED Programmatic Cumulative Impacts Analysis

The analysis of cumulative effects in this Draft EIS tiers to the cumulative effects assessment in the CALFED PEIS/R. The "Millerton Lake Enlargement or Equivalent" project was included in the cumulative impacts analysis of the CALFED PEIS/R as a project in CALFED's Storage Program (CALFED 2000).

This project-specific analysis refines and updates, but stands alone from, the analysis of cumulative effects in the CALFED PEIS/R (CALFED 2000). This analysis focuses on issues resulting from the effects of the action alternatives combined with other reasonably foreseeable future projects. This Draft EIS considers CALFED projects that have been implemented, are being implemented, or are reasonably foreseeable future projects. The projects that have been implemented are considered as part of existing conditions; reasonably foreseeable future projects are considered as part of future conditions.

Methods and Assumptions

For purposes of this Draft EIS, cumulative impacts of an action alternative would be significant if implementing the alternative would make a considerable incremental contribution to a significant cumulative effect. The alternative plan's contribution is evaluated in combination with the effects of other past, present, and reasonably foreseeable future projects to determine whether (1) the overall cumulative effect would be significant and (2) the alternative's contribution would be considerable. Cumulatively significant impacts would do any of the following:

- Cause a significant adverse effect on a resource (using the criteria for significance described in the "Environmental Consequences and Mitigation Measures" sections of Chapters 4 through 26 of this Draft EIS)

- Adversely affect a resource that already has a degraded or declining condition because of substantial adverse effects that have already occurred

- Cause effects that initially were not significant, but would be part of an irreversible degrading or declining trend

Following CEQ guidance, Reclamation has identified associated actions (past, present, or future) that, when viewed with the proposed or alternative actions, may have significant cumulative impacts. Table 27-1 lists the actions and conditions that were considered for each resource area.

The State CEQA Guidelines identify two basic methods for establishing the cumulative environment in which the project is to be considered: using a list of past, present, and probable future projects (the "list approach"); or using adopted projections from a general plan, other regional planning document, or certified EIR for such a planning document (the "plan approach"). For this analysis of cumulative impacts, the list approach and the plan approach have been combined in quantitative and qualitative assessments to generate a comprehensive future projection. The methodology for each of these assessments is described following Table 27-1.

Table 27-1. Present and Reasonably Foreseeable Future Actions and Conditions Included in the Analysis of Cumulative Impacts, by Resource Area

Quantitative Assessment of Actions and Conditions Related to Water Resources
Forecasted 2030 Level of Demands for Water Supplies Methodology
Freeport Regional Water Project
Delta Water Supply Project
DWR South Bay Aqueduct Improvement and Enlargement Program
Vernalis Adaptive Management Plan
San Joaquin River Restoration Program
Grassland Bypass Project
Common Assumptions for Water Storage Projects
Coordinated Long-Term Operation of the CVP and SWP
Quantitative Assessment Methodology for Effects on Air Quality
Qualitative Assessment of Actions and Conditions Related to Water/Natural Resource Management and Restoration
Central Valley Project Improvement Act
CALFED Ecosystem Restoration Program
Conveyance of Refuge Water Supply, Mendota Wildlife Area
Coordinated Long-Term Operation of the CVP and SWP
Water Quality Control Plan for the Sacramento and San Joaquin River Basins
Bay Delta Conservation Plan (and Alternative Delta Conveyance Facilities)
San Joaquin River Restoration Program
North-of-Delta Offstream Storage Investigation
Shasta Lake Water Resources Investigation
North Bay Aqueduct Alternative Intake Project
North Delta Flood Control and Ecosystem Restoration Project
Franks Tract Project, North/Central Delta Improvement Study
Dutch Slough Tidal Marsh Restoration Project
Suisun Marsh Management, Preservation, and Restoration Plan
In-Delta Storage Program (Delta Wetlands Project)
Los Vaqueros Reservoir Expansion Project
East Bay Municipal Utility District Water Supply Management Program 2040
San Joaquin River Salinity Management Plan
San Luis Reservoir Low Point Improvement Project and San Luis Reservoir Expansion
Delta-Mendota Canal/California Aqueduct Intertie
Delta-Mendota Canal Recirculation Project
Lower San Joaquin River Flood Improvement Project
Bay Area Water Quality and Supply Reliability Program
Conditional Waiver of Waste Discharge Requirement for Irrigated Lands
Tracy Fish Collection Facility and Tracy Fish Facility Improvement Program
Central Valley Joint Venture

Table 27-1. Present and Reasonably Foreseeable Future Actions and Conditions Included in the Analysis of Cumulative Impacts, by Resource Area (contd.)

Qualitative Assessment of Actions and Conditions Related to Water/Natural Resource Management and Restoration (contd.)
Comprehensive Conservation Management Plans for National Wildlife Refuges
Jensen River Ranch Habitat Enhancement and Public Access Project
Lost Lake Park Master Plan
Riparian Habitat Joint Venture
San Joaquin River Parkway Plan
Fresno County General Plan
Madera County General Plan
City of Fresno General Plan
Brighton Crest/Eagle Springs Golf Course and Country Club
Millerton New Town
Friant Ranch Specific Plan
Millerton Specific Plan
Gunner Ranch West Area Plan
Gateway Village Specific Plan
Rio Mesa Area Plan
North Fork Village
Ventana Hills Estates Annexation
Bureau of Land Management-Bakersfield Office Resource Management Plan
Friant-Kern Canal Reverse Flow Project
Friant-Kern and Madera Canals Capacity Restoration Project
Delta Stewardship Council's Delta Plan
State Water Board Delta Flow Action
San Joaquin River Exchange Contractors Water Authority Water Transfer Program 2014–2038
Westside Regional Drainage Plan
Semitropic Water Storage District Groundwater Banking Project
State Water Project Water Supply Contract Extension Program
State Water Project Water Settlement Agreement
Poso Creek IRWMP
Southern Sierra IRWMP
Kern River IRWMP
Kings Basin IRWMP
Kaweah River Basin IRWMP
Deer Creek & Tule River Authority Groundwater Management Plan Update
Westside Integrate Water Resources Plan
Madera County IRWMP
Merced IRWMP
East Stanislaus Region IRWMP
Eastern San Joaquin IRWMP

Table 27-1. Present and Reasonably Foreseeable Future Actions and Conditions Included in the Analysis of Cumulative Impacts, by Resource Area (contd.)

Qualitative Assessment of Actions and Conditions Related to Flood Management
Central Valley Flood Protection Plan
CALFED Levee System Integrity Program
Folsom Dam Joint Federal Project
Delta Islands and Levees Feasibility Study
South Delta Flood Bypass
Qualitative Assessment of Actions and Conditions Related to Power and Energy
Big Creek Facilities FERC Relicensing
California Department of Water Resources Oroville Facilities FERC Relicensing
PG&E Kerckhoff Hydroelectric Project Licensing
PG&E Crane Valley Hydroelectric Project
New Friant River Outlet Powerhouse
Merced River Hydroelectric Project, FERC Project No. 2179
Don Pedro Project Relicensing, FERC No. 2299
Qualitative Assessment of Actions and Conditions Related to Recreational Resources
Bureau of Land Management-Bakersfield Office Resource Management Plan
Millerton Lake Resource Management Plan and General Plan
San Joaquin River Parkway Plan

Key:
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
FERC = Federal Energy Regulatory Commission
IFIM = Instream Flow Incremental Methodology
IRWMP = Integrated Regional Water Management Plan
NMFS = National Marine Fisheries Service
PG&E = Pacific Gas and Electric Company
SWP = State Water Project
TMDL = total maximum daily load

Quantitative Assessments

Quantitative assessments were completed for each of the resource areas in this Draft EIS, where feasible. The effects of actions related to water resources and effects of development projects were assessed quantitatively. Quantitative changes to water resources and air quality were evaluated in the consideration of cumulative impacts on affected resources. The methodologies for the quantitative assessments are described below.

Quantitative Assessment of Actions and Conditions Related to Water Resources

In this Draft EIS, the quantitative assessment related to water resources relied primarily on CalSim II modeling to evaluate

the hydrologic conditions of past, present and reasonably foreseeable future actions that could affect the environment, when combined with the effects of the alternatives. As described in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences," CalSim II was run using two different baselines, one for existing conditions, and one for future conditions. The future conditions analysis includes those projects and conditions in place under existing conditions, (based on a 2005 level of land use development and current facilities in place as of January 2014), modified to reflect a mix of forecasted 2020 and 2030 land use development and reasonably foreseeable future projects and facilities anticipated to be in place by 2030, and provides the basis for quantitative assessment of actions and conditions related to water resources described in this chapter. The future conditions were compared to the existing conditions in the environmental consequences sections of Chapters 4 through 26; conclusions made in those chapters are used to support the cumulative effects analysis presented in this chapter).

The future conditions do not account for potential changes in water demands resulting from the effects of climate change. Potential changes in water demand due to climate change are described qualitatively in the "Qualitative Assessments" section. The past, present, and reasonably foreseeable projections and conditions considered in this cumulative analysis include the following (described separately below):

- Forecasted 2030 level of demands for water supplies
- Freeport Regional Water Project
- Delta Water Supply Project
- DWR South Bay Aqueduct Improvement and Enlargement Project
- VAMP
- SJRRP – Full Restoration Flows
- Grassland Bypass Project
- Common Assumptions for Water Storage Projects

- Coordinated Long-Term Operation of the CVP and SWP
- Quantitative Assessment of Effects on Air Quality

Other reasonably foreseeable actions and conditions with the potential to affect water resources were assessed qualitatively, as described in the Qualitative Assessment of Actions and Conditions Related to Water/Natural Resource Management and Restoration section of this chapter.

Forecasted 2030 Level of Demands for Water Supplies Methodology Reclamation and DWR developed assumptions for evaluating systemwide hydrologic and water supply conditions with CalSim II under existing and future conditions. Detailed descriptions of the CalSim II model, the modeling methodology used in evaluations, and key assumptions (including forecasted 2030 facilities and demands) are provided in the Modeling Appendix. For a summary of the analysis and modeling results, see the Hydrology, Hydraulics, and Water Management Technical Report (in the Physical Resources Appendix).

To quantify cumulative effects on hydrologic conditions, modeling runs with No-Action Alternative (2030) conditions were compared to modeling runs with existing (2005) conditions. For example, the No-Action Alternative (2030 baseline) was compared to existing conditions (2005 baseline) to identify the cumulative impacts of reasonably foreseeable future projects and conditions on hydrologic conditions. Similarly, project alternatives were compared to existing conditions (consistent with CEQA requirements) and to the No-Action Alternative (2030) (satisfying NEPA requirements) to identify the combined cumulative effect of project alternatives and other foreseeable projects and facilities. The No-Action Alternative (2030) includes forecasted year-2030 demands for water. These forecasted demands are considered to be reasonably foreseeable for determining cumulative impacts.

Freeport Regional Water Project The Freeport Regional Water Project provides water for EBMUD customers in dry years and needed water for the Sacramento region by drawing water from the Sacramento River near the town of Freeport. The project consists of a 185-million-gallon-per-day water intake structure and pumping plant on the Sacramento River, a large-diameter pipeline to transport water eastward from the

intake to a Sacramento County Water Agency water treatment plant and to the existing Folsom South Canal. Construction began in 2007 and operations in 2010, and the project is substantially complete. The Freeport Regional Water Project is included only in future conditions for this Draft EIS.

Delta Water Supply Project The Delta Water Supply Project provided a new, supplemental high-quality water supply for the Stockton metropolitan area. The project replaces declining surface water resources, protects groundwater supplies, and provides for current and future water needs in the Stockton metropolitan area. The project included a new intake and pump station that diverts water from the San Joaquin River through miles of underground pipeline to a new 30-million-gallon-per-day water treatment plant. The project will help meet Stockton's water needs through 2025, as detailed in the City of Stockton's general plan. The Delta Water Supply Project was completed in June 2012 and is included only in future conditions for the Investigation.

DWR South Bay Aqueduct Improvement and Enlargement Project The South Bay Aqueduct conveys water from the Delta through more than 40 miles of pipelines and canals to the Zone 7 Water Agency, Alameda County Water District (ACWD), and Santa Clara Valley Water District (SCVWD), (DWR 2014a). The purpose of this project is to increase the capacity of the South Bay Aqueduct from 300 cfs to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce the SWP's peak power consumption. The project was completed in 2012. The South Bay Aqueduct Improvement and Enlargement Project is included only in the future conditions for the Investigation.

Vernalis Adaptive Management Plan VAMP was a 12-year experimental management program, which the State Water Board accepted as the implementation of the San Joaquin River flow standard pursuant to D-1641. VAMP expired in 2011. It was initiated to protect juvenile Chinook salmon emigrating through the San Joaquin River and Delta, and to evaluate how Chinook salmon survival rates change in response to alterations in San Joaquin River flows and exports at CVP and SWP facilities in the south Delta when the Head of Old River Barrier is installed. A water acquisition program for in-stream flows and a monitoring program for VAMP were implemented through the San Joaquin River Agreement (SJRA), which was adopted in 2000 and twice extended, finally expiring in December 2011. Signatories to the SJRA included Reclamation, DWR, CDFW, USFWS, San

Joaquin River Group Authority and member agencies, Exchange Contractors, and select CVP and SWP Contractors, San Francisco Public Utilities Commission, and several environmental interest groups.

The expiration of VAMP in 2011 introduced uncertainty regarding responsibility for meeting San Joaquin River flow standards set forth in the 1995 Bay Delta Plan in the interim until new San Joaquin River flow standards are identified. Future State Water Board objectives will likely be as protective as the original VAMP requirements and are anticipated to remain in place through 2030. Additionally, the 2009 NMFS BO RPAs include requirements for a continuation of VAMP-like flow objectives, as described in the Coordinated Long-Term Operation of the CVP and SWP section of this chapter. Accordingly, the Investigation's modeling of existing and future conditions has incorporated full VAMP flow requirements.

San Joaquin River Restoration Program In 1988, a coalition of environmental groups, led by the NRDC, filed a lawsuit challenging the renewal of long-term water service contracts between the United States and water contractors in the Friant Division of the CVP. The Settlement was approved in late 2006 by the District Court (NRDC et al. 2006). The Settlement ended an 18-year legal dispute over the operation of Friant Dam and resolved longstanding legal claims brought by a coalition of conservation and fishing groups led by the NRDC.

The San Joaquin River Restoration Settlement Act, included in Public Law 111-11 and signed into law on March 30, 2009, authorizes and directs the Secretary of the Interior to implement the Settlement. The Settlement establishes two goals. The Restoration Goal is to restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. The Water Management Goal is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The Settlement provides for substantial river channel improvements and water flow to sustain a salmon fishery upstream from the confluence of the Merced River tributary,

while reducing or avoiding the water supply impacts of implementing the Settlement on the Friant Division long-term water contractors. At the heart of the Settlement is a commitment to provide continuous flows in the San Joaquin River in the 153-mile stretch of the San Joaquin River between Friant Dam and the Merced River (the Restoration Area).

Reasonably foreseeable SJRRP actions, and their inclusion in existing and future conditions, are described in Chapter 2, "Alternatives."

Grassland Bypass Project The Grassland Bypass Project is a stakeholder initiative designed to improve water quality in the channels used to deliver water to the San Joaquin River and wetland areas in the Grassland watershed. Irrigation of soils containing high levels of salt and selenium has caused high levels of selenium to leach into the subsurface drainage water in the 97,000-acre Grassland Drainage Area.

Approximately 8,200 acres of Grassland's watershed marshes, a portion of the lower San Joaquin River (from the confluence with Mud Slough to the Merced River confluence), and Mud Slough are listed on the CWA Section 303(d) list of impaired waters for exceeding water quality objectives for selenium. Between 1998 and 2009, BMPs implemented by Grassland area farmers prevented the discharge of more than 22,000 pounds of selenium to listed waters. As a result, Salt Slough and a portion of the lower San Joaquin River have been removed from the 303(d) list of impaired waters.

The Grassland Bypass Project, 2010–2019 extension continues the San Luis Drain Use Agreement to allow time to acquire funds and develop feasible drainage water treatment technology to meet revised Basin Plan objectives and waste discharge requirements by December 30, 2019 (in accordance with the Westside Regional Drainage Plan and the San Luis Drainage Feature Reevaluation plan for drainage service); continues the separation of unusable agricultural drainage water discharged from the Grassland Drainage Area from wetland water supply conveyance channels for 2010 to 2019; facilitates drainage management that maintains the viability of agriculture in the Grassland Bypass Project Area; and promotes continuous improvement of water quality in the San Joaquin River (Reclamation and SLDMWA 2009).

For the Investigation, the water operations models for existing conditions and future conditions include partial implementation

and full implementation, respectively, of the Grassland Bypass Project.

Common Assumptions for Water Storage Projects A Common Assumptions Work Group was established to develop common baseline conditions against which the various water storage investigations would assess the feasibility of proposed projects. A major task of the Common Assumptions effort was to develop common analytical tools. The work group assembled a number of modeling tools under one package, termed the Common Model Package.

The Common Model Package includes the CalSim II, DSM2, Sacramento River Water Quality Model (SRWQM), the Salmonid Population Model (SALMOD), LTGen, SWP Power California (SWP Power), the LCPSIM, and the SWAP. CalSim II is a statewide water resources planning model, primarily reflecting the Central Valley and Delta operations of the CVP and SWP. The model is used to evaluate water supply facilities and demands; regulatory standards, including minimum flow requirements, water rights, contracts, and water quality standards; system operations; and likely foreseeable actions. DSM2 simulates hydrodynamic and water quality conditions in the Delta. Temperature and fisheries models specific to the San Joaquin River were incorporated in the Investigation and are described in the Modeling Appendix.

Coordinated Long-Term Operation of the CVP and SWP As described in Chapter 3, “Considerations for Describing the Affected Environment and Environmental Consequences,” the RPAs included in the 2008 USFWS BO and 2009 NMFS BO include conditions for revised water operations, habitat restoration and enhancement actions, and fish passage actions, and are considered reasonably foreseeable future actions for the purposes of this Draft EIS. Water operations defined in RPAs were included in the modeling evaluations in this Draft EIS for both existing and future conditions, and therefore were included in the quantitative cumulative effects analyses as described in the following sections. Other actions included in the RPAs were not included in the modeling evaluations but were assessed qualitatively, as described in the Qualitative Assessments section of this chapter.

The 2008 Long-Term Operations BA outlined several future projects, including the DMC/California Aqueduct Intertie, Freeport Regional Water Project, DWR Oroville Facilities FERC Relicensing, Sacramento River Water Reliability

Project, CCWD Alternative Intake Project, Red Bluff Diversion Dam Pumping Plant, and the South Delta Improvements Program. Where relevant to the assessment of cumulative impacts, these projects are described separately in this chapter.

2009 NMFS Biological Opinion The 2009 NMFS BO included RPAs to improve conditions for anadromous fish in the San Joaquin River basin. These RPAs included revised water operations, habitat restoration and enhancement actions, and fish passage actions. The actions related to the 2009 NMFS BO described below were identified as present or reasonably foreseeable actions, and include Stanislaus River actions and Delta Division actions. Where the actions include specific water or operational limitations that can be captured in the available quantitative tools, those actions were assessed quantitatively and are described below, and others were assessed qualitatively and are described in the Qualitative Assessments section of this chapter. Quantitatively assessed actions were included in the water operations modeling evaluations for both existing and future conditions, and therefore were included in cumulative effects analyses.

The Stanislaus River RPAs were designed to ensure a viable steelhead population in the Stanislaus River by securing freshwater migration routes to and from the Delta and by stopping or rectifying negative modification to steelhead critical habitat (NMFS 2009). The actions that were assessed quantitatively include the following:

- **Provide cold water releases from New Melones Dam** – This action specifies that Reclamation will manage the cold water supply in New Melones Reservoir, and make cold water releases to provide river temperatures to support steelhead rearing, spawning, egg incubation, and adult migration downstream from Goodwin Dam. This is a present action.

- **Operate New Melones Dam, Turlock Dam, and Goodwin Dam to meet minimum flow targets** – This action requires that a minimum base flow be maintained and that releases be managed to provide migratory cues to smolts. This is a present action. The Delta Division RPAs were developed to encourage migrating winter-run and spring-run Chinook salmon, steelhead, and green sturgeon juveniles to remain in the northern portion of the Delta. In the central and southern portion

of the Delta, juveniles are at increased risk of predation, exposure to pollutants, and entrapment in pumping facilities. Actions included in the Delta Division RPAs that were assessed quantitatively are as follows:

- **San Joaquin River Inflow to Export Ratio** – The goal of this RPA is to increase the likelihood of juveniles successfully exiting the Delta at Chips Island. It specifies minimum flow requirements in the San Joaquin River at Vernalis and restricts CVP and SWP export pumping amounts and ratios dependent on San Joaquin River flow at Vernalis. This is a present action.

- **Old and Middle River Flow Management** – The goal of this RPA is to create more suitable hydrologic conditions along the mainstem of the San Joaquin River, thereby encouraging migrating juveniles to avoid channels in the South Delta and the CVP and SWP export pumps. This programs requires that negative flows be limited in the Old and Middle rivers, limiting CVP and SWP exports to support migration of juveniles from the San Joaquin, Mokelumne, and Calaveras rivers past Chips Island. This is a present action.

2008 USFWS Biological Opinion The 2008 USFWS BO concluded that "the coordinated operation of the CVP and SWP, as proposed, [was] likely to jeopardize the continued existence of the delta smelt" and "adversely modify delta smelt critical habitat" and included RPAs for CVP and SWP operations designed to modify CVP and SWP operations to avoid causing jeopardy or adverse modification. The RPAs have provisions that affect the protection of adult, juvenile, and larval delta smelt and habitat improvements for delta smelt growth and rearing.

Actions included in the RPAs that are intended to control Old River and Middle River flows include daily limits and adaptive management that cannot be reflected in CalSim II or other operational simulations with complete accuracy. Therefore, quantitative modeling for this Draft EIS uses a monthly flow standard for Old and Middle rivers as a surrogate for these actions. The actions assessed quantitatively include the following:

- **Action 1** – Limit exports such that the average daily flow in Old and Middle rivers is no more negative (flowing upstream) than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent). This is a present action.

- **Action 2** – The range of net daily flow in the Old and Middle rivers will be no more negative than -1,250 cfs to - 5,000 cfs. Depending on extant conditions, specific Old and Middle River flows within this range are recommended by the Smelt Working Group. The Smelt Working Group will provide weekly recommendations for Old and Middle river flows based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. This is a present action.

- **Action 3** – Net daily flow in the Old and Middle rivers will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable requirement for flow in the Old and Middle rivers. Depending on extant conditions, specific flows in the Old and Middle rivers within this range are recommended by the Smelt Working Group from the onset of Action 3 through its termination. The Smelt Working Group will provide these recommendations based upon weekly review of sampling data, from real-time salvage data at the CVP/SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. This is a present action.

Quantitative Assessment Methodologies for Effects on Air Quality

For this analysis of cumulative impacts, regional impacts on air quality are analyzed quantitatively using the plan approach. As described in Chapter 4, “Air Quality and Greenhouse Gas Emissions,” significance thresholds for the SJVAB are defined in the San Joaquin Valley Air Pollution Control District’s *Guide for Assessing and Mitigating Air Quality Impacts* (SJVAPCD 2002). The analysis of local cumulative impacts is based on both the plan approach, which defines impact

thresholds, and the list approach, which identifies projects that may emit pollutants in the same area as the Investigation. SJVAPCD standards for criteria pollutants have been established to limit the emissions of individual projects when considering the cumulative effect of all projects on regional pollutant concentrations. Therefore, a significant direct project impact would also be a cumulatively considerable incremental contribution to a significant cumulative impact.

The 2007 Urban Emissions model (URBEMIS) was used to estimate emissions of pollutants from construction activities. Among the inputs to the model for construction analysis were the types and quantities of construction equipment to be used, along with the hours of use; areas of land to be graded; number of truck trips and trip distances for export of spoils and import of materials; volumes of buildings to be demolished; areas of buildings to be built; and areas of land to be paved. For activities after construction, the principal inputs were the number of vehicle trips and average trip distances. The methods and results of this analysis are described in greater detail in Chapter 4.0, “Air Quality and Greenhouse Gas Emissions.”

Qualitative Assessments

Past, present, and reasonably foreseeable future actions and conditions were assessed qualitatively when quantitative information was not readily available. Information on current and historical conditions was used to evaluate the combined effects of past actions and conditions on resource areas and issues. For present and reasonably foreseeable future actions and conditions, a list of related actions was compiled. The combined effects of past, present, and reasonably foreseeable future actions and conditions were then evaluated with effects of the project. Table 27-1 summarizes projects that were evaluated quantitatively and qualitatively.

A large number of past actions and conditions in the study area have strongly influenced existing conditions, and some past actions have created “legacies” that are still affecting resources today. Among the legacies is the San Joaquin River’s limited ability to sustain anadromous fish populations as a result of the construction of Friant Dam and other water management facilities, and the conversion of habitat into agricultural land. Additionally, groundwater pumping in the San Joaquin Valley continues to result in land subsidence. The following are the most important combined effects of these past actions:

- Population growth and associated development of socioeconomic resources and infrastructure
- Conversion of natural vegetation and floodplain habitat to agricultural and developed land uses
- Introduction of nonnative plant and animal species
- Development of water supply, particularly the construction and operation of Friant Dam, the rest of the CVP, and the SWP

Further, some unknown subset of the following projects, though not strictly meeting the criteria above, is likely to be implemented: the BDCP (and associated alternative Delta conveyance facilities), the North-of-Delta Offstream Storage Facility (Sites Reservoir), and the SLWRI (Shasta Dam Raise). However, it would be speculative to consider these projects at any more than a conceptual level because these projects and their effects are not far enough along in the planning and decision process to allow meaningful analysis.

The combined effects of past actions and the list of related present and reasonably foreseeable future projects are described further below.

Qualitative Assessment of Actions and Conditions Related to Water/Natural Resource Management and Restoration

In addition to the water resources actions described above in the Quantitative Assessment of Actions and Conditions Related to Water Resources section, the water/natural resources–related management and restoration actions described below were identified as present or reasonably foreseeable.

Central Valley Project Improvement Act The CVPIA (Title 34, Sections 3401 through 3408(h) of Public Law 102-575) was enacted in 1992 and is concerned with restoring anadromous fish populations, providing water supplies for Federal and State refuges, mitigating effects of the CVP on other fish and wildlife, and retiring drainage-impaired farmlands. A major purpose of the CVPIA is to provide equal priority and consideration to protection, restoration, and enhancement of fish, wildlife, and associated habitats of the Delta estuary and tributaries when evaluating the purpose of the CVP. The CVPIA also addresses the operational flexibility of the CVP and methods to expand the use of voluntary water

transfers and improved water conservation. The CVPIA dedicated approximately 1.2 MAF of water annually to fish, wildlife, and habitat restoration. Of this water, 800 TAF is dedicated to environmental needs as Section 3406(b)2 water, approximately 200 TAF was designated for wildlife refuges, and approximately 200 TAF was dedicated for increased Trinity River flows for fisheries restoration. Through operations flexibility, this results in a net reduction of 516 TAF per year on average, and 585 TAF in the driest years, previously available to CVP contractors (Reclamation 2008a).

Ecosystem Restoration Program USFWS and NMFS implement CALFED's Ecosystem Restoration Program (ERP) with guidance from the Delta Stewardship Council and the Delta Plan, and in coordination with the Sacramento–San Joaquin Delta Conservancy. The ERP works to improve the ecological health of the Bay-Delta watershed by restoring and protecting habitats, ecosystem functions, and native species. Since the program's inception, ERP agencies have identified more than 600 programmatic actions and 119 milestones throughout the Bay-Delta watershed. The program includes all projects authorized, funded, and permitted (even if not constructed) to date, particularly in the Delta, that aim to do any of the following:

- Recover at-risk native species dependent on the Delta, Suisun Bay, and San Francisco Bay
- Minimize the downward population trends of native species that are not listed
- Protect and restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values
- Prevent the establishment of additional nonnative invasive species and reduce the negative ecological and economic impacts of established nonnative species in the Bay-Delta estuary
- Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed

Conveyance of Refuge Water Supply, Mendota Wildlife Area Reclamation and the Central California ID have prepared an Environmental Assessment (EA)/Initial Study (IS)

evaluating the potential effects of alternatives to provide reliable year-round water deliveries to the Mendota Wildlife Area, which is located next to Fresno Slough in the San Joaquin Valley, approximately 30 miles west of Fresno (Reclamation 2008b). Under normal operations, Mendota Dam impounds water, creates the Mendota Pool, and fills Fresno Slough, providing water supplies to Mendota Wildlife Area and the CVP Settlement and Exchange Contractors and others. The Mendota Pool is currently drained (dewatered) for several weeks at least once every 2 years to facilitate inspection, maintenance, and any necessary repairs to Mendota Dam. Drops in the Mendota Pool level at other periods during the year also affect the water level of Fresno Slough and restrict the Mendota Wildlife Area pumps from extracting water from Fresno Slough.

The Locally Preferred Alternative would entail constructing a new dam approximately 400 feet downstream from the existing dam. Although the Mendota Pool would continue to be dewatered during flushing and maintenance operations, these periods of dewatering would be briefer than in recent years and manage to avoid disrupting water deliveries to the Mendota Wildlife Area. The Final EA/IS for this project was completed in May 2008 by Reclamation. Operation of the Mendota Pool and proposed new dam could affect the SJRRP; thus, as part of the SJRRP, the proposed new dam would be designed so that it could be retrofitted with a fish passageway in the future, as necessary. Alternatives considered for the SJRRP Mendota Pool Bypass and Reach 2B Channel Improvements project would fulfill constant water supply requirements under section 34069(d) of the CVPIA. The Draft EIS/R for Mendota Pool Bypass and Reach 2B Channel Improvements is expected to be available in 2015 (SJRRP 2014).

Coordinated Long-Term Operation of the CVP and SWP
As previously mentioned in the Quantitative Assessments section of this chapter and described in the following sections, some of the actions required under the 2008 USFWS and 2009 NMFS BOs were assessed qualitatively. The Fish Restoration Program, which addresses specific habitat restoration requirements of the USFWS and NMFS BOs, is also described below. Actions assessed quantitatively are described in the Quantitative Assessments section of this chapter.

2009 NMFS Biological Opinion As described in the Quantitative Assessments section of this chapter, some of the actions required under the 2009 NMFS BO were assessed

quantitatively, and others were assessed qualitatively. Actions assessed qualitatively include Stanislaus River actions and Delta actions. The Stanislaus River actions that were assessed qualitatively include:

- **Real-time operational decision making at New Melones Dam** – To accomplish this, the Stanislaus Operations Groups will ensure that 2009 NMFS BO actions are implemented, monitored, and evaluated. This is a present action.

- **Restore Steelhead habitat** – Under this action, Reclamation is required to improve spawning conditions in the Stanislaus River by adding 50,000 tons of gravel. The gravel replenishing sites will be monitored for geomorphic changes and spawning use. This is a present action.

- **Release floodplain restoration and inundation flows to inundate steelhead juvenile rearing habitat** – On a one to three year schedule, Reclamation is required to release flows necessary to inundate steelhead juvenile rearing habitat every 1 to 3 years. This is a present action.

- **Restore Freshwater migratory habitat through projects to increase floodplain connectivity and reduce migratory predation risk** – Projects to restore freshwater migratory habitat can include flow and non-flow actions, may mitigate for predation by improving rearing habitat to delay juvenile migration, and should mitigate causes of high juvenile mortality rates. This is a present action.

- **Fish Passage Program** – The action requires Reclamation to complete an evaluation of options for providing steelhead access to historic habitat upstream from New Melones Reservoir. This is a reasonably foreseeable action.

Delta Division actions that were assessed qualitatively include:

- **Delta Cross Channel Gate Operations** – This action specifies closing the Delta Cross Channel gates when migrating juveniles are present, discouraging them from entering Georgiana slough and the central Delta.

Migrating juveniles would be directed to Sutter and Steamboat sloughs. This is a present action.

- **Delta Cross Channel Monitoring and Alerts Program** – This action continues current monitoring of Chinook salmon migration in the Sacramento River and Sacramento River flow and temperature conditions to determine when the Delta Cross Channel gates should be closed. The first alert is triggered by one of two conditions: either capture of yearling-sized spring-run Chinook salmon at the mouths of natal tributaries between October and April, or an increase in tributary flow or more than 50 percent over levels preceding the flow spike from October onward. The second alert is triggered by Sacramento River flows greater than 7,500 cfs at Wilkins Slough and water temperatures less than (56.3°F) at Knights Landing. This is a present action.

- **Reduce Likelihood of Entrainment of Salvage at Export Facilities** – This action limits CVP and SWP exports when large numbers of Chinook salmon are migrating into the upper Delta region to reduce the likelihood of migration to the central and southern Delta and the CVP and SWP export pumps. This is a present action.

- **Modifications to the Operations and Infrastructure of the CVP and SWP Fish Collection Facilities** – The goal of this RPA is to increase the efficiency of the Tracy and Skinner Fish Collection Facilities to improve salvage survival of winter-run and spring-run Chinook salmon, steelhead, and green sturgeon. Specific actions include new procedures and modifications to improve current conditions and continued funding and implementation of the CVPIA Tracy Fish Facility Program. This is a present action.

- **Tracy Fish Collection Facility Improvements** – This action includes measures to reduce pre-screen loss and improve screening efficiency at Federal Facilities. This action is further discussed under the qualitative assessment of the Tracy Fish Collection Facility and Tracy Fish Facility Improvement Program. This is a present action.

- **Skinner Fish Collection Facility Improvements** – This RPA requires DWR to achieve a minimum salvage

efficiency of 75 percent at the Skinner Fish Collection Facility for salmon, steelhead, and southern distinct population segments of green sturgeon after the fish enter the primary channel in front of the louvers. DWR is also required to develop predator control methods for the Clifton Court Forebay. This is a present action.

- **South Delta Improvement Program** – This RPA prevents DWR from replacing temporary barriers in the south Delta with permanent operable gates. This is a reasonably foreseeable action.

2008 USFWS Biological Opinion The 2008 USFWS BO is described in the Quantitative Assessments section of this chapter. As mentioned, some of the actions required under the 2008 USFWS BO were assessed quantitatively, and others were assessed qualitatively. Actions assessed quantitatively include daily limits and adaptive management that cannot be reflected in CalSim II or other operational modeling with complete accuracy. Therefore, quantitative modeling for this Draft EIS uses a monthly flow standard for Old and Middle rivers as a surrogate for these action. These actions are therefore also considered qualitatively, in additional to other actions. The actions assessed qualitatively include the following:

- **Action 1** – Limit exports such that the average daily flow in the Old and Middle rivers is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent). This is a present action.

- **Action 2** – The range of net daily flow in the Old and Middle rivers will be no more negative than -1,250 cfs to - 5,000 cfs. Depending on extant conditions, specific Old and Middle River flows within this range are recommended by the Smelt Working Group from the onset of Action 2 through its termination. The Smelt Working Group will provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination. This is a present action.

- **Action 3** – Net daily flow in the Old and Middle rivers will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable requirement for flow in the Old and Middle rivers. Depending on extant conditions, specific flows in the Old and Middle rivers within this range are recommended by the Smelt Working Group from the onset of Action 3 through its termination. The Smelt Working Group will provide these recommendations based upon weekly review of sampling data, from real-time salvage data at the CVP/SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination. This is a present action.

- **Action 4** – Subject to adaptive management as described below, provide sufficient Delta outflow to maintain average X2 for September and October no greater (more eastward) than 74 km in the fall following wet years and 81km in the fall following above normal years. The monthly average X2 must be maintained at or seaward of these values for each individual month and not averaged over the two month period. In November, the inflow to CVP/SWP reservoirs in the Sacramento Basin will be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall target. The action will be evaluated and may be modified or terminated as determined by USFWS. This is a present action.

- **Action 5** – Do not install the Head of Old River Barrier if delta smelt entrainment is a concern. If installation of the Head of Old River Barrier is not allowed, the agricultural barriers would be installed as described in the Project Description. If installation of the Head of Old River Barrier is allowed, the South Delta Temporary Barrier Project flap gates would be tied in the open position until May 15. This is a present action.

- **Action 6** – A program to create or restore a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh is expected to be implemented. A monitoring program will be developed

to focus on the effectiveness of the restoration program. This is a present action.

Fish Restoration Program The Fish Restoration Program Agreement between the CDFW and DWR, addresses specific habitat restoration requirements of the USFWS and NMFS BOs for SWP and CVP operations. The agreement is also intended to address the habitat requirements of the CDFW longfin smelt Incidental Take Permit (ITP) for SWP Delta operations. The agreement was signed by the Directors of DWR and CDFW on October 18, 2010 and has been amended once (November 15, 2010) since that time.

The primary objective of the Fish Restoration Program is to implement the fish habitat restoration requirements and related actions of the NFMS and USFWS BOs and the ITP in the Delta, Suisun Marsh, and Yolo Bypass. The program is focused on restoring 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh to benefit delta smelt, 800 acres of low salinity habitat to benefit longfin smelt, and a number of related actions for salmonids. Habitat restoration actions implemented in compliance with the 2008 USFWS BO that also meet the habitat restoration requirements of the ITP will satisfy the acreage requirements of the ITP (DWR and CDFW 2010).

Water Quality Control Plan for the Sacramento and San Joaquin River Basins The Water Quality Control Plan for the Sacramento and San Joaquin River Basins outlines several agricultural water quality control programs, including the San Joaquin River Subsurface Agricultural Drainage Control Program, the Lower San Joaquin River Salt and Boron Control Program, and the San Joaquin River Dissolved Oxygen Control Program, which are being implemented to achieve the water quality objectives outlined in the plan. These programs aim to establish water quality objectives for specific pollutants and to develop strategies to meet those objectives by implementing monitoring programs and limiting pollutant discharges.

Bay Delta Conservation Plan (and Alternative Delta Conveyance Facilities) The BDCP is an HCP and Natural Communities Conservation Plan with the goals of restoring the Delta ecosystem and securing California water supplies. The BDCP would secure California's water supply by building new water delivery infrastructure and operating the system to improve the ecological health of the Delta. The BDCP also would restore or protect approximately 150,000 acres of habitat

to address the Delta's environmental challenges (Reclamation and DWR 2013a).

The DWR, acting as the lead agency for compliance with CEQA, and Reclamation, the USFWS, and NMFS, acting as lead agencies for compliance with NEPA, issued a Draft EIR/EIS for public review and comment in December 2013. The BDCP consists of conservation measures that include components for water conveyance facilities combined with water conveyance operations; conservation components including land acquisition for major habitat restoration efforts in the Delta; and components related to reducing other stressors on the Bay-Delta ecosystem The conservation strategy includes biological goals and objectives; conservation measures; avoidance and minimization measures; and a monitoring, research, and adaptive management program.

Currently, several alternative Delta conveyance facilities are being evaluated as part of the plan. Among these alternatives are a through-Delta facility and an isolated facility that would convey water around the Delta for local supply and export through a hydraulically isolated channel or tunnel.

San Joaquin River Restoration Program As described previously (see the discussion of full SJRRP Restoration Flows in "Quantitative Assessment of Actions Related to Water Resources," above), the SJRRP was established based on the 2006 Settlement of the *Natural Resources Defense Council et al., v. Rodgers, et al*. lawsuit. The program would restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish; and reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement. Reasonably foreseeable SJRRP actions are described in Chapter 2.

North-of-Delta Offstream Storage Investigation The North-of-Delta Offstream Storage Investigation is a feasibility study being performed by Reclamation and DWR, in partnership with local interests. Pursuant to the CALFED solution principles, storage locations that would not add a new dam on a major stream were considered and evaluated. As its name indicates, the North-of-Delta Offstream Storage Investigation focuses on offstream storage north of the Delta –

specifically, potential projects for offstream storage of surface water at Sites Reservoir in the upper Sacramento River basin.

Offstream storage located north-of-the-Delta would require conveying water from the Sacramento River or one of its major tributaries to the new storage location. An offstream storage conveyance system could use either existing diversions and canals or new diversions and conveyance. Water would be diverted during periods of relatively higher flow through the conveyance system, into the new offstream storage reservoir, and stored until it is needed to meet the planning objectives.

Such storage could increase water supply reliability for all beneficial uses (agricultural, urban, and environmental). The Sites Reservoir Project could increase water supplies available for export in years when export supplies otherwise would be limited. This project also could modify the timing and magnitude of upstream reservoir releases in wet years.

A notice of intent/notice of preparation for this project was issued in November 2001. The complete plan formulation report was published in September 2008 and a progress report of current feasibility studies activities and accomplishments was released in December 2013. Ongoing studies include: additional engineering designs, feasibility level cost estimates, mitigation requirements, federal economic analyses, sensitivity analyses related to BDCP, and project financial feasibility (Reclamation and DWR 2013b).

Shasta Lake Water Resources Investigation In June 2013, Reclamation released a Draft EIS in relation to the Shasta Lake Water Resources Investigation. The Draft EIS evaluates the feasibility of raising Shasta dam through five alternatives: 6.5 feet raise, 12.5 feet raise, and three 18.5 feet raises. All alternatives focus on anadromous fish survival and water supply reliability. The project alternatives provide between 47.3 and 113.5 TAF of increased firm water supplies per year, develop between 54 and 117 GWh/year of increased hydropower generation, and reduce flood damages downstream from Shasta Lake. All alternatives also enhance anadromous fish survival through expansion of the cold water pool in Shasta Lake. Additionally, two of the 18.5 feet dam raise alternatives include further fisheries benefits by providing a combination of dedicated cold water pool; adaptive management plans; augmented spawning gravel in the upper Sacramento River; enhanced aquatic habitat in tributaries to Shasta Lake; and restoration of riparian, floodplain, and side

channel habitat in the upper Sacramento River (Reclamation 2013a). Reclamation is preparing the Final EIS for the Shasta Lake Water Resources Investigation.

North Bay Aqueduct Alternative Intake Project DWR proposes to implement the North Bay Aqueduct Alternative Intake Project to improve water quality and to provide reliable deliveries of SWP supplies to its contractors, the Solano County Water Agency and the Napa County Flood Control and Water Conservation District. This proposed project would include the construction and operation of an alternative intake on the Sacramento River, generally upstream from the Sacramento Regional Wastewater Treatment Plant, and connect it to the existing North Bay Aqueduct system by a new segment of pipe. The proposed alternative intake would be operated in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The North Bay Aqueduct Alternative Intake Project would include the following facilities:

- A new alternative intake structure and pump station on the Sacramento River with state-of-the-art, positive-barrier fish screens
- A new pipeline segment to convey the water from the alternative intake to a point of connection with the existing North Bay Aqueduct near the North Bay Regional Water Treatment Plant
- Other project-related support facilities such as surge tanks

The notice of completion and transmittal for the North Bay Aqueduct Alternative Intake Project EIR was published in November 2009 (DWR 2009a). A scoping report was released in February 2010 (ESA 2010). It is anticipated that the public review draft EIR will be available in summer 2014.

North Delta Flood Control and Ecosystem Restoration Project DWR certified the EIR for the North Delta Flood Control and Ecosystem Restoration Project in 2010 and filed a Notice Of Determination with the Governor's Office of Planning and Research on November 9, 2010. This project will implement flood control improvements in the north Delta, principally on and around McCormack-Williamson Tract, Dead Horse Island, and Grizzly Slough, in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce

damage to land uses, infrastructure, and the Bay-Delta ecosystem caused by catastrophic levee failures in the Delta. Lack of funding has delayed the implementation of the project (DWR 2014d).

Franks Tract Project, North/Central Delta Improvement Study Reclamation and DWR propose to implement the Franks Tract Project to improve water quality and fisheries conditions in the Delta. Operable gates would be installed to control the flow of water at one of two locations on either Threemile Slough or West False River. The project gates would be operated seasonally (January through September) and during certain hours of the day, depending on fish presence and tidal conditions. The Franks Tract Project is consistent with ongoing planning efforts for the Delta to help balance competing uses and to create a more sustainable system for the future. The North/Central Delta Improvement Study (Delta Cross Channel, Franks Tract, and Through-Delta Facility Evaluation) recommended alternatives include constructing an operable gate on Threemile Slough and an operable gate on West False River for further analysis (Reclamation 2009). The Franks Tract Project has been delayed.

Dutch Slough Tidal Marsh Restoration Project This proposed project is a cooperative partnership between DWR, CALFED, the California Coastal Conservancy, landowners, the Natural Heritage Institute, the City of Oakley, and Ironhouse Sanitary District. The project entails restoring wetlands and uplands and providing public access to the 1,166-acre Dutch Slough property owned by DWR.

The primary goal of the Dutch Slough Tidal Marsh Restoration Project is to provide ecosystem benefits, including habitats for sensitive aquatic species. The project will be designed to maximize opportunities to assess the development of those habitats and measure ecosystem responses so that future Delta restoration projects will be more successful (DWR and California State Coastal Conservancy 2008). Since the release of the Final EIR in 2010, there have been significant changes to the tidal wetlands restoration project near the mouth of Dutch Creek. These changes include construction of flood protection levees, levee setback changes, changes to proposed levee upgrades, new habitat management strategies, trails, and construction methods (DWR and California State Coastal Conservancy 2014). In January 2014, the supplement to the Dutch Slough Tidal Marsh Restoration Project Final EIR was

released to address the environmental effects of the proposed changes to the project.

Suisun Marsh Management, Preservation, and Restoration Plan Federal and State agencies jointly developed this comprehensive 30-year regional plan to address the use of resources on about 52,000 acres of wetland and upland habitats in Suisun Marsh near Fairfield. The focus of the Suisun Marsh Management, Preservation, and Restoration Plan is to achieve an acceptable multiple-stakeholder approach to the restoration of tidal wetlands and the enhancement of managed wetlands and their functions. The plan balances implementation of the CALFED Program, the Suisun Marsh Preservation Agreement, and other management and restoration programs for Suisun Marsh and is based on voluntary participation by private landowners.

DWR and Reclamation have collaboratively prepared the environmental documents with NMFS, CDFW, and the Suisun Resource Conservation District. The Final EIS/EIR was made available in December 2011 (Reclamation et al. 2011), and the ROD was signed April 2014.

In-Delta Storage Program (Delta Wetlands Project) DWR, in coordination with the CALFED Bay-Delta Authority and with technical assistance from Reclamation, completed the State feasibility study for the In-Delta Storage Program in the south Delta, within the extended study area. The In-Delta Storage Project would provide capacity to store approximately 217 thousand acre-feet of water in the south Delta for a wide array of water supply, water quality, and ecosystem benefits. The project would consist of two storage islands (Webb Tract and Bacon Island) and two habitat islands (Holland Tract and Bouldin Island), an embankment design, consolidated inlet and outlet structures, project operations, and habitat management plans. The objectives of the project are to enhance water supply reliability and the operational flexibility of the CVP/SWP system, contribute to ecosystem restoration, and provide water for the Environmental Water Account (DWR 2010a). Detailed planning work by the State on the In-Delta Storage Project has been suspended since July 2006 when State funding was cut (DWR 2010a); however, a Final EIR was certified in 2012 by Semitropic Water Storage District and other environmental documentation is under way (USACE 2013).

Los Vaqueros Reservoir Expansion Project Los Vaqueros Reservoir was completed in 1997 to provide 100,000 acre-feet

of offstream water storage to improve water quality and provide emergency storage for CCWD customers. The purpose of the Los Vaqueros Reservoir Expansion Project is improve Bay Area water supply reliability and quality, develop water supplies for environmental water management, and help meet municipal and industrial water demands during drought and emergency periods, primarily through the expansion of Los Vaqueros Reservoir.

To date, the project has entailed the expansion of Los Vaqueros Reservoir from 100,000 acre-feet to 160,000 acre-feet, which required a dam raise, the relocation of recreation facilities, and an upgrade of the pumps at the Transfer Pump Station. The dam raise to 160,000 acre-feet was completed in 2012 and mitigation activities were completed in 2013. Further expansion of Los Vaqueros Reservoir is feasible to as much as 500,000 acre-feet. New Delta intakes, pumps, and pipelines would be required to fill the additional reservoir capacity, and water deliveries would be made from the expanded reservoir to Bay Area beneficiaries through new conveyance facilities.

Completion of the Draft Federal Feasibility Report is planned for 2015 and a final report is to be completed in 2016. A final decision on further expansion of the reservoir beyond 160,000 acre-feet is expected to occur in 2016, depending on the level of participation by other Bay Area water agencies, Reclamation, and DWR. Project implementation will also consider the CCWD Board Principles and the additional assurances, commitments, and requirements adopted by the CCWD Board on June 25, 2003.

East Bay Municipal Utility District Water Supply Management Program 2040 The Water Supply Management Program 2040 (WSMP 2040) is a program-level effort that estimates EBMUD's water supply needs over a 30-year planning horizon and proposes a diverse portfolio of policy initiatives and potential projects to ensure that those needs can be met in dry years. On October 13, 2009, the EBMUD Board of Directors approved the WSMP 2040. The CEQA analysis was challenged in court, and in a ruling issued on April 11, 2011, EBMUD was directed to analyze certain plan components in more detail. On May 24, 2011, the EBMUD Board set aside certification of the WSMP 2040 Program EIR and directed staff members to revise the program. That revision effort has since been completed, and on April 24, 2012, the EBMUD Board of Directors certified the revised program EIR

and adopted the revised final plan for the WSMP 2040 (EBMUD 2012).

San Joaquin River Salinity Management Plan Reclamation has a Management Agency Agreement with the Central Valley Water Board to meet the San Joaquin River salinity objective at Vernalis and implement a TMDL program to meet the San Joaquin River salt and boron objectives at Vernalis through activities identified in its Salinity Management Plan. This plan outlines actions used for management of water quality to improve salt, boron, and other constituent conditions on the lower San Joaquin River. The plan was developed in conjunction with the Management Agency Agreement and focuses on three major groups of actions taken by Reclamation: providing flows to the system, reducing salt load to the river, and facilitating mitigation.

The TMDL could be implemented through a base load allocation plus offset or mitigation activities, or through the Central Valley Water Board adoption of a stakeholder-developed Real Time Management Program. The first TMDL compliance deadline for Reclamation and westside discharges is July 2014. Reclamation is also evaluating alternatives for a programmatic management approach to meet the salt and boron TMDLs by 2014. Salt load reduction actions include the Grassland Bypass Project, as previously described.

San Luis Reservoir Low Point Improvement Project and San Luis Reservoir Expansion B.F. Sisk Dam (also known as San Luis Dam) is a 300-foot-high, compacted earthfill embankment located on the west side of the Central Valley approximately 12 miles west of Los Banos. Owned by Reclamation and operated by DWR, the dam is more than 3.5 miles long. B.F. Sisk Dam impounds San Luis Reservoir, which has a total capacity of more than 2 million acre-feet The Gianelli Pumping-Generating Plant lifts water from both the California Aqueduct and the Delta-Mendota Canal (via O'Neill Forebay) into San Luis Reservoir for storage. The dam and reservoir are located in an area of high potential for severe earthquakes on active faults, primarily the Ortigalita Fault, which crosses the reservoir.

Reclamation and SCVWD initiated feasibility studies of water supply delivery reliability risks associated with algal blooms and low reservoir levels in San Luis Reservoir in 2001 with the San Luis Low Point Improvement Project (SLLPIP) appraisal study. A feasibility study was subsequently authorized by

Public Law 108-361. The SLLPIP Initial Alternatives Information Report identified raising B.F. Sisk Dam as one alternative to the low-point problem (Reclamation, SCVWD, and San Luis and Delta Mendota Water Authority 2008); however, the alternative was eliminated from study because more cost-effective solutions seemed available at that time (Reclamation, SCVWD, and San Luis and Delta Mendota Water Authority 2011).

In December 2013, Reclamation completed the San Luis Reservoir Expansion Draft Appraisal Report (2013b). The report recommends further studies in coordination with Reclamation's Dam Safety Office, DWR, SCVWD, and the San Luis & Delta-Mendota Water Authority, and other entities to ensure development of a feasible solution to the several risks to CVP and SWP water delivery reliability. Recommendations in the report include restoring one or more San Luis Reservoir expansion alternatives to the SLLPIP to determine (1) actions needed to correct the identified dam safety risks, and (2) technical, environmental, economic, and financial feasibility of increasing south of Delta surface water storage capacity under a wide range of future conditions, including climate change and changes in Delta export and conveyance capacity.

Delta-Mendota Canal/California Aqueduct Intertie
Construction on the DMC/California Aqueduct Intertie project began in October 2010 and was completed in April 2012. The intertie connects the DCM and the California Aqueduct near San Luis Reservoir and is used in a number of ways to achieve multiple benefits, including meeting current water supply demands, allowing for the maintenance and repair of CVP Delta export and conveyance facilities, and providing operational flexibility to respond to emergencies related to both the CVP and SWP.

Delta-Mendota Canal Recirculation Project Reclamation is evaluating the feasibility of the DMC Recirculation Project, which would involve recirculating water from the Delta through CVP pumping and conveyance facilities to the San Joaquin River where it enters the Delta. The project would provide flows to reduce salinity concentrations in the San Joaquin River. It could also reduce reliance on New Melones Reservoir for meeting water quality and fishery flow objectives. Reclamation prepared a plan formulation report in September 2010, and project evaluation is ongoing.

Lower San Joaquin River Flood Improvement Project The Lower San Joaquin River Flood Improvement Project is a component of the CALFED Conveyance Program, and would be designed to improve flood control capacity on the lower San Joaquin River and enhance ecosystem structure and function in the lower San Joaquin River and the south Delta. USACE and DWR are the lead agencies for this project. In February 2009, DWR, USACE, and the San Joaquin Area Flood Control Agency (SJAFCA) signed a cost share agreement. SJAFCA has partnered with Reclamation districts 2042, 2126, 2115, 1608, 2074, 1614, 828, 404, 403, 17, and the City of Lodi. The multi-year feasibility study will extend along the San Joaquin River from the southern portion of San Joaquin County, through Stockton, and up to the Lodi waste water treatment plant.

Bay Area Water Quality and Supply Reliability Program The Bay Area Water Quality and Supply Reliability Program encourages participating Bay Area partners, specifically the Alameda County WD, Alameda County Flood Control and Water Conservation District, Bay Area Water Users Association, CCWD, EBMUD, City of San Francisco, and SCVWD, to develop and coordinate regional exchange projects to improve water quality and supply reliability. This project involves the cooperation of these agencies in operating their water supplies for the benefit of the entire Bay Area, as well as the potential construction of interconnects between existing water supplies. In September 2013, the 2013 Bay Area Integrated Regional Water Management Plan was released and seeks to integrate projects and actions proposed in the 2006 Bay Area Integrated Regional Management Plan. The plan establishes a framework to address water conflicts and challenges in the Bay Area from 2013 to 2033 (Bay Area IRWMP Coordinating Committee 2013). Specific strategies of the plan were updated to be consistent with the California Water Plan Update 2013 and include water use efficiency, integrated flood management, conjunctive groundwater management, water recycling, desalination of brackish and seawater, imported water, surface storage, and water transfers.

Conditional Waiver of Waste Discharge Requirements for Irrigated Lands A conditional waiver is a regulatory process under California's nonpoint source program plan designed to meet requirements of the CWC. The CWC requires any person who is discharging waste, other than to a community water system that could affect the quality of the waters of the State within the Central Valley, to file a report of waste discharge

with the Central Valley RWQCB. The CWC requires the Central Valley RWQCB to prescribe Waste Discharge Requirements (WDR), or waive WDRs, for the discharge. The Central Valley RWQCB's Irrigated Lands Waiver Program (Agricultural Order) was established under Order WQ 2013-0101 and waives the waste discharge permit requirement for discharges from irrigated lands so long as certain compliance conditions are met. The Agricultural Order defines discharges from irrigated lands as tier 1 (least concern), tier 2 (moderate concern), or tier 3 (highest concern) according to the risk the discharges pose to water quality conditions in a water of the State. All discharges are required to implement control to reduce pollutant runoff, such as backflow prevention devices, maintain riparian vegetative over and riparian areas, and prepare of a farm management plan. Tier 2 dischargers are required to implement certain irrigation and nutrient management practice to control nitrates, and tier 3 dischargers are required to maintain water quality buffers (State Water Board 2013).

Tracy Fish Collection Facility and Tracy Fish Facility Improvement Program The Tracy Fish Collection Facility, located in the Central Valley near Stockton, was developed and built in the 1950s by Reclamation with interagency cooperation as part of the CVP. The purpose of the facility was to protect fish from entering the DMC by way of the Tracy Pumping Plant. Reclamation began the Tracy Fish Facility Improvement Program in 1989 with the overall goal of improving fish protection and fish salvage at the Tracy Fish Collection Facility.

Facility improvement under the Tracy Fish Facility Improvement Program have included new fish hauling trucks, new louver cleaner rakes, repair of metals in bypasses, new trash racks, replacement of the upstream trash boom, improved instrumentation for monitoring hydraulic conditions, re-surfacing holding tanks with "fish friendly" coatings, development of on-site fisheries labs, development of research level fish holding facilities for biological testing, installation of a demonstration of a "fish-friendly" pumping system with an above ground holding tank and installation of a large traveling screen for mitten crab removal (Reclamation 2013d).

Central Valley Joint Venture The CVJV is a self-directed coalition consisting of 21 Federal and State agencies and private conservation organizations. This partnership directs its efforts toward the common goal of providing for the habitat

needs of migrating and resident birds in the Central Valley of California. From 1988 through March 2013, the CVJV has protected, restored, and enhanced a total of 762,000 acres in California (CVJV 2013).

Comprehensive Conservation Management Plans for National Wildlife Refuges USFWS is directed to develop comprehensive conservation management plans to guide the management and resource use for each refuge of the National Wildlife Refuge System under requirements of the National Wildlife Refuge Improvement Act of 1997. Refuge planning policy also directs the process and development of comprehensive conservation management plans. A comprehensive conservation management plan describes the desired future conditions and long-range guidance necessary for meeting refuge purposes. It also guides management decisions and sets forth strategies for achieving refuge goals and objectives within a 15-year time frame. Efforts are on-going to complete all required plans.

Jensen River Ranch Habitat Enhancement and Public Access Project The site for this project covers approximately 167 acres on the San Joaquin River north of Fresno, below the Woodward Park bluffs along the north side of Woodward Regional Park. The property is owned by the SJRC, which was created by the State legislature to develop and manage the San Joaquin River Parkway. Phase II of project received grant funding from the California Wildlife Conservation Board in 2011.

When completed, the project will connect the Jensen River Ranch site with Woodward Regional Park via paved and natural public trails, and would include habitat restoration and picnic sites near the San Joaquin River. Currently, the property is accessible through the Lewis S. Eaton Trail and through Woodward Park and an interim loop trail provides access to the San Joaquin River (SJRPCT 2014a).

Lost Lake Park Master Plan Lost Lake Park is located at the southern edge of the community of Friant 1.5 miles downstream from Friant Dam. The Master Plan Study Area is in an unincorporated area of Fresno County and consists of 374 acres owned by the County of Fresno, California Department of Fish and Game, and the San Joaquin River Conservancy. The Lost Lake Park Master Plan seeks to improve recreation areas for the general public, and enhance wildlife habitat values. The plan includes recontouring steep slopes to improve

hydrology, habitat, and public access; a native riparian forest and shade tree planting program; upgrades to existing facilities along the San Joaquin River; construction of a new camping area; bicycle and equestrian trails, facilities, parking, and access outside of the 100-year flood plain; a Friant Community Park; and a 11.5 miles inter-connected formal trail system (Fresno County and State of California San Joaquin River Conservancy 2011).

Riparian Habitat Joint Venture The RHJV was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird population through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in the *Riparian Bird Conservation Plan* (RHJV 2004). The conservation plan targets 14 “indicator” species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy.

San Joaquin River Parkway Plan The San Joaquin River Parkway and Conservation Trust was created in 1988 with the goal of establishing a continuous greenway along 33 miles of the San Joaquin River in the Fresno-Madera region. Working with Federal, State, and local agencies and governments, to protect lands around the San Joaquin River through acquisitions, easements, and wildlife habitat restoration, the San Joaquin River Parkway & Conservation Trust seeks to provide public access to the river and improve the Lewis S. Eaton Trail. The trust is currently focusing on the 22-mile stretch of River between Friant Dam and Highway 99. The San Joaquin River Parkway Task Force drafted the Interim San Joaquin River Parkway Master Plan in December 1997, and work to update the plan began in 2012 (SJRPCT 2014b).

Fresno County General Plan The *Fresno County General Plan* (Fresno County 2000) was updated in October 2000. In

the study area, Fresno County's land use jurisdiction lies south and west of the San Joaquin River centerline. Agriculture is essential to the visions and goals of the *Fresno County General Plan* (Fresno County 2000). The general plan also identifies as a priority the protection and enhancement of water quality and quantity in Fresno County's streams, creeks, and groundwater basins through the protection of floodplain lands. Notably, the general plan seeks to preserve and enhance the San Joaquin River corridor principally in those areas adjoining the county's river corridor by avoiding adverse impacts from development and encouraging environmentally friendly recreational and agricultural activities.

Madera County General Plan The Madera County General Plan prioritizes the maintenance of agriculturally designated areas for continued agricultural uses and directs urban uses to designated new growth areas, existing communities, and existing cities. It discourages the conversion of prime agricultural land to nonagricultural land uses unless an immediate and clear need can be demonstrated (Madera County 1995a).One of the goals in the general plan is to protect and enhance the natural qualities of Madera County's streams, creeks, and groundwater, minimizing sedimentation and erosion of creeks and damage to riparian habitat. The general plan also prioritizes the protection of wetland communities and related riparian areas throughout Madera County as valuable resources, the protection of riparian zones around natural watercourses, and the conservation of remaining upland habitat areas adjacent to wetlands and riparian areas that are critical to the feeding or nesting of wildlife species associated with these wetland and riparian areas.

City of Fresno General Plan The City of Fresno's 2025 *Fresno General Plan* (2002) was adopted on February 1, 2002. The general plan "constitutes an update of the Master Parks Plan and will be used as a programmatic framework by the City of Fresno to ensure sufficient park facilities and to maintain a variety of meaningful and balanced recreational programs for residents for the upcoming 20-plus year planning horizon" (City of Fresno 2002). The plan supports the San Joaquin River Parkway Master Plan and supports the following actions:

- Delineating the parkway and defining existing uses

- Preserving and enhancing the San Joaquin River and bluffs while allowing appropriate recreational development
- Providing guidance on location and design of recreational facilities in the river bottom and bluff areas
- Minimizing impacts from parkway facilities and uses on adjacent private property
- Providing law enforcement and safety services for the parkway
- Providing facilities and activities that are compatible with surface mining activities in the river
- Providing a parkway trail network and linkages to the city
- Providing new opportunities for equestrian use in parkway areas
- Providing new and enhanced canoeing opportunities on the river

Brighton Crest/Eagle Springs Golf Course and Country Club In December 1990, Fresno County approved a 184-lot subdivision on a 55-acre parcel located south of Millerton Road between the Brighton Crest Subdivision and Friant-Kern Canal, approximately 1.5 miles east of the unincorporated community of Friant. The project is now known as the Eagle Springs Golf Course and Country Club. A golf course has been constructed as part of this development, and a total of 86 water connections have been established for the project. It is unknown when this residential project will be completed.

Millerton New Town Millerton New Town, a self-funded 2,000 acre community, would be located just south of Millerton Lake. Over 4,500 units are proposed that would house between 10,000 and 12,000 people in a range of custom homes, apartments, single-family, and manufactured homes. In additional to water treatment and tertiary wastewater treatment plans and a civic center, Millerton New Town would also include wildlife and cultural resources corridors and a scenic roadway designation (Fresno County 2008).

Friant Ranch Specific Plan As the Lead CEQA agency for this project, Fresno County released the *Friant Community Plan Update & Friant Ranch Specific Plan Draft EIR* in 2011. The Friant Ranch Specific Plan would develop a community for people age 55 and older next to the existing community of Friant northeast of the City of Fresno and near Friant Dam. The plan would develop a mixed use community with 2,638 age-restricted single family residences, 83 age-restricted multifamily residences, 180 non-age-restricted multifamily units, and a 250,000 square foot Village Core. The Plan also includes 15 miles of trails, and parkways, 20 acres of parks and public open space, 92 acres of landscaped slopes, and 275 acres of conservation open space (Fresno County 2009).

Millerton Specific Plan If implemented, the Millerton Specific Plan would develop approximately 540 acres on the northern and southern sides of Millerton Road in Fresno County. The development would include post-graduated residential housing, open space, and institutional lands for use by a private post-graduate medical campus with 2,000 students. The campus will cover at least 175 plus acres of land between Winchell Cove Road and the western edge of the *Millerton Specific Plan Area* (Fresno County 2013).

Gunner Ranch West Area Plan In 1994, the Gunner Ranch West Area Plan was approved. This document builds upon the Madera County General Plan to guide development in the 1,135-acre project site located along the San Joaquin River in southeastern Madera County. The plan proposes increased commercial, industrial, and residential development and also provides guidelines for the associated roadways, landscaping, infrastructure, and open space that should accompany the new development.

Gateway Village Specific Plan Gateway Village is a 1,973-acre area in southeastern Madera County, east of Road 40 and west of the community of Rolling Hills Estates. The Gateway Village Specific Plan was developed in 2006 to establish a cohesive framework for development in the area. The plan aims to “develop a distinctive, master-planned community that fosters interaction with neighbors and between neighborhoods through pedestrian-friendly design.”

Rio Mesa Area Plan In 1995, Madera County developed the *Rio Mesa Area Plan*, which is intended to guide the development of the Rio Mesa Area, which is located East of Highway 41 and South of Highway/Road145 and borders the

San Joaquin River and Millerton Lake on the north (Madera County 1995b). The plan also includes rural residential and agricultural lands and a community core that will include housing, retail and service industry developments, and offices.

North Fork Village The North Fork Village project site spans 2,238 acres in the northern most section of the Rio Mesa Area Plan footprint and is adjacent to the northern side of Millerton Lake. The project would develop nearly 3,000 residential units, 1,500,000 square feet of commercial and mixed used space, an elementary school, and 629 acres of open space and revegetation areas on land that is currently used for agricultural use (Madera County 2008a). The Final EIR for the project was released in July 2008, and the most northern portion of the project has been approved for development (Sierra Star 2012).

Ventana Hills Estates Annexation Ventana Hills Estates Annexation is a 310-acre community located north of Auberry Road and south of Millerton Lake. This development consists of 91 lots for custom homes and includes 70 acres of natural open space and a trail system for recreation.

Bureau of Land Management-Bakersfield Office Resource Management Plan The planning area for the Bureau of Land Management-Bakersfield Office RMP comprises 17 million acres within Kings, San Luis Obispo, Santa Barbara, Tulare, Ventura, Madera, eastern Fresno, and western Kern counties and will replace the 1997 Caliente Regional Management Plan. The preferred alternative in the Final RMP and EIS, issued in 2012, specifies continued production of commodities and public land use while preserving important ecological, cultural, and recreational resources. The preferred alternative includes a reduction in non-energy mineral activities, but an increase in agricultural grazing land (BLM 2012).

Friant-Kern Canal Reverse Flow Project The San Joaquin River Restoration Settlement Act authorized the construction of pump-back facilities on the Friant-Kern Canal, subject to feasibility and availability of funds from the SJRRP. The facilities would allow the canal to deliver water conveyed from the Cross-Valley Canal north, in reverse of gravity flows; with a capacity of 500 cfs at the Poso Creek and Shafter check structures and 300 cfs at the Lake Woollomes check structure. Reclamation is currently leading the feasibility study for this project.

Friant-Kern and Madera Canals Capacity Restoration Project The San Joaquin River Restoration Settlement Act authorized the restoration of the Friant-Kern and Madera canals to capacities designed and built by Reclamation, subject to feasibility. The Friant-Kern and Madera canals have developed canal capacity constraints, which limit the delivery of surplus supplies from Friant Dam during wet periods. The Draft EA and Feasibility Report for the Friant-Kern Canal Capacity Restoration Project was released in June 2011 (Reclamation 2011a) and feasibility report was finalized following the public comment period. The EA is expected to be finalized in 2014. Reclamation is currently pursuing implementation in coordination with the Friant Water Authority. Reclamation is currently leading the feasibility study for the Madera Canal Capacity Restoration Project.

Delta Plan The Delta Stewardship Council was established by the California Legislature in 2009 as part of the comprehensive water legislation, SB 1, and is tasked with protecting the Delta and the critical role the Delta serves through implementing two "coequal goals." The coequal goals are (1) providing a more reliable water supply for California, and (2) protecting, restoring, and enhancing the Delta ecosystem. The coequal goals are to be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place (CWC Section 85054). Members of the council include representatives from different areas of the State who offer diverse expertise in fields, such as agriculture, science, the environment, and public service.

The California Legislature established the Delta Stewardship Council to do the following:

> *…provide for the sustainable management of the Sacramento-San Joaquin Delta ecosystem, to provide for a more reliable water supply for the state, to protect and enhance the quality of water supply from the Delta, and to establish a governance structure that will direct efforts across state agencies to develop a legally enforceable Delta Plan.*

The Delta Stewardship Council developed the Delta Plan and Program EIR to serve as a basis for future findings of consistency by State and local agencies. The Delta Plan is a legally enforceable, comprehensive management plan for the

Delta and the Suisun Marsh that achieves the coequal goals and all of the inherent subgoals and objectives (Delta Stewardship Council 2013). The document served as the basis for submittal of a Notice of Proposed Rulemaking to the Office of Administrative Law. The Delta Plan advises and urges timely completion of the BDCP by agencies involved. When completed, the BDCP must be incorporated into the Delta Plan if it meets certain statutory requirements described under CWC 85320 (Delta Stewardship Council 2011). Implementing the Delta Plan in conjunction with the BDCP could change CVP and SWP operations and could possibly affect operations of Friant Dam and Millerton Lake.

State Water Board Delta Flow Action Both the CVP and SWP operate pursuant to water right permits and licenses issued by State Water Board for water storage, releases, and diversions. Over time, the State Water Board has issued decisions that modify the terms and conditions of CVP and SWP water rights. As a result of the 2009 Delta Reform Act, the State Water Board has initiated a new administrative process to evaluate water outflow requirements on upstream tributaries to the Delta as a component of updates to the Bay-Delta Plan. This may, if implemented, significantly impact CVP and SWP operations, as well as those of other upstream reservoirs.

San Joaquin River Exchange Contractors Water Authority Water Transfer Program 2014 to 2038 The Exchange Contractors and Reclamation completed a EIS/EIR to support a 25-Year Water Transfer Program, from 2014 to 2038, to allow the transfer of up to 150 TAF of substitute water from the Exchange Contractors to other water users (Reclamation and Exchange Contractors 2013). Under the 25-Year Water Transfer Program, the existing water transfer of up to 80 TAF via conservation measures (primarily tailwater recovery) would continue, up to 50 TAF of water could be made available via land fallowing, and up to 20 TAF of conserved water could be made available under certain specified conditions, for a total water transfer amount of up to 150 TAF. Finally, the 25-Year Water Transfer Program includes the transfer and/or exchange of the transferred water described above to not only those CVP contractors who were included in the existing program but also to other CVP and SWP contractors in Alameda, Contra Costa, Monterey, Santa Cruz, and Kern counties (other receiving areas).

Westside Regional Drainage Plan The Westside Regional Drainage Plan was developed by the Exchange Contractors, Broadview Water District, Panoche Water District, and Westlands Water District to quick-start drainage elements identified in the San Luis Drainage Feature Reevaluation feasibility study. Implementing the Westside Regional Drainage Plan is assumed to result in the elimination of salt discharges to the San Joaquin River from the Grassland Drainage Area. The Westside Regional Drainage Plan seeks to manage subsurface drainage and achieve a salt balance on productive lands through several mechanisms, including the application of drainage to salt-tolerant crops at a regional reuse facility to reduce the volume of water discharged into Mud Slough (North) and improve the water quality of that discharge. An element of the Westside Regional Drainage Plan is the San Joaquin River Water Quality Improvement project. For this project, the Panoche Water District evaluated the acquisition of up to 2,900 acres of land to expand the existing 4,000-acre Phase I In-Valley Treatment/Drainage Reuse Facility to reach up to 6,900 acres of reuse area within the Grassland Drainage Area. The proposed project would also install minor conveyance modifications and plant salt-tolerant crops.

Semitropic Water Storage District Groundwater Banking Project The Semitropic Groundwater Storage Bank began operation in 1990 and is one of the largest groundwater banking programs in the world. The purpose of the Semitropic WSD groundwater banking program is to provide water for agricultural and urban use during drought years. Currently, six banking partners commit surplus water to Semitropic WSD in wet years: MWD, SCVWD, ACWD, Newhall Land and Farming Company, Zone 7 Water Agency, and San Diego County Water Authority. These partners have delivered approximately 700 TAF of water to Semitropic WSD, and more storage will become available when expansion of the facility is complete.

The Stored Water Recovery Unit of the groundwater banking program has been permitted and is ready for construction. This new unit will increase storage by 650 TAF to an expanded total capacity of 1.65 MAF, and will increase recovery capacity to 200 TAF, resulting in a guaranteed water supply or pumpback capacity of 290 TAF per year. This new unit enables Semitropic to deliver up to 423 TAF of water to the SWP in dry years (Semitropic 2014).

State Water Project Water Supply Contract Extension Program The Water Supply Contract Extension Program's goal is to amend the financial provisions of SWP long-term water supply contracts and extend contract terms beyond 2035, through negotiations between DWR and the SWP contractors in a public forum. Bonds used to finance SWP expenditures currently have terms less than 30 years, since most SWP contracts expire in 2035, and challenge the affordability of servicing debt for SWP Contractors. The program will allow for financing through the sale of 30 year bonds, ensuring water supply affordability, while maintaining compliance with CEQA and the Monterey Settlement Agreement. Negotiations began in May 2013 and a final CEQA document is expected in 2015 (DWR 2014c).

State Water Project Water Settlement Agreement In 2013, DWR issued the Final Initial Study/Negative Declaration of a settlement to amend agreements related the SWP long-term water supply contacts for the Solano County Water Agency, the Napa County Flood Control and Water Conservation District, the City of Yuba City, and the County of Butte (Plaintiffs). The Plaintiffs claim that they are entitled to preferred SWP deliveries under Water Code Section 10505 (county of origin statute), Water Code Section 11460 et seq (area of origin statutes), and Article 18 of the SWP Contracts (urban preference and limitations of SWP contractual rights). Implementation of the Settlement would modify SWP allocation to improve water supply reliability and increase volumes of water to the Plaintiffs, which are located NOD. Deliveries to the Plaintiffs have been reduced due to export limitations SOD resulting from regulatory restricts. In the proposed Settlement, additional water delivered to the four contractors would be dependent on hydrologic conditions and regulatory restrictions at the time of delivery. The deliveries would include water available at Delta outflow, available as exports SOD, and available to the four contractors as a different SWP water type. DWR plans to implement the Settlement while continuing to meet regulatory requirements and not encouraging previously unplanned growth (DWR 2013b).

Poso Creek Integrated Regional Water Management Plan The Poso Creek Integrated Regional Water Management Plan (IRWMP) was adopted in July 2007 by the Poso Creek Regional Management Group, which comprises Semitropic Water Storage District, Cawelo Water District, Delano-Earlimart ID, Kern-Tulare Water District, North Kern Water

Storage District, Rag Gulch Water District, Shafter-Wasco ID, and the North West Kern Resource Conservation District. These districts overlay the Tulare Lake Basin Hydrologic area in northern Tulare County and southern Kern County. The goal of the IRWMP is to conjunctively manage the water resources that are available to member agencies (Poso Creek Regional Management Group 2007). These resources include the following:

- SWP via the California Aqueduct
- CVP via the California Aqueduct and Friant-Kern Canal
- Kern River
- Poso Creek
- Common groundwater basin

Projects recommended in the IRWMP and constructed include the Friant-Kern Canal–Lerdo Canal intertie and the Cross Valley Canal–Calloway Canal intertie.

Southern Sierra Integrated Regional Water Management Plan The Southern Sierra IRWMP spans from the headwater of the San Joaquin, Kings, Kaweah, Tule, and Kern River watersheds to the foothills. The IRWMP was completed but has yet to receive funding for projects. It is currently being revised by a workgroup that includes 17 local, state, and federal agencies, as well as local land owners and Native American tribes. Regional priorities include increased water supply reliability, meadow restoration, and land use changes to improve water quality and reduce recreational impacts and fire and flood risk (Southern Sierra IRWMP workgroup 2012).

Kern River Integrated Regional Water Management Plan The purpose of the Kern River IRWMP is to address the expanding M&I water needs and continued agricultural needs in the Tulare Lake Basin portion of Kern County that are currently served by limited SWP and CVP supplies that have been impacted by drought and regulatory restrictions. The IRWMP lists potential projects and establishes a project ranking system that will:

- Increase water supply

- Increase operational efficiency
- Improve water quality
- Promote land use planning and resource stewardship
- Improve regional flood management (Kern County 2011)

In February 2014, the following projects in the IRWMP were awarded Proposition 84 funding: Kern Water Bank Recharge and Recovery Enhancement, Snyder Well Intertie Pipeline for Irrigation and Nitrate Removal, Sycamore Road Flood Reduction, Tehachapi Regional Water Use Efficiency, and Urban Bakersfield Water Conservation Project (DWR 2014b).

Kings Basin Integrated Regional Water Management Plan
The Kings Bain IRWMP was adopted in 2012 and was a collaborative effort between 54 agencies to update the 2007 plan to comply with newer DWR standards. The IRMWP covers approximately 610,000 acres of portions of Fresno, Kings, and Tulare counties, overlaying a sub-basin of the San Joaquin Valley groundwater basin that is located within the Tulare Lake Hydrologic Region. Goals of the IRWMP include the following:

- Reduction of groundwater overdraft
- Increased water supply reliability
- Improved water quality and drinking water reliability
- Enhanced flood protection
- Enhanced ecosystem and services (Kings Basin Water Authority 2012)

In February 2014, five projects were selected to receive Proposition 84 funding: Fresno ID's Southwest Groundwater Banking Project, Laguna ID Recharge Basin 11, Bakman Water Company Water Supply Reliability and Conservation Project, City of San Joaquin Water Supply Reliability and Conservation Project, and City of Kerman Residential Water Meter Project (DWR 2014b). These projects are in addition to several projects that were funded before the 2012 IRWMP update.

Kaweah River Basin Integrated Regional Water Management Plan The Kaweah River Basin IRWMP is currently in development and will build upon the Kaweah Delta Water Conservation District's 1995 and 2006 groundwater management plans. The plan will focus on groundwater management and projects that will reduce groundwater overdraft, but will also include the broader goals of improving water supply, water quality, flood control, and ecosystem restoration. (Kaweah Delta Water Conservation District 2014). In 2011, the Kaweah Delta Water Conservation District received funding for the Groundwater Quality Protection and Investigation Project, the Oakes Basin Habitat Enhancement Project, the Paragien Basin Project, Plum Basin Project, and the Water Reuse Pipeline Project (DWR 2011a).

Deer Creek & Tule River Authority Groundwater Management Plan Update While no IRWMP has been developed for the Tule River, the Deer Creek & Tule River Authority (DCTRA) released a groundwater management plan update in 2012. The groundwater management plan was adopted to monitor and manage groundwater activities, and implement groundwater projects between DCTRA member agencies: Lower Tule River, Pixley, Porterville, Terra Bella, Saucelito, Tea Pot Dome, and Vandalia irrigation districts. The groundwater basin underlying the Tule Basin is critically overdrafted. The plan seeks to mitigate groundwater overdraft through groundwater recharge and extraction management, management of well heads and recharge areas to protect groundwater quality, and conjunctive use policies (DCTRA 2012).

Westside Integrated Water Resources Plan The San Luis & Delta-Mendota Water Authority produced the Westside Integrated Water Resources Plan in 2006, which encompasses all areas served by the Water Authority's member agencies: Banta-Carbona, Byron-Bethany, Patterson, Westside, and West Stanislaus IDs; Centinella, and Del Puerto water districts; and the City of Tracy. The plan specifies projects and actions to address the existing water supply and demand gap, while benefiting the environment and improving socio-economic status through drainage. The plan also includes projects and actions to improve flood control, groundwater management, land use, and water conservation, supply, and efficiency (San Luis & Delta-Mendota Water Authority 2006). Projects listed in the integrated water resources plan include the Westside Regional Drainage Plan and the San Luis Reservoir Low-Point Improvement Project.

Madera County Integrated Regional Water Management Plan The Madera County IRWMP (2008) was developed to address the county's reliance on groundwater to meet domestic and agricultural needs, and to address flood risks in the San Joaquin Valley. In the foothills and mountains in Madera County, the plan recommends:

- Development of new water supply wells, where appropriate
- Protection of groundwater recharge areas
- Use of recycled water
- Protection of groundwater quality
- Implementation of vegetation management projects

On the Valley floor, the plan recommends:

- Participation in water banking, increased use of recharge facilities, and groundwater conjunctive use
- Preserving and better-managing CVP allocations, and purchasing Section 215 water from the CVP
- Storage of water supplied by Temperance Flat RM 274 in water banks
- Importing Merced River water
- Analyzing the feasibility of expanding the Madera Canal
- Development of a county flood control program and emergency management program
- Assessing the legality of imposing limits on groundwater pumping (Madera County 2008b)

Merced Integrated Regional Water Management Plan The Merced IRWMP, adopted in 2013 and covering all of Merced County, seeks to meet water demand for all users while correcting current groundwater overdraft conditions, maximizing water use efficiency, improving flood management, addressing climate change, and protecting restoring, and improving natural resources. Priority projects include recharge basins, flood control projects, surface water

infrastructure upgrades, educational programs, and conservation and water metering projects (Merced ID, County of Merced, and City of Merced 2013). In 2014, Proposition 84 funding was awarded for the Black Rascal Flood Control Project, the El Nido Recharge Basin, the Merced River Education and Enhancement Program, and the Planada Community Services District Water Conservation Project (DWR 2014b).

East Stanislaus Integrated Regional Water Management Plan The East Stanislaus IRWMP was completed in 2013 and covers a region bordered by the Stanislaus River on the north, Tuolumne County on the east, the Merced River, Turlock Groundwater Subbasin and the Turlock ID on the south, and the San Joaquin River on the west. Major rivers within the planning region also include the Tuolumne River and Dry Creek. The plan evaluates surface water and groundwater supplies available to the region, quantifies current and projected water supply demands, and evaluates the potential effects of climate change on water supply timing and availability. The goals of the plan are to:

- Reduce water demand
- Improve operational efficiency and transfers
- Increase water supply
- Improve water quality
- Practice resource stewardship
- Improve flood management (City of Modesto, City of Turlock, City of Ceres, and City of Hughson 2013)

Eastern San Joaquin Integrated Regional Water Management Plan The Eastern San Joaquin IRWMP was adopted in 2007 by the Northeastern San Joaquin County Groundwater Banking Authority, which was formed to mitigate groundwater overdraft conditions in San Joaquin County (Northeastern San Joaquin County Groundwater Banking Authority 2007). The IRWMP defines and integrates water management strategies to mitigate and mange groundwater overdraft. The plan calls for implementation of the Eastern San Joaquin Integrated Conjunctive Use Program. The program would develop 140-160 TAF per year of new water supply for the Basin that would be used to support conjunctive use by the

Groundwater Banking Authority. Potential additional water supply sources were limited based on existing water rights permits, water service contracts and agreements, and pending water rights applications (Northeastern San Joaquin County Groundwater Banking Authority 2011).The Integrated Conjunctive Use Program final PEIR was released in 2011.

Qualitative Assessment of Actions and Conditions Related to Flood Management

The actions related to flood management described below were identified as present or reasonably foreseeable.

Central Valley Flood Protection Plan Legislation passed in 2007 directed DWR to develop three documents to support improvement of integrated flood management in the Central Valley:

- *State Plan of Flood Control Descriptive Document* to inventory and describe the flood management facilities, land, programs, conditions, and mode of operations and maintenance for the State/Federal flood protection system in the Central Valley (DWR 2011b).

- *Flood Control System Status Report* to assess the status of the facilities included in the State Plan of Flood Control Descriptive Document, identifies deficiencies, and makes recommendations (DWR 2011b).

- CVFPP to describe a sustainable, integrated flood management plan that reflects a systemwide approach for protecting areas of the Central Valley that currently receive protection from flooding by existing facilities of the State Plan of Flood Control. The 2012 CVFPP (DWR 2012a) is supported by the *State Plan of Flood Control Descriptive Document* (DWR 2012b), the *Flood Control System Status Report* (DWR 2011b), and the *2012 Central Valley Flood Protection Plan Consolidated Final Program Environmental Impact Report* (DWR 2012c).

The CVFPP is a sustainable, integrated flood management plan that describes the existing flood risk in the Central Valley and recommends actions to reduce the probability and consequences of flooding. Produced in partnership with Federal, tribal, local, and regional partners and other interested parties, the CVFPP also identifies the mutual goals, objectives, and constraints important in the planning process; distinguishes

plan elements that address mutual flood risks; and recommends improvements to the State/Federal flood protection system. The 2012 CVFPP was completed by DWR and adopted by the Central Valley Flood Protection Board in July 2012. It is currently being implemented through regional planning efforts and two basinwide feasibility studies for the Sacramento and San Joaquin river basins, respectively.

CALFED Levee System Integrity Program DWR, CDFW, and USACE implement the CALFED Levee System Integrity Program, which maintains and improves the integrity of the Bay-Delta estuary's levee system. The goal of the Levee System Integrity Program is to reduce risks to land use and associated economic activities, water supply, agricultural and residential uses, infrastructure, and the ecosystem from the effects of catastrophic breaching of Delta levees.

Maintenance has been ongoing along more than 600 miles of eligible project and nonproject levees, and levee stability has been improved for more than 45 additional miles of levees. Large levee rehabilitation projects have been undertaken on numerous islands. Projects have also been implemented to grow native vegetation, reuse more than 2 million cubic yards of dredged material for levee stability and habitat development, and develop approximately 50 acres of riparian and wetland habitat and 3,000 linear feet of shaded riverine aquatic habitat (CALFED 2011).

Folsom Dam Joint Federal Project Folsom Dam regulates flows in the American River for flood control, and releases from Folsom Reservoir are used for irrigation, power, municipal and industrial, fish and wildlife, water quality, and other purposes. The Folsom Joint Federal Project is a collaborative effort by Reclamation and USACE to address the hydrologic risk related to dam safety at the dam, and to improve flood protection. This project, scheduled for completion in 2017, includes construction of a new auxiliary spillway southwest of the existing main concrete dam. The new spillway facility will allow Reclamation's dam operators to better manage large floods by safely releasing more water from Folsom Reservoir earlier during a large storm through both the spillway gates on Folsom Dam and the new auxiliary spillway's six gates, thus reducing hydrologic risk and leaving more storage capacity in the reservoir. Improvements to Folsom Dam also include construction of a 3.5-foot dam raise. USACE is currently preparing an EIS/EIR for the potential dam raise.

Delta Islands and Levees Feasibility Study The Delta Islands and Levees Feasibility Study is USACE's mechanism to participate in a cost-shared solution to address ecosystem restoration needs, flood risk management problems, and related water resources in the Delta and Suisun Marsh area. A Feasibility Cost Share Agreement was executed on May 26, 2006 with DWR, the non-Federal sponsor. A combined Draft Feasibility Report / Draft EIS for the study was issued April 2014 (USACE and DWR 2014). The proposed action is to restore approximately 89.5 acres of lost or degraded tidal marsh habitat in the west central portion of the Delta through transporting and placing dredged material into open water habitat to restore 80.3 acres and 9.2 acres of tidal marsh at Big Break and Little Franks Tract, respectively (USACE and DWR 2014).

South Delta Flood Bypass Construction of a flood bypass through the southern Delta in the vicinity of Paradise Cut and Steward Tract has been considered in recent years by various parties, including USACE, the State of California, SJAFCA, various non-governmental organizations, and land developers. Proposals have suggested that a new bypass could reduce the potential for flooding along the lower San Joaquin River and south Delta, particularly for the communities of Lathrop, Manteca, and Stockton (NRDC 2008). Other proposals have suggested that a new bypass could also contribute to habitat restoration and improvement efforts in the south Delta and provide mitigation for the effects of sea level rise. No specific proposals have reached the environmental review stage at this time, but broad support for the concept would suggest that that some form of action is likely to move forward in the future.

Qualitative Assessment of Actions and Conditions Related to Power and Energy

The actions related to energy that are described below were identified as present or reasonably foreseeable.

Big Creek Facilities FERC Relicensing SCE owns and operates seven hydroelectric projects, collectively comprising the Big Creek System, in the eastern portion of the upper San Joaquin River Basin upstream from Kerckhoff Lake. SCE is completing a multiyear collaborative process for relicensing four of its seven Big Creek hydroelectric projects. FERC provided approval to SCE on March 15, 2000, to use an Alternative Licensing Process (ALP) to relicense four of the seven projects (SCE 2000). A settlement agreement was signed during April 2007 by SCE and more than 45 diverse

stakeholders. The settlement agreement calls for extensive plans to mitigate project-related effects on aquatic, terrestrial, and cultural resources, and improve land and recreation management (SCE 2007) and will become effective once FERC has issued an Order Issuing New License for any of the four facilities. The FERC Final EIS for Hydropower Licenses Big Creek ALP Projects was released on March 13, 2009 (FERC 2009).

California Department of Water Resources Oroville Facilities FERC Relicensing P-2100 The 762-megawatt project is located on the Feather River in Butte County and occupies 6,240 acres of Federal lands. The Final EIR and Notice of Determination were issued in July 2008. The Final EIS was issued in June 2008 (DWR 2007). FERC is currently waiting for the NMFS BO before completing the relicensing process for P-2100.

PG&E Kerckhoff Hydroelectric Project Licensing PG&E owns and operates the Kerckhoff Hydroelectric Project, consisting of Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse. On November 27, 2012, PG&E filed an application with FERC to retire Kerckhoff No. 2 Powerhouse (PG&E 2012). The application constitutes a non-capacity amendment as it does not propose enlarging the capacity of the project. The license for the Kerckhoff Hydroelectric Project expires November 30, 2022.

PG&E Crane Valley Hydroelectric Project The Crane Valley Hydroelectric project was constructed between 1895 and 1920 and comprises Willow, Peckinpah, and Whiskey creeks and Bass, Manzanita, Chilkoot, and Corrine lakes. Crane Valley Dam impounds the North Fork Willow Creek and creates Bass Lake. Bass Lake also receives water from the South Fork Willow Creek through the 2-mile Brown Creek conduit, and through other small streams. Water travels beneath Bass Lake through a tunnel to the Crane Valley Powerhouse, then to a forebay upstream from the PG&E San Joaquin No. 3 Powerhouse and empties into Manzanita Lake. Water from Manzanita Lake travels through a conduit to a second forebay before passing through the PG&E San Joaquin No.2 Powerhouse. Water is then conveyed to the PG&E San Joaquin No. 1A Powerhouse and released into Corrine Lake, which serves as the forebay from the A.G. Wishon Powerhouse. Water from the A.G. Wishon Powerhouse is released to the San Joaquin River near the upstream end of Kerckhoff Lake (PG&E 2006b).

New Friant River Outlet Powerhouse A small powerhouse owned by Orange Cove ID using water supplied to the San Joaquin Hatchery is located at Friant Dam, but is not part of the Friant Power Project or associated with the CVP. In March 2008, Orange Cove ID informed FERC of a partnership with the FPA to add a new 1.8 MW powerhouse, the Friant Fishwater Release Hydroelectric Project, under an existing FERC license authorized in October 13, 2006. FPA and Orange Cove ID later filed an amendment to their existing license to construct a new powerhouse at a different location, and to increase installed capacity from 1.8 to 7.0 MW and hydraulic capacity from 130 to 370 cfs. The amendment of license application was filed by FERC on February 22, 2010, and supplemented on May 13, 2010 (FERC 2010). FPA issued a Negative Declaration in May 2010, followed by a Notice of Determination in July 2010. The new powerhouse would share a common penstock connection to an outlet pipe through Friant Dam, controlled from a common control room at Friant-Kern Powerhouse, and would be a separate structure from the existing River Outlet Powerhouse, with a single vertical turbine and synchronous generator (Reclamation 2011b).

Merced River Hydroelectric Project, FERC Project No. 2179 Merced ID's Hydroelectric Project is located on the Merced River near the City of Merced. It consists of a major storage reservoir, Lake McClure, with storage of just over one million acre-feet. The New Exchequer Powerhouse, located at the downstream base of New Exchequer Dam, has a capacity of 94.5 MW. The New Exchequer Powerhouse releases directly into the 9,730 acre-foot McSwain Reservoir, which serves as an afterbay. The main purpose of the project is to provide agricultural water for the Merced ID. The initial FERC license for the Project expired February 28, 2014, and Merced ID is currently pursuing relicensing of the project.

Don Pedro Project Relicensing, FERC No. 2299 Owned by the Modesto ID and the Turlock ID, the project was placed into service in 1971. The Don Pedro Project is a federally-licensed water storage and hydroelectric generating facility located on the Tuolumne River in the Sierra Nevada foothills nearly 130 miles east of San Francisco. It consists of a 2,030,000 AF reservoir and a 203 MW powerhouse. Don Pedro provides water storage for irrigation and domestic use as well as energy from a renewable resource. Don Pedro operations also benefit fish, wildlife, and recreation resources, as well as providing flood control benefits through cooperation with the USACE.

The project operates under a 50-year license granted to the Districts by FERC. The current license extends through April 30, 2016. The Modesto ID and Turlock ID filed the Draft License Application in November 2013 and then the Final License Application for relicensing on April 28, 2014.

Qualitative Assessment of Actions and Conditions Related to Recreational Resources

Bureau of Land Management-Bakersfield Office Resource Management Plan The *Bakersfield Proposed Resource Management Plan & Final Environmental Impact Statement* was released by BLM in 2012. The preferred alternative proposes designating the 5.4 miles of the San Joaquin River Gorge from the base of Kerckhoff Dam to Kerckhoff Powerhouse tailrace as wild and scenic. The preferred alternative proposes to designate 6,490 acres as the San Joaquin River Gorge Special Recreation Management Area to increase hiking, mountain biking horseback riding, camping, and educational opportunities. Additionally, the proposed alternative proposes to designate Millerton Cave as a significant cave due to its important and significant cave resources (BLM 2012).

Millerton Lake Resource Management Plan and General Plan The Millerton Lake RMP and General Plan was developed by Reclamation and California State Parks in 2011. The plan selected in the ROD, Alternative 2, seeks to enhance current recreated uses and public access at Millerton Lake, while protecting natural resources with new or modified land and recreation management practices. The plan manages boat densities and speeds on Millerton Lake and would develop new recreation opportunities while protecting natural resources. Specifically, the plan would upgrade campground, picnic and access areas around Millerton Lake and develop a group camping area at Temperance Flat on the south side of the river. New facilities would be balanced with resource protection and mitigation lands/ buffer lands could be acquired surrounding developments (Reclamation and California Department of Parks and Recreation 2010).

San Joaquin River Parkway Plan The San Joaquin River Parkway and Conservation Trust was created in 1988 with the goal of establishing a continuous greenway along 33 miles of the San Joaquin River in the Fresno-Madera region. Working with Federal, State, and local agencies and governments, to protect lands around the San Joaquin River through acquisitions, easements, and wildlife habitat restoration, the

San Joaquin River Parkway & Conservation Trust seeks to provide public access to the river and improve the Lewis S. Eaton Trail. The trust is currently focusing on the 22-mile stretch of River between Friant Dam and Highway 99. The San Joaquin River Parkway Task Force drafted the Interim San Joaquin River Parkway Master Plan in December 1997, and work to update the plan began in 2012 (SJRPCT 2014b).

Air Quality and Greenhouse Gas Emissions

For criteria air pollutants, the SJVAPCD acknowledges that the entire SJVAB, including Fresno and Madera Counties, is designated as nonattainment area for ozone and $PM_{2.5}$ with regards to the California and National ambient air quality standards, and for PM_{10} with regards to the California Ambient Air Quality Standards due to the combined levels of emissions generated by sources throughout the SJVAB. These sources include, but are not limited to, the following:

- Population growth and associated development of infrastructure and traffic
- Conversion of natural vegetation to agricultural and developed land uses
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)
- CVP operations and local water development actions
- PG&E and Southern California Edison hydroelectric projects

With regard to TACs and related levels of health risk exposure, both SJVAPCD and the ARB have acknowledged that background levels of health risk are too high in the SJVAB.

Because climate change-causing GHGs persist in the atmosphere long enough periods to be dispersed around the globe, they are considered global pollutants. Therefore, all past and present GHG-emitting projects formulate the cumulative context for analyzing the contribution to climate change from the GHG emissions generated by the action alternatives.

Table 27-2 summarizes the direct, indirect, and cumulative impacts to air quality.

Table 27-2. Direct, Indirect, and Cumulative Impacts to Air Quality and Greenhouse Gas Emissions

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
AQ-2: Project-Generated Construction-Related Toxic Air Contaminant Emissions that would Expose Sensitive Receptors to Substantial Pollutant Concentrations and Increased Health Risks	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
AQ-3: Project-Generated Operational Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

Reasonably foreseeable probable future projects involving construction or changes in traffic patterns in the vicinity of the primary study area would generate emissions of criteria air pollutants and precursors, as well as TACs and GHGs. These projects include development projects (e.g., Gunner Ranch West Specific Plan, Brighton Crest, Ventana Hills Estates Annexation) and hydroelectric projects (e.g., PG&E Kerckhoff Hydroelectric Project licensing and the Big Creek

Hydroelectric Project). In addition, continued development, as allowed in the Fresno County and Madera County general plans, would result in increases in population and traffic in the primary study area.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area associated with air quality and greenhouse gas emissions.

Impact AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations

Under all action alternatives, construction-related activities would result in a direct effect on air quality from project-generated criteria air pollutant (PM_{10}) and precursor emissions (ROG and NOx) from heavy-duty truck travel on proposed haul routes; and from heavy-duty construction equipment at the activity areas. Based on the modeling conducted, project-generated construction-related ROG, NOx, and PM_{10} emissions would exceed SJVAPCD's significance thresholds. All control measures in compliance with the requirements of Regulation VIII are incorporated into the project description, as described in Chapter 2, "Alternatives." However, the remaining project-generated construction-related fugitive PM_{10} dust emissions would violate or contribute substantially to an existing or projected air quality violation, especially considering the current nonattainment status of the area and could expose nearby existing sensitive receptors to substantial pollutant concentrations. Consequently, project-generated construction-related emissions, when added to other closely related past, present, and reasonably foreseeable probable future projects could further violate or contribute substantially to an existing or projected air quality violation, especially considering the current nonattainment status of the area and expose sensitive receptors to substantial pollutant concentrations. For these reasons, implementation of the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impact** on air quality.

Impact AQ-2: Project-Generated Construction-Related Toxic Air Contaminant Emissions that would Expose Sensitive Receptors to Substantial Pollutant Concentrations and Increased Health Risks

Construction-related activities under all the action alternatives would result in a direct effect on air quality from project-

generated TAC emissions from heavy-duty truck travel on proposed haul routes and heavy-duty construction equipment. Based on the modeling conducted, the worst-case project-generated construction-related excess cancer risk would be less than SJVAPCD's significance threshold of 10 chances per million with implementation of Mitigation Measure AQ-1 and AQ-2, under any of the action alternatives regardless of whether Option A, B, or C is selected. SJVAPCD's threshold is considered to represent the allowable incremental level of health risk exposure without subjecting any exposed sensitive receptors to unacceptable levels of risk while still progressing toward overall risk reduction goals within both the primary study area and the SJVAB. Also, given that exposure to project-related TAC emissions would decrease with increasing distance from the source, TAC emissions from other projects would not combine with project-related emissions to result in substantial increases in cancer risk at nearby sensitive receptors. For these reasons, implementation of the action alternatives would not cause a cumulatively considerable incremental contribution to the overall significant cumulative impact of health risk exposure from TACs.

Impact AQ-3: Project-Generated Operational Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations

As explained above, the project area is designated as nonattainment for the ozone and $PM_{2.5}$ Federal and State ambient air quality standards, and for the PM_{10} California Ambient Air Quality Standards. Under all action alternatives, operations would not result in project-generated criteria air pollutant (PM_{10}) and precursor emissions (ROG and NOx) associated with recreational activities that exceed SJVAPCD's significance thresholds. Emissions for all criteria air pollutants would be considered minor (i.e., less than 1 ton per year). Therefore, operational emissions would be minimal and would not interfere with attainment of Federal or State ambient air quality standards and would not result in a cumulatively considerable incremental contribution to the overall significant cumulative impacts on air quality.

Impact AQ-4: Generation of Greenhouse Gas Emissions that Would Significantly Impact the Environment

Estimated annual GHG emissions would exceed the applicable threshold of 25,000 MT/year for all action alternatives, regardless of the implementation of other projects. Therefore,

the generation of GHG emissions (Impact AQ-4, significant and unavoidable), as described in Chapter 4, "Air Quality and Greenhouse Gas Emissions," would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impact** related to GHG emissions.

Extended Study Area

The action alternatives would not result in any impacts to air quality in the extended study area. Given that the contribution of GHG emissions to climate change is inherently a global issue, GHG emission generated by the proposed project affect both the primary study area and extended study area.

Biological Resources – Fisheries and Aquatic Ecosystems

Actions of past and present projects that have resulted in a change in fisheries and aquatic ecosystems in the primary and extended study areas include:

- Population growth and associated development of socioeconomic resources and infrastructure
- Introduction of nonnative plant and animal species
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)
- CVP operations and local water development actions and transfers
- PG&E, Merced ID, Turlock ID, Modesto ID, and Southern California Edison hydroelectric projects

Past and present actions by humans have substantially altered aquatic ecosystems in the central Sierra Nevada foothill region and throughout the Central Valley compared to historical conditions. These past and present actions have resulted in significant adverse impacts on the suitability and connectivity of aquatic ecosystems. The degraded nature of the remaining habitat affects the survivability of native fisheries and other aquatic species.

As discussed in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," and shown in Table 27-3, the action alternatives could result in direct and/or indirect impacts in

both the primary and extended study areas. There are no HCPs adopted for the primary study area that currently directly protect fisheries resources (although the PG&E HCP, through the protection of riparian habitat, may indirectly benefit fish). Therefore, implementing any of the action alternatives would not result in conflicts with adopted HCPs in the primary study area. As a result, this issue is not evaluated further in the cumulative impact analysis for the primary study area.

Table 27-3. Direct, Indirect, and Cumulative Impacts to Biological Resources – Fisheries and Aquatic Ecosystems

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
FSH-1: Loss of Riverine Habitat for Lotic Fish Species	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
FSH-2: Short-term Degradation of Aquatic Habitat from Accidental Spills or Seepage of Hazardous Materials during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
FSH-3: Short-term Degradation of Aquatic Habitat from Increased Turbidity or Sedimentation during Construction of Temperance Flat RM 274 Dam and Other Facilities	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
FSH-4: Loss of Reservoir Fish Habitat Resulting from Changes in Water Temperature	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
FSH-5: Changes to Reservoir Fish Habitat Caused by Turbidity from Increased Surface Area of Exposed Shoreline	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
FSH-6: Loss of Reservoir Fish Caused by Entrainment	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
FSH-7: Change in Shallow-Water Habitat for Largemouth Bass, Spotted Bass, Smallmouth Bass, and Other Sport Fish Species	Primary Study Area	All	Beneficial	NC
	Extended Study Area	All	NI	NC

Table 27-3. Direct, Indirect, and Cumulative Impacts to Biological Resources – Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
FSH-8: Change in Open-Water Habitat for Striped Bass and American Shad	Primary Study Area	All	Beneficial	NC
	Extended Study Area	All	NI	NC
FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
FSH-10: Change in Habitat Potential for Spring-Run Chinook Salmon	Primary Study Area	All	NI	NC
	Extended Study Area	Alternative Plans 1 - 4	LTS and Beneficial	BC
		Alternative Plan 5	PSU	CU
FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration	Primary Study Area	All	NI	NC
	Extended Study Area	All	SU	CU
FSH-12: Change to Habitat for Moderately Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	BC
FSH-13: Changes to Habitat for Highly Tolerant Native Fish Species from Altered Water Temperatures	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	NC
FSH-14: Changes to Spawning and Rearing Habitat from Changes to Flood Pulses and Floodplain Connectivity	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
FSH-15: Change in Fish Habitat and Migratory Behaviors from Changes in Water Temperatures	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Table 27-3. Direct, Indirect, and Cumulative Impacts to Biological Resources – Fisheries and Aquatic Ecosystems (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
FSH-16: Change in Fish Habitat and Migratory Behaviors from Changes in Flows	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
FSH-17: Loss of Fish Habitat from Changes in Tributary Flows	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations	Primary Study Area	All	NI	NC
	Extended Study Area	All	PSU	CU
FSH-19: Loss of Suitable Fish Habitat from Salinity Changes in the Delta	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
FSH-20: Loss of Suitable Fish Habitat from Change in Flow Patterns in the South Delta	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
FSH-21: Reduction in Fish Abundance from Changes in Exports and Entrainment in the South Delta	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	NC
FSH-22: Loss of Suitable Fish Habitat Resulting from Changes in X2	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
PSU = potentially significant and unavoidable
SU = significant and unavoidable

Primary Study Area

A few of the reasonably foreseeable probable future projects in the vicinity of the primary study area have the potential to affect aquatic resources that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects (e.g., Gunner Ranch West Specific Plan, Brighton Crest, Ventana Hills Estates

Annexation) and hydroelectric projects (e.g., PG&E Kerckhoff Hydroelectric Project licensing and the Big Creek Hydroelectric Project). Additionally, throughout the central Sierra Nevada foothill region, alteration of aquatic habitat may occur, affecting native fishes.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact FSH-1: Loss of Riverine Habitat for Lotic Fish Species

Past and present actions, particularly the construction and operation of Friant Dam and other water storage and hydroelectric dams, have contributed to significant habitat loss for lotic fish species. Implementing any of the action alternatives would further contribute to habitat loss for lotic fish, and therefore would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** to hardhead and Kern brook lamprey.

Impacts FSH-2 Through FSH-5: Changes in Reservoir Water Quality

The impacts of past and present projects upstream from the primary study area have reduced the sediment load entering the San Joaquin River below Kerckhoff Dam and entering Millerton Lake. Reasonably foreseeable projects could contribute sediment to surface waters in the primary study area, but these contributions would be minimized through compliance with regulatory requirements and implementation of mitigation measures, and would be small compared to the reduced sediment load caused by upstream dams and reservoirs.

Under the action alternatives, construction-related activities would have less-than-significant temporary impacts to fish resulting from an increase in sediment input. This impact would be avoided and minimized via implementation of the erosion and sediment control plans and SWPPP. Because the overall cumulative impact is a reduced sediment load to the San Joaquin River and the action alternatives, as well as reasonably foreseeable future projects, would minimize erosion and associated sediment effects, these impacts (FSH-2 through FSH-5) would not cause a cumulatively considerable incremental contribution to the overall significant cumulative impact related to sediment effects on fish in the primary study area.

Impacts FSH-6 through FSH-8: Changes in Reservoir Fish Habitat and Entrainment

Past projects, including the construction and operations of Friant Dam, Millerton Lake, and Kerckhoff Dam and Reservoir, have resulted in overall significant benefits and less-than-significant impacts to reservoir fish. The presence of Millerton Lake created habitat for reservoir fish that did not previously exist, however operations of Friant Dam periodically create conditions less-than-optimal for the fish by the rapidly changing reservoir elevations.

Past, present, and reasonably foreseeable future projects that have the potential to change reservoir elevations or flow directly into Millerton Lake or Temperance Flat RM 274 Reservoir could affect entrainment as well as both shallow water and open water reservoir fish habitat. The PG&E Kerckhoff Hydroelectric Project licensing and the Big Creek Hydroelectric Project could result in altered flows depending on any outcomes in each license renewal process. This could change inflows and/or timing of inflows to Temperance Flat RM 274 Reservoir, which could affect the reservoir elevations of both Temperance Flat RM 274 Reservoir and Millerton Lake (flows in the San Joaquin River downstream from Millerton Lake would not be affected by these projects). Therefore, these impacts (FSH-6 through FSH-9) would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to reservoir fish habitat in the primary study area.

Impact FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass

Operation of the Kerckhoff No. 2 Powerhouse currently provides the hydraulic conditions that create American shad spawning habitat. If any of the action alternatives were to be implemented, PG&E would retire a portion of the Kerckhoff No. 2 Powerhouse, resulting in elimination of American shad spawning habitat. Therefore would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** to American shad.

Extended Study Area

A number of reasonably foreseeable probable future projects in the vicinity of the extended study area have the potential to affect aquatic resources that also may be affected by implementing any of the action alternatives. Because the aquatic resources vary so greatly between different regions in

the extended area, this section is broken into 4 regions, following the aquatic regions described in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems."

San Joaquin River from Friant Dam to the Merced River
Reasonably foreseeable probable future projects with the potential to affect aquatic resources that also may be affected by implementing any of the action alternatives include various actions under the SJRRP, such as the release of full Restoration Flows, reintroduction of spring-run Chinook salmon, control of piscivorous species, and fish habitat restoration including restoration of spawning gravel and floodplain and riparian habitat in the San Joaquin River between Friant Dam and the Merced River. Overall, the SJRRP is designed to benefit fisheries and aquatic ecosystems in this portion of the extended study area, although some adverse effects would occur (primarily as a result of temporary construction activities). Flows of cooler water to maintain suitable water temperatures in the upper sections of this river to protect the early life stages of spring-run Chinook salmon would be released as part of Restoration Flows. Release of full Restoration Flows under the SJRRP would reduce or avoid peak flood releases in some years but, as described in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems," the SJRRP would substantially increase the number of years with flood pulse flows sufficient to manage for desired floodplain habitat functions.

Projects such as the Grassland Bypass and the DMC Recirculation will improve water quality, and habitat enhancement projects along the San Joaquin River (e.g., Jensen River Ranch Habitat Enhancement, Lost Lake Park Master Plan, and San Joaquin River Parkway Plan) have the potential to improve riparian habitat. The significant changes to fish habitat and to the native fisheries occurring in the San Joaquin River between Friant Dam and the Merced River resulting from the implementation of the SJRRP and other water quality improvement programs is expected to cumulatively benefit the San Joaquin River fisheries.

Impact FSH-10: Change in Habitat for Spring-Run Chinook Salmon Past, present, and reasonably foreseeable projects to improve riparian habitat and water quality in the San Joaquin River would improve conditions for rearing and migrating spring-run Chinook salmon. Alternative Plans 1 through 4 would further reduce or avoid peak flood releases in some years, but the ability to achieve stipulated flood pulse and

peak flows under the SJRRP would be retained as described in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems." Under Alternative Plans 1 through 4, Impact FSH-10 would result in a **beneficial contribution to the overall significant cumulative impact** to fish habitat in the San Joaquin River between Friant Dam and the Merced River confluence.

Alternative Plan 5 would reduce habitat capacity and productivity during certain year types, primarily Wet and Normal-Wet years. This impact was determined to be potentially significant. No feasible mitigation is available to reduce the severity of Impact FSH-10; therefore, Alternative Plan 5 would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** to spring-run Chinook salmon.

Impact FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration The action alternatives all increase simulated water temperatures between December and May and decrease temperatures in mid- to late-summer and fall, which may improve spawning and holding habitat conditions for spring-run Chinook salmon. Each of the action alternatives produces similar simulated effects on the number of weeks below threshold throughout the 84-mile stretch of river extending from Reach 1A through Reach 3. This has the effect of altering the timing and distribution of water temperatures suitable for juvenile salmon and steelhead migration and smolting throughout a large component of the migratory corridor, increasing both the distance and duration of exposure to water temperatures that inhibit smolting transformation. No feasible mitigation is available to reduce the severity of Impact FSH-11; therefore the action alternatives would result in **a cumulatively considerable incremental contribution to the overall significant cumulative impact** to water temperature conditions supporting juvenile salmon and steelhead migration.

Impact FSH-12: Change to Habitat for Moderately Tolerant Native Fish Species from Altered Water Temperatures The action alternatives would have a mixed effect on water temperature conditions for moderately tolerant fish species under most, but not all, circumstances. When averaged across all years, Alternative Plans 1, 2, 3, and 4 either maintain or modestly improve temperature conditions in each reach. Alternative Plan 5 negatively affects temperatures in Reaches 4A and 5 by decreasing the number of weeks during

which water temperatures are under 77°F. However, when the duration of suitable water temperatures is averaged across all reaches, Alternative Plan 5 temperatures are similar to the No Action Alternative. Therefore, these negative impacts may be offset by the large increases in the number of weeks below threshold in Reaches 2A, 2B1, and 2B2. This impact would be less than significant and beneficial under the action alternatives. Impact FSH-12 would result in **a beneficial contribution to the overall significant cumulative impact**.

Impact FSH-13: Change to Habitat for Highly Tolerant Native Fish Species from Altered Water Temperatures
The action alternatives are projected to have small but potentially beneficial effects on water temperature conditions for highly tolerant native fish species in specific years and specific reaches. The action alternatives would produce a mix of water temperature effects that could influence the extent of suitable habitat conditions for highly tolerant fish species at the warmer 90th percentile water temperatures improving conditions in some reaches, and degrading them in others. When averaged across all reaches, the net water temperature effect of each action alternative is small, decreasing the number of 7-day periods with average water temperatures below 84°F by less than 1 week. Impact FSH-13 would not cause a cumulatively considerable incremental contribution to the overall significant cumulative impact related to water temperatures for highly tolerant native fish species.

Impact FSH-14: Changes to Spawning and Rearing Habitat from Changes to Flood Pulses and Floodplain Connectivity
The action alternatives are designed to capture flood flows, resulting in a reduction in peak and annual average spill rates relative to the No Action Alternative. Because each action alternative captures flood peaks, each affects both the size and frequency of extreme flow events exceeding 8,000 cfs at Friant Dam, and the size and frequency of flow peaks between the Restoration Flows and 8,000 cfs. This impact would be minimal under the action alternatives on the basis that, at minimum, the restoration flow requirements in the Settlement would be achieved in all years under each of the action alternatives. Some effects on the duration of flow volumes between 4,000 and 8,000 cfs may occur. Impact FSH-14 would not cause a cumulatively considerable incremental contribution to the overall significant cumulative impact related to spawning and rearing habitat from changes to flood pulses and floodplain connectivity.

San Joaquin River from Merced to Delta

Reasonably foreseeable probable future projects to improve riparian habitat, flows and water quality in the San Joaquin River, including those identified in the 2009 NMFS BO, CALFED ERP, and the San Joaquin River Exchange Contractors water authority water transfer program 2014 – 2038, may potentially improve conditions for rearing and migrating salmonids and other native fish.

Impact FSH-16: Change in Fish Habitat and Migratory Behaviors from Changes in Flows The action alternatives, when considered in combination with past and present actions, would not significantly change the water temperatures in the San Joaquin River downstream from the Merced River, and would not significantly change the magnitude of flows during critical periods for rearing and migrating, such that a significant cumulative effect would result. Past and present, and reasonably foreseeable projects, including actions under the 2009 NMFS BO (e.g., VAMP), CALFED ERP, and the San Joaquin River Exchange Contractors water authority water transfer program 2014 – 2038, would cumulatively improve riparian habitat, flows and water quality in the San Joaquin River between the Merced River confluence and the Delta. Therefore, Impact FSH-16) would not make a contribution to a significant cumulative impact related to rearing and migrating salmonids and other native fish in the San Joaquin River between the Merced River confluence and the Delta.

San Joaquin River Tributaries

Reasonably foreseeable probable future projects in the San Joaquin River tributaries have the potential to affect native fish. Fisheries instream flows in the Merced and the Tuolumne rivers are being negotiated in the ongoing FERC relicensing processes for New Exchequer and Don Pedro dams. Additionally, the NMFS 2009 BO identified fisheries instream flow requirements in the Stanislaus River. These projects are designed to benefit anadromous fish in the San Joaquin River tributaries.

Delta

The Delta is a vital region for fisheries in the Central Valley, both for resident and anadromous species. Therefore, numerous programs have been established and proposed for restoring habitat conditions for native fisheries, many of which are protected under the ESA. Several programs include direct tidal and marsh habitat restoration (e.g., Suisun Marsh, Dutch Slough, and Franks Tract), while others are directed at

protecting the Delta hydrodynamics (e.g., BDCP, VAMP), and fish facilities (i.e., Tracy Fish Collection Facility Improvement Program). Both the NMFS 2009 BO and USFWS 2008 BO have actions directly targeted at improving conditions for listed fish species in the Delta.

Impact FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations Past, present and reasonably foreseeable probable future projects are likely not sufficient to eliminate the risk to fish caused by low DO in the Delta. No feasible mitigation is available to reduce the severity of Impact FSH-18; therefore the action alternatives would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** to Delta fish habitat from changes in DO concentrations.

Impacts FSH-19 Through FSH-22: Changes in Habitat for Fish in the Delta Past, present and reasonably foreseeable probable future projects intended to improve flows and habitat for fish in the Delta. The action alternatives would not significantly change the conditions in the Delta. Therefore, these impacts (FSH-19 through FSH-22) would not make a contribution to a significant cumulative impact related to Delta fish.

Biological Resources – Botanical and Wetlands

Actions of past and present projects that have resulted in loss and degradation of botanical resources and wetlands in the primary and extended study areas include:

- Population growth and associated development of socioeconomic resources and infrastructure
- Conversion of natural vegetation to agricultural and developed land uses
- Introduction of nonnative plant and animal species
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)
- CVP operations and local water development actions

- PG&E and Southern California Edison hydroelectric projects

Past and present actions by humans have substantially altered botanical resources and waters of the United States, including wetlands, in the central Sierra Nevada foothill region compared to historical conditions. These past and present actions have resulted in significant adverse cumulative impacts on the extent, species composition, and functioning of wetlands, riparian habitats, and oak woodland communities and on the distribution and abundance of plant species associated with these habitats. Large areas of wetland, riparian, and oak woodland vegetation have been lost or degraded in the region over the past 100 years. Other contributing factors to significant adverse cumulative impacts include substantial alteration of flow regimes and reduced flows; dewatering of stream reaches; isolation of floodplains from the river channel by channelization and levee construction; substantial reductions in the frequency, magnitude, and duration of floodplain inundation; habitat fragmentation by physical barriers; and poor water quality. The increase in the distribution and abundance of invasive plant species and nonnative plant communities, the large number of plant species listed as threatened or endangered or assigned a California Rare Plant Rank by CDFW, and the dramatic reductions in the extent of wetland and riparian vegetation in the central Sierra Nevada foothill region are evidence of these overall significant adverse cumulative impacts. These actions have altered habitats, biotic interactions, and physical processes that continue to affect botanical and wetland resources in the region today.

As discussed in Chapter 6, “Biological Resources – Botanical and Wetlands,” and shown in Table 27-4, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-4. Direct, Indirect, and Cumulative Impacts to Biological Resources – Botanical and Wetlands

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat	Primary Study Area	All	LTS	CU
	Extended Study Area	All	LTS	NC
BOT-2: Loss of Riparian Habitat and Other Sensitive Communities	Primary Study Area	All	SU	CU
	Extended Study Area	All	LTS	NC
BOT-3: Loss or Degradation of Waters of the United States, Including Wetlands, and Waters of the State	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
BOT-4: Introduction and Spread of Invasive Plants	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
BOT-5: Elimination of a Plant Community or Substantial Reduction in the Number or Restriction of the Range of an Endangered, Rare, or Threatened Plant Species	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
BOT-7: Conflict with Provisions of an Adopted Habitat Conservation Plan Protecting Wetland or Botanical Resources	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

A number of reasonably foreseeable future projects that would be located in the vicinity of the primary study area have the potential to affect botanical resources and wetlands that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects (e.g., Gunner Ranch West Specific Plan, Brighton Crest, Ventana Hills Estates Annexation) and hydroelectric projects (e.g., PG&E Kerckhoff Hydroelectric Project licensing and the Big Creek Hydroelectric Project). In addition, continued development, as allowed in the Fresno County and Madera County general plans, would result in additional loss of wetlands and of riparian and oak woodland habitats, stream fragmentation and alteration, and loss of special-status plant occurrences and habitat. Throughout the central Sierra Nevada foothill region, conversion, fragmentation, and alteration of native plant communities would continue as a result of planned agricultural and urban development. The proponents of projects that would contribute to significant cumulative impacts on botanical resources and wetlands in the central Sierra Nevada foothill region will be required to identify these impacts and provide mitigation in compliance with the Federal ESA and CESA; NEPA and CEQA; and other Federal, State, and local statutes. Even with compliance with regulatory requirements and implementation of mitigation, a continued decline in the extent and quality of botanical resources and wetlands is expected in the region. Therefore, continued net loss of native plant communities and special-status plant habitats that contribute to an overall significant adverse cumulative impact is expected throughout the region.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat

Implementing any of the action alternatives would result in the direct loss of Madera leptosiphon and tree anemone occurrences and the loss or degradation of their habitat. This loss of habitat cannot be fully mitigated. Continued development in the region will result in the incremental decline in the amount of habitat remaining to support these special-status species. Because implementing any of the action alternatives in the primary study area would contribute to this ongoing decline, it would result in a **cumulatively considerable incremental contribution to the overall**

significant cumulative impact on Madera leptosiphon and tree anemone. No additional feasible mitigation measures are available to avoid or minimize the cumulative considerable incremental contribution of the action alternatives. Therefore, implementing any of the action alternatives would result in a significant and unavoidable cumulative impact.

Impact BOT-2: Loss of Riparian Habitat and Other Sensitive Communities

Oak woodland provides important functions and values to common and special-status plant and wildlife species and functions in carbon sequestration. The extent of oak woodland habitat in the Sierra Nevada foothill region is rapidly declining, and a large percentage of oak woodland has already been lost from the region. Over 1 million acres of California's prior extant oak woodlands have been altered, and 20 percent of the remaining oak woodlands are at risk of being converted to nonwoodland land uses before 2040 (California Oak Foundation 2006). Eighty percent of at-risk oak woodlands are in the Sierra Nevada foothill region. The San Joaquin region (composed of 15 counties extending from Alpine and Amador counties in the north to Kern County in the south) contains 27 percent of the state's oak woodlands, and 10 percent of the region's oak woodlands have already been developed as a result of past projects. It is estimated that approximately 250,000 acres of oak woodland in this region are at risk for loss by 2040 (California Oak Foundation 2006). Most of these losses would occur in the Sierra Nevada foothill belt in Mariposa, Madera, and Fresno counties.

Implementing any of the action alternatives would result in the direct loss of approximately 5,000 acres of oak woodlands. This loss constitutes a cumulatively considerable incremental contribution to the overall significant cumulative impact on oak woodlands in the Sierra Nevada foothills.

Implementing Mitigation Measure BOT-2 would reduce the project's significant impact on oak woodlands; however, there would still be a net loss in oak woodland habitat because the mitigation measure would only preserve existing habitat and would not replace the oak woodland acreage lost from the primary study area. It would be generally infeasible to recreate the functions and values provided by the relatively isolated and undisturbed oak woodland habitat in the primary study area due to a lack of comparable available suitable land and the time it would take to create over 5,000 acres of mature, fully functioning oak woodland communities similar to those that

would be removed by project implementation. Therefore, the impact would remain significant and unavoidable and implementing Alternative Plans 1 through 5 would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** on oak woodlands.

Implementing any of the action alternatives would result in the loss of approximately 40 acres of native riparian habitat that provides important habitat functions and values. However, Mitigation Measure BOT-2 would replace riparian habitat to achieve no net loss of riparian habitat acreage or functions. Therefore, implementing any of the action alternatives, when added to other closely related past, present, and reasonably foreseeable probable future projects, would not make a cumulatively considerable incremental contribution to the significant cumulative impact on native riparian habitat in the region.

Impact BOT-3: Loss or Degradation of Waters of the United States, Including Wetlands, and Waters of the State

Past and present actions by humans have substantially altered waters of the United States, including wetlands, in the central Sierra Nevada foothill region compared to historical conditions. Future actions would contribute to the cumulative loss of wetlands and other waters in the region. Implementing any of the action alternatives would result in the loss of approximately 12 acres of wetlands consisting of seasonal wetland, swale, and freshwater seep and 22 acres of other waters consisting of ephemeral, intermittent, and perennial streams. Most of the existing waters of the United States within the primary study area would be converted to open water lacustrine habitats, but this would not represent an overall loss of waters of the United States. Furthermore, implementing Mitigation Measure BOT-3 would reduce the project's significant impact by replacing aquatic habitats such that the project would not result in a net loss of acreage or functions. Therefore, implementing any of the action alternatives, when added to other closely related past, present, and reasonably foreseeable probable future projects, would not make a cumulatively considerable incremental contribution to a significant cumulative impact on wetlands and other waters in the region.

Impact BOT-4: Introduction and Spread of Invasive Plants

Past and present actions, particularly cattle grazing, in the primary study area, have resulted in widespread introductions of invasive plant species that have degraded habitat for native

species and altered species composition. Implementing any of the action alternatives could result in the introduction and spread of invasive plant species. Implementing Mitigation Measure BOT-4 would reduce the project's potentially significant impact by requiring the implementation of a weed management plan that would prevent the introduction and spread of invasive plant species as a result of project implantation. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to the spread of noxious invasive species in the central Sierra Nevada foothill region.

Impact BOT-5: Elimination of a Plant Community or Substantial Reduction in the Number or Restriction of the Range of an Endangered, Rare, or Threatened Plant Species

Past projects, including road improvement and hydroelectric projects have resulted in losses of tree anemone, a species that is state listed as threatened. Implementing any of the action alternatives could result in further reduction in the number of occurrences of tree anemone by inundating one existing occurrence. Mitigation would reduce the project's significant impact by requiring the collection of seed from affected populations and establishment of new populations of the species in the watershed, as near as practical to the area affected by their implementation, to replace populations that would be eliminated by the project. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact related to the elimination of a plant community or reduction in the number or restriction of the range of special-status plant species in the central Sierra Nevada foothill region.

Impact BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources

The implementation of reasonably foreseeable future projects might result in a variety of physical impacts related to consistency with adopted land use plans. Inconsistencies with adopted land use plans or policies and zoning (Impact LUP-2, significant and unavoidable) generally would not combine to result in cumulative impacts. As described in Appendix G of the State CEQA Guidelines, an impact related to this issue would be significant if implementing an alternative would conflict with any applicable land use plan or policy adopted for the purpose of avoiding or mitigating environmental impacts.

Such a conflict is site specific and is addressed on a project-by-project basis. Land use inconsistency by itself is not considered a significant cumulative impact because it involves land use regulations, not physical environmental impacts. However, inconsistency of an alternative with plans and policies adopted for the purpose of avoiding or mitigating environmental impacts can lead to direct and indirect physical environmental impacts.

Implementing any of the action alternatives would result in significant impacts through conflict with Fresno County and Madera County general plan documents and BLM RMP, including the proposed Wild and Scenic River designation. Depending on the timing of designation with respect to construction of Temperance Flat RM 274 Dam and Reservoir, the action alternatives would either inundate the designated section, or remove the river's eligibility for designation. According to the National Wild and Scenic Rivers System, "as of April 2012, the National System protects 12,598 miles of 203 rivers in 39 states and the Commonwealth of Puerto Rico; this is a little more than one-quarter of one percent of the nation's rivers. By comparison, more than 75,000 large dams across the country have modified at least 600,000 miles, or about 17 percent, of American rivers" (Wild and Scenic Rivers System 2014). Temperance Flat RM 274 Dam and Reservoir would result in less than a 1 percent increase to this total, and would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact** through conflict with local and regional plans and policies.

Extended Study Area

The geographic area being considered in the cumulative impacts analysis of the extended study area is the San Joaquin River and bypass systems extending from Friant Dam to the Delta, Delta waterways, and associated riparian and wetland habitats. The geographic area is limited to riverine, riparian, and wetland habitats because the discharge of water resulting from implementing any of the action alternatives would remain within the current channel capacity of the San Joaquin River, bypass channels, and Delta waterways. Implementing any of the action alternatives would have virtually no impact on land uses, cropping patterns, or botanical or wetland resources in the CVP and SWP water service areas. Therefore, these areas are not included in the geographic extent of this cumulative impacts analysis. Implementing any of the action alternatives would have no impact on wetlands or waters of the United States located in the extended study area, and would not

conflict with local policies or with adopted HCPs. Therefore, consistency with applicable plans or policies is not evaluated further in the cumulative impacts analysis of the extended study area.

Reasonably foreseeable future projects in the extended study area with the potential to affect botanical resources and wetlands include the Jensen River Ranch Habitat Enhancement, Lost Lake Park Master Plan, and San Joaquin River Parkway Plan, which could all contribute to improved riparian habitat in the San Joaquin River between Friant Dam and the Merced River. In the Delta, several programs include direct tidal and marsh habitat restoration (e.g., Suisun Marsh, Dutch Slough, and Franks Tract), which could also benefit riparian species in the area.

The following describes potential cumulative effects to the identified project-related impacts in the extended study area.

Impact BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat

Within the extended study area, implementing any of the action alternatives would result in minor, less-than-significant impacts on special-status plants, because water deliveries would remain within the current normal range of variation and would not result in hydrological changes that could lead to plant mortality, conversion of habitat, or substantial changes in natural community composition or extent.

The relatively minor changes to San Joaquin River instream flows associated with implementing any of the action alternatives would not result in a cumulatively considerable incremental contribution to existing significant cumulative impacts in the extended study area on special-status plants because instream flow changes would remain within the existing channel capacity of the San Joaquin River, bypass channels, and Delta waterways and would not make a cumulatively considerable incremental contribution to significant cumulative impacts related to special-status plant species in the extended study area.

Impact BOT-2: Loss of Riparian Habitat and Other Sensitive Communities

Within the extended study area, implementing any of the action alternatives would result in minor, less-than-significant impacts on riparian habitats because water deliveries would remain within the current normal range of variation and would not

result in hydrological changes that could lead to conversion of habitat.

The relatively minor changes to San Joaquin River instream flows associated with implementing any of the action alternatives would not result in a cumulatively considerable incremental contribution to existing significant cumulative impacts on extended study area riparian habitats, wetlands, and other sensitive communities because instream flow changes would remain within the existing channel capacity of the San Joaquin River, bypass channels, and Delta waterways and would not make a cumulatively considerable incremental contribution to significant cumulative impacts related to riparian habitats, wetlands, and other sensitive communities in the extended study area.

Impact BOT-4: Introduction and Spread of Invasive Plants
Within the extended study area, implementing any of the action alternatives would result in minor, less-than-significant impacts on introduction and spread of invasive plants because water deliveries would remain within the current normal range of variation and would not result in hydrological changes that could lead to increased spread of invasive plant species. The relatively minor changes to San Joaquin River instream flows associated with implementing any of the action alternatives would therefore not result in a cumulatively considerable incremental contribution to existing significant cumulative impacts involving the introduction or spread of invasive plants.

Biological Resources – Wildlife

Actions of past and present projects that have resulted in loss and degradation of wildlife habitats in the Study Area include the following:

- Population growth and associated development of socioeconomic resources and infrastructure both in the Sierra foothills and the Central Valley
- Conversion of natural vegetation to agricultural and developed land uses
- Introduction of nonnative plant and animal species
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)

- CVP and SWP operations and local water development actions
- PG&E and Southern California Edison hydroelectric projects

Past and present actions by humans have substantially altered wildlife habitat in the central Sierra Nevada foothill region compared to historical conditions. These changes include the conversion of natural vegetation to agricultural and developed land uses; hydroelectric power development; and water resource development actions, particularly the construction and operation of Friant Dam and other water storage and hydroelectric dams. In the extended study area, substantial alteration of suitable wildlife habitat has resulted from habitat fragmentation by development, agricultural conversion, and barriers to dispersal corridors such as highways. These past and present actions have resulted in significant adverse impacts on the extent, suitability, and connectivity of wildlife habitat. The degraded nature of the remaining habitat affects the ability of the remaining habitat to support native wildlife species.

As discussed in Chapter 7, “Biological Resources – Wildlife,” and shown in Table 27-5, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-5. Direct, Indirect, and Cumulative Impacts to Biological Resources – Wildlife

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
WLD-1: Substantial Impact on Special-Status Invertebrates	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-3: Substantial Impact on Special-Status Raptors	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-5: Substantial Impact on Ringtail	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-6: Substantial Impact on American Badger	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-7: Substantial Impact on San Joaquin Pocket Mouse	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-8: Substantial Impact on Special-Status Bat Species	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC

Table 27-5. Direct, Indirect, and Cumulative Impacts to Biological Resources – Wildlife (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
WLD-9: Substantial Impact on Migratory and Wintering Deer Herds	Primary Study Area	All	LTS	CU
	Extended Study Area	All	NI	NC
WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
WLD-11: Potential Reduction in Habitat or Populations of Special-Status Invertebrates	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
WLD-12: Potential Reduction in Habitat or Populations - of Special Status Amphibians and Reptiles	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
WLD-13: Potential Reduction in Habitat or Populations of Special-Status Bird Species	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
WLD-14: Potential Reduction in Habitat or Populations of Special-Status Mammal Species	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
WLD-15: Potential Interference with Migratory Corridors or Nursery Sites	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
WLD-16: Potential Impact on Riparian Habitat for Special-Status Bird Species	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC

Table 27-5. Direct, Indirect, and Cumulative Impacts to Biological Resources – Wildlife (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
WLD-17: Conflict with Local or Regional Policies Protecting Wildlife Resources	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
WLD-18: Potential Conflict with Adopted Conservation Plans	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

A number of reasonably foreseeable probable future projects in the vicinity of the primary study area have the potential to affect wildlife resources that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects (e.g., Brighton Crest, Gunner Ranch West Specific Plan, Ventana Hills Estates Annexation) and hydroelectric projects (e.g., PG&E Kerckhoff Licensing, Big Creek Facilities FERC Relicensing). In addition, buildout of the Fresno County and Madera County general plans would result in additional losses of natural habitat. Throughout the central Sierra Nevada foothill region, conversion, fragmentation, and alteration of native wildlife habitat could occur because of additional agricultural and urban development.

Most projects that could result in significant impacts on wildlife species or their habitat in the central Sierra Nevada foothill region will be required to identify and provide mitigation in compliance with the Federal ESA and CESA; CEQA; the California Fish and Game Code; and other local, State, and Federal statutes. However, compliance with regulatory requirements and implementation of mitigation would still result in a decline in the extent and quality of natural habitats in the region. Therefore, continued net loss of wildlife habitats is expected throughout the region.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts WLD-1 Through WLD-9: Substantial Impact on Wildlife Species

Implementing any of the action alternatives would result in a substantial loss of habitat that supports a variety of wildlife species including special-status species such as bald eagle, golden eagle, and special-status bat species. Impacts on these habitats cannot be fully mitigated because of the overall net loss of habitat that would result from the construction and operation of the project. Continued development in the region will result in the incremental decline in the amount of habitat remaining to support special-status wildlife species. Because development in the primary study area would contribute to this ongoing decline, it would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact**.

Impact WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines

The Fresno County and Madera County general plans have an objective to protect natural communities within their boundaries. Implementing any of the action alternatives would result in significant impacts on natural upland and wetland communities that provide habitat for wildlife species that are included in the general plans. Continued development in the region will result in the incremental decline in the amount of habitat remaining to support special-status wildlife species. Because development in the primary study area would contribute to this ongoing decline and would be in conflict with the Fresno County and Madera County general plans, it would result in a **cumulatively considerable incremental contribution to the overall significant cumulative impact**.

Extended Study Area

The geographic area considered in the cumulative impacts analysis for the extended study area is the San Joaquin River and bypass systems extending from Friant Dam to the Delta. Implementing any of the action alternatives would have no impact on land uses or wildlife habitat in the CVP and SWP water service areas. Therefore, these areas are not included in the geographic extent of this cumulative impact analysis. The cumulative impact analysis in the extended study area is limited to riverine, riparian, and wetland habitats within the existing channel of the San Joaquin River because the flow alterations resulting from implementing any of the action

alternatives would remain within the current channel capacity of the San Joaquin River, bypass channels, and Delta waterways.

Reasonably foreseeable future projects in the extended study area with the potential to affect wildlife resources include the Central Valley Joint Venture, and Riparian Habitat Joint Venture, which could contribute to improved riparian habitat in the extended study area.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts WLD-11 Through WLD-16: Potential Impact on Wildlife Habitat

Within the extended study area, implementing any of the action alternatives would result in potential impacts on existing habitats, especially riparian habitats, within the area where water deliveries would take place. Water volume and delivery schedules may be altered from their current levels. However, water volumes will continue to be within the range of natural variation and timing for these systems. Therefore, these potential impacts would be less than significant on special-status wildlife and their habitat because water deliveries would remain within the current channel capacity of the San Joaquin River, bypass channels, and Delta waterways and would not result in hydrological changes that could lead to conversion of existing wildlife habitat, or result in substantial changes in natural community composition or extent that would affect the ability of the extended study area to support wildlife species.

The relatively minor changes to flows associated with implementing any of the action alternatives would not result in a cumulatively considerable incremental contribution to significant cumulative impacts on riparian habitats, wetlands, and other sensitive communities, or on special-status plants in the extended study area because any changes would remain within the range of normal flow variability under existing conditions and would not make a cumulatively considerable incremental contribution to significant cumulative impacts to existing habitats or significant adverse impacts on special-status plant species.

Climate Change

Please refer to the Air Quality and Greenhouse Gas Emissions section of this chapter, Impact AIR-4, for a discussion of the cumulative impact associated with generation of GHG emissions.

Cultural Resources

Actions of past and present projects that may have resulted in cumulative impacts to cultural resources in the primary and extended study areas include the following:

- Construction and operations of Friant Dam and Millerton Lake
- Development of infrastructure
- Residential, commercial, and industrial development
- Resource extraction (including gold and gravel mining)

Past and present actions by humans have adversely affected cultural resources throughout the Study Area through disturbance and destruction of these resources.

As discussed in Chapter 9, “Cultural Resources,” and shown in Table 27-6, the action alternatives could result in direct and/or indirect impacts in the primary study area. As no construction activities or changes in the landscape would occur in extended study area under the action alternatives, this geographic area is not considered further in this analysis.

Table 27-6. Direct, Indirect, and Cumulative Impacts to Cultural Resources

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
CUL-4 Destruction or Damage to Traditional Cultural Properties	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
CUL-5 Destruction or Damage to Indian Sacred Sites	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
CU = considerable and unavoidable contribution
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

A number of reasonably foreseeable future projects that would be located in the vicinity of the primary study area have the potential to affect cultural resources that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects, such as the Brighton Crest/Eagle Springs Golf Course and Country Club and the Millerton New Town Specific Plan, as well as local plans, such as the BLM Bakersfield Proposed RMP, the Business Plan for the SJRG SRMA, and the Millerton Lake RMP/General Plan. Most projects that could result in

significant impacts on cultural resources in the primary study area will be required to identify and provide mitigation in compliance with NEPA, CEQA, and other local, State, and Federal statutes. Despite compliance with regulatory requirements and implementation of mitigation, these projects could still result in impacts to cultural resources in the region.

The following describes potential cumulative effects to the identified project-related impacts to cultural resources in the primary study area.

Impact CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation

Within the primary study area, past projects have resulted in an overall significant cumulative impact on prehistoric resources in the primary study area. Various reasonably foreseeable future projects would also involve construction activities or changes in the landscape near the primary study area, and have the potential to adversely impact other cultural resources and contribute to this overall impact.

Surveys of the Millerton Lake State Recreational Area have identified 19 sites that lie below the 578-foot maximum water level and above a 500-foot low water level (e.g., Theodoratus and Crain 1962). These are all prehistoric sites, including 13 bedrock milling sites, four residential sites, and one lithic scatter. Additionally, two large prehistoric residential sites were recorded by Hewes in the 1930s and are fully inundated by Millerton Lake. These seasonally inundated sites may become more regularly inundated with an increase in the carryover pool and increase in the elevation of the low water level. As such, implementation of the action alternatives would contribute to the continued inundation of these sites.

No feasible mitigation is available to reduce the severity of Impact CUL-1; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on known or previously undiscovered prehistoric resources in the primary study area.

Impact CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation

Within the primary study area, past projects have resulted in an overall significant cumulative impact on historic resources in

the primary study area. Construction and operation of any of the action alternatives would also cause significant and unavoidable impacts on known or previously undiscovered historic-era resources.

The survey of known historic-era archaeological resources categorizes the resources as sites, multi-component sites, and structures. Known historic-era sites comprise 8 percent of the survey sample of total archaeological resources, and include two mining sites, one location with two ore crushers, and a series of rock cairns, some of which are located outside of the primary study area. None of these previously recorded historic-era sites has intact standing structures.

When filled, the reservoir fluctuation zone of Temperance Flat RM 274 Reservoir would be subject to the erosive processes of periodic fluctuations in water level. The action alternatives would not change the size of Millerton Lake, but would increase the carryover pool and hence increase the elevation of the low water level. Operation and maintenance of Temperance Flat RM 274 Dam and Reservoir could damage or destroy known and previously undiscovered historic-era cultural resources through exposure in the fluctuation zone, through increased recreational access through new recreation facilities, roads, utilities, trails, etc., and increased recreational access to resources in the fluctuation zone.

No feasible mitigation is available to reduce the severity of Impact CUL-2; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on known or previously undiscovered historic-era resources in the primary study area.

Impact CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District

Within the primary study area, past projects have contributed to a historical trend in the loss of archeological and historic resources as artifacts of cultural significance and as objects of research importance; therefore, there is an overall significant cumulative impact on cultural resources within the primary study area. Various reasonably foreseeable future projects would involve construction activities or changes in the landscape near the primary study area, and have the potential to

further adversely impact historical and/or unique archaeological resources and contribute to this overall significant cumulative impact.

Construction and operation of any of the action alternatives would cause significant and unavoidable impacts on significance of a historical and/or unique archaeological resource, or historic property or historic district. No feasible mitigation is available to reduce the severity of Impact CUL-3; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on historical and/or archaeological resources in the primary study area.

Impact CUL-4: Destruction or Damage to Traditional Cultural Properties

Within the primary study area, past projects have resulted in an overall significant cumulative impact on traditional cultural properties in the primary study area. Various reasonably foreseeable future projects would also involve construction activities or changes in the landscape near the primary study area, and have the potential to further adversely impact traditional cultural properties in or near the primary study area.

The records search at the Information Center revealed that no Traditional Cultural Properties have been formally recorded in the primary study area, however, there is a possibility that Traditional Cultural Properties exist within the primary study area. Should Congress authorize and fund the Investigation, additional information about Traditional Cultural Properties in the primary study area will be sought by Reclamation.

Construction and operation of any of the action alternatives would cause additional significant and unavoidable impacts on Traditional Cultural Properties. No feasible mitigation is available to reduce the severity of Impact CUL-4; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on traditional cultural properties in the primary study area.

Impact CUL-5: Destruction or Damage to Indian Sacred Sites

Within the primary study area, past projects have resulted in an overall significant cumulative impact on Indian sacred sites in the primary study area. Various reasonably foreseeable future projects would also involve construction activities or changes

in the landscape near the primary study area, and have the potential to further adversely impact sacred sites in or near the primary study area.

The records search for sacred areas by the Sacred Lands files of the California Native American Heritage Commission has identified sacred lands within the study area. Their locations are confidential.

Construction and operation of any of the action alternatives would cause additional significant and unavoidable impacts on Indian sacred sites. No feasible mitigation is available to reduce the severity of Impact CUL-5; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on sacred sites in the primary study area.

Extended Study Area

The action alternatives would not result in any impacts related to cultural resources in the extended study area. Therefore, none of these action alternatives would make a cumulatively considerable incremental contribution to a cumulative impact associated with existing or reasonably foreseeable projects in the extended study area.

Environmental Justice

Actions of past and present projects have resulted in disproportionately high and adverse effects on minority and low-income populations in the primary and extended study areas. These past and present projects are described for each resource topic area throughout this chapter and include conversion of open space and agricultural land to developed land uses; hydroelectric power development; and water development actions, particularly the construction and operation of Friant Dam, Millerton Lake, and Kerckhoff Dam and Reservoir.

A CEVA was prepared for the eight counties that comprise the San Joaquin Valley. The CEVA considers the combined past and present single, multiple, routine, and accidental release of hazardous materials and air quality emissions and produces spatial analysis that identifies the places that are subject to both the highest concentrations of cumulative environmental hazards and the fewest social and economic resources to prevent, reduce, or adapt to these conditions. The CEVA

determined that substantial overlap between environmental hazards and social vulnerability occurs in many rural areas throughout the San Joaquin Valley where minority and low-income communities reside in the vicinity of agricultural fields, regional transportation corridors, and non-agricultural industries such as power plants and waste disposal facilities (Ganlin and London 2012).

As discussed in Chapter 10, "Environmental Justice," and shown in Table 27-7, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-7. Direct, Indirect, and Cumulative Impacts to Environmental Justice

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation	Contribution to Overall Cumulative Impact
ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low Income Populations	Primary Study Area	All	DHA	CU
	Extended Study Area	All	NDHA	NC

Key:
CU = considerable and unavoidable contribution
DHA = disproportionately high and adverse
NC = no contribution
NDHA = not disproportionately high and adverse

Primary Study Area

Reasonably foreseeable future projects in the primary study area that could affect low-income or minority populations are described for each resource topic area throughout this chapter. Future implementation of planned and approved development in Fresno and Madera counties would result in temporary construction-related impacts and long-term operational impacts in Fresno and Madera counties. Within the primary study area, the Millerton New Town Specific Plan, the Brighton Crest subdivision, and the Ventana Hills Estates Annexation involve constructing residential and commercial land development. Other large-scale planned and approved developments in Fresno and Madera counties include the Friant Ranch Specific Plan, in Fresno County, and the Gunner Ranch West Area Plan, Gateway Village, and Rio Mesa Plan Area in Madera County. Additional infill development and urban development would occur in accordance with the Fresno and Madera county general plans and other applicable city general plans within those counties.

The following describes potential cumulative effects to the identified project-related impacts associated with environmental justice in the primary study area.

Impact ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low-Income Populations

As discussed in Chapter 10, "Environmental Justice," the environmental justice population was determined to be in areas that could be subject to construction- or operation-related impacts associated with implementing any of the action alternatives, including Census Tract 64.05, Census Tract 1.02, and the Auberry CDP in the primary study area. Potentially affected areas outside of the primary study area, consisting of Census Tract 55.15, Census Tract 55.25, Census Tract 10, the Friant CDP, and the Fresno CCD, were also analyzed. Finally, the nearby cities of Clovis, Fresno, and Madera, and the entire Fresno and Madera county areas, were also evaluated.

Implementing any of the action alternatives could cause disproportionately high and adverse impacts on minority and low-income populations because the population percentages of American Indian in the primary study area is meaningfully greater than for the State, the Hispanic population in areas adjacent to the primary study area is greater than 50 percent of the total population and the State as a whole, and there are clusters of low-income populations within this area.

To determine whether the impact on the minority or low-income population would be disproportionately high and adverse, this cumulative impact analysis considers cumulative impacts associated with implementing any of the action alternatives on each resource topic area. If an impact remains cumulatively significant after all mitigation is implemented, then the impact is included in the environmental justice analysis, and the equity of the impact across the affected population is determined. For cumulative impacts determined to be less than significant or less than significant with implementation of mitigation, no additional evaluation is needed because those effects would not result in disproportionate effects on minority and low-income populations.

Cumulative impacts on botanical and terrestrial biological resources, geology and soils, and surface water quality, by themselves, would not result in effects on environmental justice populations. Cumulative impacts associated with air quality and GHG emissions, noise and vibration, power and

energy, and visual resources would affect the populations of the primary study area equally regardless of race, ethnicity, or income level, and would not cause disproportionately high and adverse impacts on minority or low-income populations in the primary study area. Therefore, the direct cumulative effects associated with the conversion of agricultural land would not result in a cumulatively significant incremental contribution to significant and unavoidable cumulative environmental justice effects on minority and low-income populations.

Conversion of farmland to nonagricultural uses would not directly affect minority populations. Rather, the loss of agricultural land from this conversion would indirectly result in the loss of jobs and personal income. As discussed below in "Land Use Planning and Agricultural Resources," it is assumed that reasonably foreseeable probable future projects in Fresno and Madera counties would develop and adopt mitigation to minimize the significance of the impacts on agricultural resources to the extent feasible. In addition, the effect of losses in agricultural production in Fresno and Madera counties would be attenuated by increases in water supply reliability for agricultural water users as a result of implementing any of the action alternatives. Nonetheless, it may not be feasible to fully mitigate all impacts on agricultural resources from numerous projects and it is unlikely that a similar amount of land in the region with similar qualities and productivity could be brought into production to mitigate the effects resulting from the cumulative loss of agricultural land. Employment groups sustaining the greatest effects would include on-site farmworkers, and losses of jobs and income for businesses that support the agricultural industry, including farm and equipment-supply stores and those that earn their income by selling, transporting, storing, marketing, and processing agricultural products, would occur. The effects would occur on the population at large and cannot be reduced to discrete effects for any particular segment of the population, but it is likely that minority and low-income populations would experience the loss of jobs and personal income. Implementing any of the action alternatives in combination with other past, present, or reasonably foreseeable future projects would indirectly result in cumulatively considerable impacts that would be disproportionately high and adverse on minority or low-income populations.

Documented prehistoric and sacred areas are located in the primary study area, and undocumented prehistoric sites, traditional cultural properties, and sacred areas or sacred sites

may also be present in the primary study area. Reclamation would follow the process in the implementing regulations at 36 CFR Part 800 to identify historic properties (including traditional cultural properties, sacred sites, and sacred areas, as appropriate), assess effects, and resolve adverse effects through the consultation process. Consulting parties for the National Historic Preservation Act Section 106 process would include the SHPO, the Advisory Council on Historic Preservation (if it chooses to participate), other Federal agencies where applicable, tribal representatives, and other interested parties (including non-Federally recognized Native Americans, members of the public, and other State or local agencies) to develop methods to avoid, minimize, and mitigate adverse effects. It is assumed that other reasonably foreseeable future projects would comply with applicable Federal and State regulations and implement mitigation measures to reduce the effects of future projects on documented and undocumented prehistoric sites, traditional cultural properties, and sacred areas or sites. However, destruction or damage to prehistoric sites, traditional cultural properties, or Indian sacred sites could occur and implementing any of the action alternatives in combination with other past, present, or reasonably foreseeable future projects would result in cumulatively considerable impacts that would be disproportionately high and adverse on Native American populations.

In summary, implementing any of the action alternatives in combination with other past, present, or reasonably foreseeable future projects would result in **cumulatively considerable incremental contributions to overall significant cumulative impacts** associated with the conversion of agricultural land and destruction or damage to traditional cultural properties or Indian sacred sites. These significant cumulative impacts would be disproportionately high and adverse on minority or low-income populations.

Extended Study Area

Reasonably foreseeable future projects in the extended study area that could affect low-income or minority populations are described for each resource topic area throughout this chapter. Examples of reasonably foreseeable future activities in the extended study area include planned development in city and county general plans; construction of levee improvement and flood control projects, including those proposed in the Central Valley Flood Protection Plan; construction of pipelines, including those proposed in the BDCP; reservoir enlargements, such as the Los Vaqueros Reservoir Expansion Project and

SLWRI; habitat restoration projects, such as those included in the BDCP and SJRRP; and changes to the San Joaquin River instream flows from implementation of the SJRRP.

Impact ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low-Income Populations

As discussed in this chapter, none of the action alternatives would make a cumulatively considerable incremental contribution to significant cumulative impacts in the CVP and SWP water service areas that could cause disproportionately high and adverse impacts on minority and low-income populations. Implementing any of the action alternatives in combination with other past, present, or reasonably foreseeable future projects would not result in cumulatively considerable impacts that would be disproportionately high and adverse on minority or low-income populations.

Geology and Soils

Actions of past and present projects that have resulted in cumulative impacts to geology and soils in the primary and extended study areas include:

- Construction and operations of Friant Dam and Millerton Lake, and Kerckhoff Dam and Reservoir
- Resource extraction (including gold and gravel mining)
- Construction and operations of flood management facilities, including the Chowchilla, Eastside, and Mariposa bypasses and associated diversion and drop structures
- Construction and operations of water supply delivery infrastructure, including Mendota Dam and Pool, Sack Dam, and Arroyo Canal
- Changes in flow regimes under the SJRRP

Past and present projects have substantially altered geology and soils throughout the study area compared to historical conditions. These changes include overall significant cumulative impacts on the geomorphology and hydrology of aquatic habitats and on soil erosion and loss of topsoil due to construction and operations within the primary study area.

As discussed in Chapter 11, "Geology and Soils," and shown in Table 27-8, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-8. Direct, Indirect, and Cumulative Impacts to Geology and Soils

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
GEO-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions and Slope Instability	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat	Primary Study Area	All	PSU	CU
	Extended Study Area	All	LTS	NC
GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations	Primary Study Area	All	PSU	CU
	Extended Study Area	All	LTS	NC

Table 27-8. Direct, Indirect, and Cumulative Impacts to Geology and Soils (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
GEO-5: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that Are Unsuited to Land Application of Waste	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
PSU = potentially significant impact

Primary Study Area

Reasonably foreseeable future projects in the vicinity of the primary study area with the potential to affect geology and soils include development projects such as Brighton Crest, Gunner Ranch West Specific Plan, and Ventana Hills Estates Annexation. Projects that could result in significant impacts on geology and soils in the primary study area would be required to identify and provide mitigation in compliance with NEPA, CEQA, and/or other local, State, and Federal statutes. Despite compliance with regulatory requirements and implementation of mitigation, these projects could still result in impacts to geology and soils in the region, including temporary (construction-related) and long-term effects related to geologic hazards, use of mineral resources, soil erosion or loss of topsoil, and wastewater disposal systems.

The following describes potential cumulative effects to the identified project-related impacts to geology and soils in the primary study area.

Impact GEO-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions and Slope Instability

Past, present, and reasonably foreseeable projects have not contributed to the significant exposure of structures and people to geologic hazards resulting from seismic conditions or slope instability, and therefore, there is not currently a significant cumulative impact. Past and anticipated future development

within the primary study area could expose structures to groundshaking. Construction of Temperance Flat RM 274 could increase this risk through RTS, however the seismic risk of the region is low, and implementation of the Seismic Action Plan under Mitigation Measure GEO-1 would further minimize risk of RTS. The action alternatives would have less-than-significant impacts (after mitigation) to local structures and people in the primary study area related to exposure of structures and people to geologic hazards resulting from seismic conditions and slope instability, and future development in the vicinity would not increase this risk. Therefore, this impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to exposure of structures and people to geologic hazards resulting from seismic conditions and slope instability in the primary study area.

Impact GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat

Within the primary study area, past projects have resulted in a significant and substantial overall significant cumulative impact on the geomorphology and hydrology of aquatic habitats in the San Joaquin River between Friant Dam and Kerckhoff Dam. Construction and operation of any of the action alternatives would cause additional significant and unavoidable impacts on the geomorphology and hydrology of aquatic habitats, due to the complete or near-complete inundation of the San Joaquin River in this reach. No feasible mitigation is available to reduce the severity of Impact GEO-2; therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on geomorphology of aquatic habitat in the primary study area.

Impact GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State

The action alternatives would have less-than-significant impacts to local mineral resources in the primary study area. It is unlikely that any impacted mineral resources would be used in the future for any local or regional needs, including anticipated future developments, which would rely on other established quarries. Aggregate and embankment/fill materials that would be mined within the primary study area under the action alternatives are not currently mapped or used, while gold mine sites that would be inundated have little or no activity.

These resources are likely to be of little value to the region or State. Therefore, this impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to the diminished availability of known mineral resources in the primary study area.

Impact GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations

Past, present, and reasonably foreseeable projects have or would require excavation, grading and other construction operations. Slope and soil disturbance could under these projects often result in soil erosion and loss of topsoil. Despite compliance with regulatory requirements and implementation of mitigation, these projects could still result in some erosion and loss of topsoil. The action alternatives would have additional significant and unavoidable impacts in the primary study area related to soil erosion or loss of topsoil. All feasible avoidance and minimization measures have been included in the project commitments, but would not reduce this impact below the level of significance. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less-than-significant level. Therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** related to soil erosion in the primary study area.

Impact GEO-5: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that Are Unsuited to Land Application of Waste

Within the primary study area, current activities and facilities including recreational facilities use wastewater facilities permitted by Fresno and Madera counties (as applicable), and have not combined to create a significant cumulative impact. Future projects, including development in the vicinity of the primary study area, if using septic tanks or alternative wastewater disposal systems, would be designed and constructed to satisfy the conditions of sewage disposal permits issued by Fresno County or Madera County, as applicable. The action alternatives would have less-than-significant impacts in the primary study area related to failure of septic tanks or alternative wastewater disposal systems, but these impacts would not overlap those areas affected by past, present, or future projects.. Therefore, this impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative

impacts related to failure of septic tanks or alternative wastewater disposal systems in the primary study area.

Extended Study Area

Reasonably foreseeable future projects in the extended study area with the potential to affect geology and soils include recreation and habitat enhancement or management projects (e.g., SJRRP, Jensen River Ranch Habitat Enhancement and Public Access Project, Lost Lake Park Master Plan, San Joaquin River Parkway Plan, SJRRP, BDCP and other projects throughout the Delta) and water management projects (e.g., SJRRP). Projects that could result in significant impacts on geology and soils in the extended study area would be required to identify and provide mitigation in compliance with NEPA, CEQA, and/or other local, State, and Federal statutes. Despite compliance with regulatory requirements and implementation of mitigation, these projects could still result in impacts to geology and soils in the region, including temporary (construction-related) and long-term effects related to alteration of fluvial geomorphology, use of mineral resources, and soil erosion or loss of topsoil.

Impact GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat

Past projects in the extended study area from Friant Dam to the confluence of the Merced River have resulted in overall significant cumulative impacts on the on geomorphology of aquatic habitat. Current and future modifications to the channel under the SJRRP are anticipated to have beneficial effects on the geomorphology of aquatic habitat. Construction and operation of any action alternative would affect the flow regime in this portion of the extended study area, and could potentially change downstream stream erosion and geomorphologic characteristics. However, it is expected that the frequency, volume, and duration of high-flow events resulting from this action would be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. This less-than-significant impact would, therefore, not cause a cumulatively considerable incremental contribution to the overall significant cumulative impacts on the on geomorphology of aquatic habitat in the extended study area.

Impact GEO-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region or the State

In the extended study area from Friant Dam to the confluence of the Merced River, the action alternatives would have less-than-significant impacts on the diminished availability of known mineral resources. The impacts of past, present, and reasonably foreseeable projects in the extended study area have not caused significant cumulative impacts in the extended study area from Friant Dam to the confluence of the Merced River, and this project would not increase these impacts to a significant level. Therefore, this impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to the diminished availability of known mineral resources in the extended study area.

Impact GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations

In the extended study area from Friant Dam to the confluence of the Merced River, past projects have resulted in overall significant cumulative impacts on soil erosion. Construction and operation of any of the action alternatives would affect the flow regime in this portion of the extended study area, and could potentially change downstream stream erosion and geomorphologic characteristics. However, it is expected that the frequency, volume, and duration of high-flow events resulting from this action would be reduced, as compared to existing conditions with current operations. Therefore, net rates of downstream erosion and sedimentation would not increase. This less-than-significant impact would, therefore, not cause a cumulatively considerable incremental contribution to the overall significant cumulative impacts on soil erosion or loss of topsoil in the extended study area.

Hydrology – Flood Management

Actions of past and present projects that have resulted in cumulative impacts to flood management in the primary and extended study areas include:

- Construction and operations of Friant Dam and Millerton Lake, and Kerckhoff Dam and Reservoir
- Increased public access to the floodplain

- Recreational and private development around Millerton Lake
- Urban development and de-vegetation along the San Joaquin River and tributary rivers
- Construction and operations of flood management facilities (including the Chowchilla, Eastside, and Mariposa bypasses and associated diversion and drop structures)
- Construction and operations of water supply infrastructure (including Friant Dam, Millerton Lake, Mendota Dam and Pool, Sack Dam, and other dams and reservoirs; the DMC; Arroyo Canal; and other diversion facilities on the San Joaquin River and in the Delta)
- Regulatory flow objectives
- Changes in flow regimes under the SJRRP
- Conversion of natural vegetation to agricultural and developed land uses
- CVP and SWP operations and local water development actions

Past and present projects have substantially altered flood management throughout the study area compared to historical conditions. These projects have increased the number of people and structures exposed to flood risk in the extended study area and have resulted in increased runoff to Millerton Lake and the San Joaquin River. Within the primary study area, past recreational and private development around Millerton Lake has contributed to runoff into Millerton Lake. However the construction of flood management and water supply facilities have increased the ability to store and manage flood releases, reducing the overall frequency and volume of flood releases within the extended study area.

As discussed in Chapter 12, “Hydrology – Flood Management,” and shown in Table 27-9, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas. However, the action alternatives would not combine with past, present, or reasonably foreseeable future projects to cause overall significant cumulative impacts on flood management in the study areas.

Table 27-9. Direct, Indirect, and Cumulative Impacts to Hydrology – Flood Management

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS and Beneficial	NC
FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
FLD-3: Place Within a 100-Year Flood Hazard Area Structures which would Impede or Redirect Flood Flows	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

One reasonably foreseeable projects in the vicinity of the primary study area, the Millerton Lake State RMP and General Plan, may affect flood management by increasing runoff into Millerton Lake by increasing impervious areas or increasing the number of people and structures exposed to flood risk through construction of new facilities.

Impact FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Within the primary study area, past projects have increased the exposure of people and structures to the risk of flooding as a result of dam failure. Reasonably foreseeable projects, including the Millerton Lake State RMP and General Plan, may develop new facilities around Millerton Lake, increasing the number of people and structures exposed to flood risk in the primary study area. However, Friant Dam is operated and maintained to minimize this risk, consistent with the *Report on*

Reservoir Regulation for Flood Control, Friant Dam and Millerton Lake, San Joaquin River, California (USACE 1980). Additionally, upstream facilities operated by PG&E and SCE provide significant storage during snowmelt and rainfall events (USACE 1955). Consequently, past, present, and reasonably foreseeable projects do not result in an overall significant cumulative impact that increases the exposure of people or structures to a significant risk of loss, injury, or death involving flooding in the primary study area.

Within the primary study area, the action alternatives would not expose people to a significant risk of loss, injury, or death as a result of flooding. The cofferdams and Temperance Flat RM 274 Dam would be constructed according to existing design standards and regulations. Therefore, this less-than-significant impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to exposure of people or structures to a significant risk of loss, injury, or death in the primary study area.

Impact FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding

Reasonably foreseeable projects, such as the Millerton Lake State RMP and General Plan, may increase runoff into Millerton Lake by increasing impervious areas. It is expected that development associated with the Millerton Lake State RMP and General Plan will use BMPs to minimize any increase in runoff into Millerton Lake (Reclamation and California Department of Parks and Recreation 2010). Consequently, past, present, and reasonably foreseeable projects do not result in an overall significant cumulative impact that substantially alters the existing drainage pattern of the area, or substantially increases the amount of surface runoff in a manner that would result in flooding in the primary study area.

The action alternatives would increase runoff to San Joaquin RM 274 from construction-related activities and from permanent structures near Temperance Flat RM 274 Reservoir. However, BMPs would be used throughout construction, and would be used to minimize runoff from permanent facilities. This impact would be localized, temporary, and less than

significant. Therefore, this impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to altering the existing drainage pattern in the primary study area.

Extended Study Area

Reasonably foreseeable future projects in the extended study area with the potential to affect flood management include the Jensen River Ranch Habitat Enhancement and Public Access Project, the Lost Lake Park Master Plan, the San Joaquin River Parkway Plan, the Fresno County General Plan, the Madera County General Plan, the City of Fresno General Plan, and the Folsom Dam Joint Federal Project. These projects would affect flood management by increasing the number of people or structures exposed to flood risk, and/or by increasing runoff. The modification of levees and flood management facilities under the SJRRP would directly affect flood management. Projects that could result in significant impacts on flood management in the extended study area would be required to identify and provide mitigation in compliance with NEPA, CEQA, and/or other local, State, and Federal statutes.

Impact FLD-1: Exposure of People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Within the extended study area, past, present, and reasonably foreseeable future projects would increase public access to the floodplain, increasing the number of people and structures exposed to flood risk in the extended study area. However, Friant Dam and levees along the San Joaquin River were designed and are operated and maintained to substantially reduce flood risk.

Under the SJRRP, drainage patterns downstream from Friant Dam will change. Construction of levees and berms in Reach 1 (to isolate gravel pits) or in Reaches 2B and 4B1 (to convey flows and provide floodplain habitat) could affect the existing drainage outside the main stem of the river by blocking channels, or by redirecting overland flows, creating interior drainage issues and potential ponding on the landward side of levees. Construction of additional hydraulic structures associated with SJRRP actions to reconfigure floodplains and modify diversion structures, roads, and a bridge also would impact internal drainage channels and facilities, and could create interior drainage, ponding, or other site-specific flooding

issues. These actions could include the installation of flap gates on new or modified levees, as well as realignment or modification of existing drainage channels. As these structures are further studied and designed in project-specific investigations, their impacts to interior drainage features would be further refined and actions would then be taken to avoid these impacts (SJRRP 2012). Consequently, past, present, and reasonably foreseeable projects do not result in an overall significant cumulative impact that increases the exposure of people or structures to a significant risk of loss, injury or death involving flooding in the extended study area.

The additional storage provided by Temperance Flat RM 274 Reservoir would reduce the magnitude and frequency of flood releases from Friant Dam and therefore lower the potential for loss, injury, or death involving flooding in the extended study area. This less-than-significant impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to exposure of people or structures to a significant risk of loss, injury, or death in the extended study area.

Impact FLD-2: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner which would Result in Onsite or Offsite Flooding

Within the extended study area, urban development and de-vegetation along the San Joaquin River and tributary rivers has increased runoff to the San Joaquin River. However, this development has been accompanied by construction of flood control systems on the San Joaquin and Kings rivers that have reduced flooding. As levees are modified under the SJRRP, flood control will improve in the extended study area. Consequently, past, present, and reasonably foreseeable projects do not result in an overall significant cumulative impact that substantially alters the existing drainage pattern of the area, or substantially increases the amount of surface runoff in a manner that would result in flooding in the extended study area.

The action alternatives will not alter the course of the San Joaquin River or alter the rate or amount of surface runoff downstream from Friant Dam, and are expected to have only residual impacts in the extended study area, due to the use of

BMPs in the primary study area. This less-than-significant impact would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to altering the existing drainage pattern in the extended study area.

Hydrology – Groundwater

Actions of past and present projects that have resulted in cumulative impacts to groundwater in the primary and extended study areas include:

- Population growth and associated development of infrastructure both in the Sierra foothills and the Central Valley
- CVP and SWP operations and local water development actions
- Construction and operations of water supply delivery infrastructure (including Mendota Dam and Pool, Sack Dam, and Arroyo Canal)
- Changes in flow regimes under the SJRRP
- Agricultural practices (including the direct use of groundwater and application of pesticides, herbicides, and fertilizers)
- Conversion of natural vegetation to agricultural and developed land uses
- Implementation of conjunctive use projects and groundwater recharge programs (including conjunctive use within the Friant Division)

Past and present actions have led to the decline of groundwater levels throughout the extended study area. In some cases, groundwater pumping has led to upwelling of poor quality groundwater. Subsurface drainage problems extend along the western side of the San Joaquin River and Tulare Lake hydrologic regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. Few wells pump from this shallow depth to groundwater zone because of high salinity concentrations, present in part because of naturally

occurring soil conditions and because of the application of surface water imported from the Delta.

As discussed in Chapter 13, "Hydrology - Groundwater," and shown in Table 27-10, the action alternatives could result in direct and/or indirect impacts to groundwater levels and quality in the extended study area. In the primary study area, the action alternatives would not result in any impacts to groundwater.

Table 27-10. Direct, Indirect, and Cumulative Impacts to Hydrology – Groundwater

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
GRW-1: Change in Groundwater Levels	Primary Study Area	All	NI	NC
	Extended Study Area	Alternative Plans 1 and 5	LTS	CU
		Alternative Plans 2, 3, and 4	LTS and Beneficial	BC
GRW-2: Change in Groundwater Quality	Primary Study Area	All	NI	NC
	Extended Study Area	Alternative Plans 1 and 5	LTS	CU
		Alternative Plans 2, 3, and 4	LTS and Beneficial	BC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

In the primary study area, the action alternatives would not result in any impacts to groundwater.

Extended Study Area

Several future reasonably foreseeable actions (e.g., groundwater recharge/banking projects, increased regulation of groundwater by the State, increased agricultural and municipal water supply demands) could affect groundwater pumping in the extended study area. These actions could cause both beneficial and adverse effects to groundwater resources. The following describes potential cumulative effects to the

identified project-related impacts to groundwater in the extended study area.

Impacts GRW-1 and GRW-2: Groundwater Impacts
Impacts GRW-1 and GRW-2 are linked in that increased pumping would both decrease groundwater levels and could degrade groundwater quality. Alternative Plans 1 and 5 could slightly increase reliance on groundwater pumping in the CVP SOD and SWP SOD water service areas, respectively, because of a small reduction in surface water deliveries relative to the No Action Alternative. The action alternatives would have either a less than significant (Alternative Plans 1 and 5) or beneficial (Alternative Plans 2 through 4) impact on groundwater resources. While the impact to groundwater use would be small under Alternative Plans 1 and 5 (the simulated reduction of 11 TAF/year would be less than 0.5 percent of the total deliveries to CVP SOD users), this impact would add to the existing and future demands on groundwater resources in the extended study area. No feasible mitigation is available to reduce the severity of this impact. Thus Alternative Plans 1 and 5 would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on groundwater in the extended study area.

Alternative Plans 2 through 4 would increase surface water deliveries to the extended study area, thereby reducing the need to pump groundwater. Thus Alternative Plans 2 through 4 would result in a **beneficial contribution to the overall significant cumulative impacts** on groundwater in the extended study area**.**

Hydrology – Surface Water Supplies and Facilities Operations

Actions of past and present projects that have resulted in cumulative impacts to surface water supplies and facilities operations in the primary and extended study areas include:

- Construction and operations of flood management facilities (including the Chowchilla, Eastside, and Mariposa bypasses and associated diversion and drop structures)

- Construction and operations of water supply infrastructure (including Friant Dam, Millerton Lake, Mendota Dam and Pool, Sack Dam, and other dams and

reservoirs; the DMC; Arroyo Canal; and other diversion facilities on the San Joaquin River and in the Delta)

- Regulatory flow objectives
- Changes in flow regimes under the SJRRP
- Conversion of natural vegetation to agricultural and developed land uses
- CVP and SWP operations and local water development actions

Past and present actions have substantially altered surface water facilities operations and constrained or enhanced the ability of water users to access available water supplies. Within the primary study area, construction of Friant Dam enabled more reliable access to San Joaquin River flows. Within the extended study area, Friant Dam, the DMC, Mendota Dam and Sack Dam increased access to supplies in this portion of the extended study area. Facilities downstream, including diversions along the San Joaquin River and within the Delta, dams and reservoirs on the Merced, Stanislaus, and Tuolumne rivers and other Delta tributaries, and Jones and Banks pumping plants, and the regulations that govern their operations have led to a highly managed system that attempts to balance ecosystem and water supply needs within the extended study area.

Table 27-11. Direct, Indirect, and Cumulative Impacts to Hydrology – Surface Water Supplies and Facilities Operations

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
SWS-1: Changes in Ability to Divert Water from Friant Dam	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
SWS-2: Changes in Ability to Divert Water from the San Joaquin River	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
SWS-3: Change in Water Levels in the Old River near the Tracy Road Bridge	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
SWS-4: Change in Water Levels in the Grant Line Canal Above the Grant Line Canal Barrier	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
SWS-5: Change in Water Levels in the Middle River near the Howard Road Bridge	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

In the primary study area, the action alternatives would not result in any impacts to surface water supplies or facilities operations.

Extended Study Area

Reasonably foreseeable probable future projects in the extended study area have the potential to affect surface water supplies and facilities operations in the extended study area. Examples of these projects include recreation and habitat enhancement or management projects (e.g., SJRRP, BDCP and

other projects throughout the Delta) and water management projects (e.g., SJRRP, North-of-Delta Offstream Storage Investigation, SLWRI, Freeport Regional Water Project, Delta Water Supply Project, DWR South Bay Aqueduct Improvement and Enlargement Program, North Bay Aqueduct Alternative Intake Project, East Bay Municipal Utility District Water Supply Management Program 2040, State Water Project Water Supply Contract Extension Program, State Water Project Water Settlement Agreement, IRWMPs in the Central Valley, and DMC Recirculation). Many of the projects in the extended study area are targeted at improving access to surface water supplies while minimizing adverse effects to biological resources, such as aquatic ecosystems in the San Joaquin River and the Delta. These projects could also affect Delta inflows and water levels. These changes in Delta conditions could lead to reoperation of CVP and SWP Delta export pumps, which would affect water levels in the south Delta. However, the overall cumulative impact of past projects and continued agricultural and urban development on water supplies and facilities operations is expected to remain significant as compared with historical conditions.

The following describes potential cumulative effects to the identified project-related impacts in the extended study area.

Impacts SWS-3 Through SWS-5: Changes in South Delta Water Levels

Several past, present, and reasonably foreseeable future projects have affected or will affect flows in the San Joaquin and Sacramento rivers, resulting in changing Delta conditions. Maximum decreases in south Delta water levels under the action alternatives would not adversely affect agricultural users' ability to divert irrigation water, and would therefore not cause a cumulatively considerable incremental contribution to a significant cumulative impact in the Delta.

Hydrology – Surface Water Quality

Actions of past and present projects that have resulted in cumulative impacts to surface water quality in the primary and extended study areas include:

- Construction and operation of Friant Dam, Millerton Lake, Kerckhoff Dam and Reservoir, and other dams and reservoirs

- Construction and operations of flood management facilities (including the Chowchilla, Eastside, and Mariposa bypasses and associated diversion and drop structures)
- Construction and operations of water supply delivery infrastructure (including Mendota Dam and Pool, Sack Dam, and Arroyo Canal)
- Changes in flow regimes under the SJRRP
- Agricultural practices (including the application of pesticides, herbicides, and fertilizers)
- Conversion of natural vegetation to agricultural and developed land uses
- Resource extraction (including gold and gravel mining)
- CVP and SWP operations and local water development actions

Past and present actions have substantially altered surface water quality throughout the study area compared to historical conditions. These changes include overall significant cumulative impacts on water temperatures and water quality (including turbidity and metals concentrations) in the primary study area, and overall significant cumulative impacts on sediment, water temperatures, and water quality in the extended study area. The development of housing and recreational resources have likely led to increased sediment loads and TDS within the San Joaquin River and Millerton Lake, but have not caused significant cumulative impacts related to sediment.

As discussed in Chapter 15, “Hydrology – Surface Water Quality,” and shown in Table 27-12, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-12. Direct, Indirect, and Cumulative Impacts to Hydrology – Surface Water Quality

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
SWQ-2: Temporary Construction-Related Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
SWQ-3: Temporary Construction-Related Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River	Primary Study Area	All	LTS	CU
	Extended Study Area	All	LTS	NC
SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses	Primary Study Area	All	LTS and Beneficial	BC
	Extended Study Area	All	LTS and Beneficial	BC
SWQ-6: Long-Term Effects on Delta Salinity that would Violate D-1641 Salinity Objectives	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
SWQ-7: Long-Term Effects on Delta Salinity that would Violate the X2 Standard	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
SWQ-8: Long-Term Effects on Water Quality that would Violate Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC

Table 27-12. Direct, Indirect, and Cumulative Impacts to Hydrology – Surface Water Quality (contd.)

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

A number of reasonably foreseeable probable future projects in the vicinity of the primary study area have the potential to affect surface water quality in the primary study area. Examples of these projects include development projects (e.g., Brighton Crest, Gunner Ranch West Specific Plan, Ventana Hills Estates Annexation) and hydroelectric projects (e.g., PG&E Kerckhoff Licensing, PG&E Crane Valley Hydroelectric Project, Big Creek Facilities FERC Relicensing). Most projects that could result in significant impacts on surface water quality in the primary study area will be required to identify and provide mitigation in compliance with NEPA, CEQA, and other local, State, and Federal statutes. Compliance with regulatory requirements and implementation of mitigation could still result in impacts to surface water quality in the region, including temporary (construction-related) and long-term effects on sediment, water temperatures, and water quality.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

The impacts of past and present projects upstream from the primary study area have reduced the sediment load entering the San Joaquin River below Kerckhoff Dam and entering Millerton Lake. Reasonably foreseeable projects could contribute sediment to surface waters in the primary study area, but these contributions would be minimized through compliance with regulatory requirements and implementation of mitigation measures, and would be small compared to the reduced sediment load caused by upstream dams and reservoirs. Under the action alternatives, construction-related activities would have less-than-significant temporary impacts

on sediment. This impact would be avoided and minimized via implementation of the erosion and sediment control plans and SWPPP. Because the overall cumulative impact is a reduced sediment load to the San Joaquin River and the action alternatives as well as reasonably foreseeable future projects would minimize erosion and associated sediment effects, these impacts would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to sediment effects in the primary study area.

Impacts SWQ-2 and SWQ-3: Temporary Construction-Related Water Temperature and Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Past projects, including the construction and operations of Friant Dam, Millerton Lake, and Kerckhoff Dam and Reservoir, have resulted in overall significant cumulative impacts on water temperatures and water quality in the primary study area. Construction-related activities under the action alternatives would further impact water temperatures and water quality; however, these impacts would be less than significant and temporary. Because the action alternatives would have only temporary impacts on water temperatures and water quality in the primary study area, they would not cause cumulatively considerable incremental contributions to the overall significant cumulative impacts on water temperatures and water quality in the primary study area.

Impact SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River

Past projects, including the construction and operations of Friant Dam and Millerton Lake, have resulted in overall significant cumulative impacts on water quality constituents (including turbidity and metals concentrations) in the primary study area through the process of shoreline erosion. Operations of any of the action alternatives would inundate three abandoned mine sites (Impact SWQ-4). Under Mitigation Measure SWQ-4, Reclamation will prepare and implement a plan to remove or otherwise remediate the Patterson, San Joaquin, and Sullivan mine sites, which have the potential to introduce metals into the proposed Temperance Flat RM 274 Reservoir. Although mitigation would reduce the potential for a discharge of contaminants into the proposed Temperance Flat RM 274 Reservoir, the potential for some contamination would

remain. No further feasible mitigation is available to reduce the severity of Impact SWQ-4; therefore, the action alternatives would cause **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on water quality in the primary study area.

Impact SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Past projects, including the construction and operations of Friant Dam, Millerton Lake, and Kerckhoff Dam and Reservoir, have resulted in overall significant cumulative impacts on water temperatures in the primary study area. All action alternatives would increase the total combined volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in action alternatives with higher carryover storage in most months. This impact (Impact SWQ-5) would result in a **beneficial contribution to the overall significant cumulative impact** related to water temperatures in the primary study area.

Extended Study Area

Reasonably foreseeable probable future projects in the extended study area have the potential to affect surface water quality in the extended study area. Examples of these projects include recreation and habitat enhancement or management projects (e.g., Jensen River Ranch Habitat Enhancement and Public Access Project, Lost Lake Park Master Plan, San Joaquin River Parkway Plan, SJRRP, BDCP and other projects throughout the Delta), hydroelectric projects (e.g., Merced River Hydroelectric Project, Don Pedro Project Relicensing, Oroville Facilities Relicensing), and water management projects (e.g., SJRRP, North-of-Delta Offstream Storage Investigation, SLWRI, Freeport Regional Water Project, Delta Water Supply Project, DWR South Bay Aqueduct Improvement and Enlargement Program, San Joaquin River Salinity Management Plan, Bay Area Water Quality and Supply Reliability Program, Westside Regional Drainage Plan, IRWMPs in the Central Valley, DMC Recirculation, and WDRs). Many of the projects in the extended study area are targeted at improving surface water quality or related resources such as aquatic ecosystems in the San Joaquin River and the Delta. However, the overall cumulative impact of past projects and continued agricultural and urban development on water quality is expected to remain significant as compared with historical conditions.

The following describes potential cumulative effects to the identified project-related impacts in the extended study area.

Impact SWQ-1: Temporary Construction-Related Sediment Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

The impacts of past and present projects upstream from Friant Dam and on tributaries to the extended study area have reduced the sediment load entering the San Joaquin River below Friant Dam and entering the San Joaquin River. Reasonably foreseeable projects could contribute sediment to surface waters in the primary study area, but these contributions would be minimized through compliance with regulatory requirements and implementation of mitigation measures, and would be small compared to the reduced sediment load caused by upstream dams and reservoirs. Under the action alternatives, construction-related activities would have less-than-significant temporary impacts on sediment. Implementation of the erosion and sediment control plans and SWPPP would avoid or minimize construction-related impacts in the primary study area. The residual effect to waters in the extended study area would be further minimized through mixing and dilution. Because the overall cumulative impact is a reduced sediment load to the San Joaquin River and the action alternatives as well as reasonably foreseeable future projects would minimize erosion and associated sediment effects, these impacts would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to sediment effects in the primary study area.

Impacts SWQ-2 and SWQ-3: Temporary Construction-Related Water Temperature and Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Past and ongoing projects in the extended study area from Friant Dam to the confluence of the Merced River have resulted in overall significant cumulative impacts on sediment, water temperatures, and water quality. Construction impacts of any action alternative would be temporary. These less-than-significant impacts (Impact SWQ-2 and Impact SWQ-3) would, therefore, not cause cumulatively considerable incremental contributions to the overall significant cumulative impacts related to sediment, temperature, or water quality effects in the extended study area.

Impact SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River

Past and ongoing projects and activities in the extended study area from Friant Dam to the Delta have resulted in overall significant cumulative impacts on surface water quality. The action alternatives would improve surface water quality conditions in some areas through the increased release of flows from Friant Dam, and adversely affect surface water quality in other areas due to the reduction in flood flows. Because the alternatives would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health, these impacts (Impact SWQ-4) would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to sediment effects in the extended study area.

Impact SWQ-5: Long-Term Water Temperature Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses

Past projects in the extended study area from Friant Dam to the confluence of the Merced River have resulted in overall significant cumulative impacts on water temperatures. In particular, the construction of Friant Dam and Mendota Pool, and the diversion and impoundment of water from and in the river have led to increased temperatures that adversely affect beneficial uses, including fisheries, in this reach. The SJRRP may improve water temperature conditions in this reach, but would not reduce this cumulative impact to a less-than-significant impact.

The action alternatives would improve San Joaquin River release temperatures from September through December, at the cost of slightly warmer winter releases than under the No Action Alternative. However, in the winter months, release temperatures would still be cooler than needed for anadromous fish. This impact (Impact SWQ-5) would result in a **beneficial contribution to the overall significant cumulative impact** related to water temperatures in the extended study area.

Impacts SWQ-6 and SWQ-7: Long-Term Effects on Delta Salinity

Past, ongoing, and reasonably foreseeable future projects, including water resources and flood risk management projects

in the San Joaquin and Sacramento River basins, have resulted in overall significant cumulative impacts on Delta salinity. As a result, the Central Valley Water Board and the State Water Board have set water quality standards for waters of the State located within the Delta. In particular, D-1641 establishes standards related to Delta salinity. As previously described, D-1641 establishes maximum salinity objectives, including objectives for salinity (measured as EC) and chloride concentrations, at several locations in the Delta. D-1641 also establishes the X2 standard. The location of the estuarine salinity gradient is regulated from February through June by the location of the X2 objective, and is required to be maintained at not more than 75 km from February through June.

CVP and SWP facilities in the Delta and upstream watersheds are operated to meet the requirements of D-1641, and this would not change under the action alternatives. Therefore, these impacts (Impact SWQ-6 and Impact SWQ-7) would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to Delta salinity.

Impact SWQ-8: Long-Term Effects on Water Quality that would Violate Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas

Within the CVP and SWP water service areas, past and ongoing projects and practices, including the conveyance of surface water from the Delta to CVP and SWP water service areas, and mixing of these water supplies with lower quality agricultural and urban return flows, have resulted in overall significant cumulative impacts on surface water quality. The quality of water delivered to the CVP and SWP water service areas would not change appreciably under the action alternatives, and when considered with other past, present, and reasonably foreseeable future projects, would not result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health; therefore, these impacts (Impact SWQ-8) would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to surface water quality in these areas.

Indian Trust Assets

As described in Chapter 16, "Indian Trust Assets," and shown in Table 27-13, the action alternatives would have no impacts related to ITAs. Because there would be no impacts to ITAs as a result of the action alternatives, the action alternatives would not contribute to significant cumulative impacts on ITAs.

Table 27-13. Direct, Indirect, and Cumulative Impacts to Indian Trust Assets

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
ITA-1: Interfere with the Exercise of a Federally Reserved Water Right, or Degrade Water Quality Where There is a Federally Reserved Water Right	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
ITA-2: Interfere with the Use, Value, Occupancy, Character or Enjoyment of an ITA	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
ITA-3: Failure to Protect ITAs from Loss, Damage, Waste, Depletion, or Other Negative Effects	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
NC = no contribution
NI = no impact

Land Use Planning and Agricultural Resources

Actions of past and present projects that have resulted in cumulative impacts to land use planning and agricultural resources in the primary and extended study areas include:

- Population growth and associated development of socioeconomic resources and infrastructure

- Conversion of natural vegetation to agricultural and developed land uses
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)
- Construction and operations of flood management facilities (including the Chowchilla, Eastside, and Mariposa bypasses and associated diversion and drop structures)
- Construction and operations of water supply infrastructure (including Friant Dam, Millerton Lake, Mendota Dam and Pool, Sack Dam, and other dams and reservoirs; the DMC; Arroyo Canal; and other diversion facilities on the San Joaquin River and in the Delta)

Past and present actions have substantially altered land use planning and agricultural resources throughout the primary study area compared to historical conditions, resulting in a loss of farmland and forestland and an increase in urban development.

As described in Chapter 17, “Land Use Planning and Agricultural Resources,” and shown in Table 27-14, implementing any of the action alternatives would result in direct and/or indirect impacts on land use and agricultural resources in the primary study area.

Table 27-14. Direct, Indirect, and Cumulative Impacts to Land Use Planning and Agricultural Resources

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
LUP-1: Disruption of Existing Land Uses	Primary Study Area	All	PSU	CU
	Extended Study Area	All	NI	NC
LUP-2: Conflict with Adopted Plans	Primary Study Area	All	PSU	CU
	Extended Study Area	All	NI	NC
LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts	Primary Study Area	All	PSU	CU
	Extended Study Area	All	NI	NC
LUP-4: Conversion of Forest Land	Primary Study Area	All	PSU	CU
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
CU = considerable and unavoidable contribution
NC = no contribution
NI = no impact
PSU = potentially significant and unavoidable

Primary Study Area

The PG&E HCP plan area is narrowly defined to include all gas and electrical transmission lines and distribution facilities, private access routes to infrastructure associated with operations and maintenance activities, minor facility expansion areas, and mitigation areas for impacts resulting from activities specifically covered by the HCP (PG&E 2006). This HCP provides coverage for routine operations and maintenance activities conducted by PG&E, which are not part of any of the action alternatives. Therefore, the PG&E HCP is not applicable to the action alternatives, nor are there other adopted HCPs or Natural Community Conservation Plans that cover the primary study area. Therefore, no impacts related to this threshold

would occur under any of the alternatives and this issue is not evaluated further in this analysis.

For environmental impacts occurring in the primary study area that are associated with implementing the action alternatives, the geographic context for the cumulative impacts analysis is the central Sierra Nevada foothill region. Reasonably foreseeable future projects within this area that could affect land use planning and agricultural resources include the Comprehensive Conservation Management Plans for National Wildlife Refuges, Lost Lake Master Plan, San Joaquin River Parkway Master Plan, Gunnar Ranch West Specific Plan, Ventana Hills Estates Annexation, and Gateway Village Specific Plan. In addition, continued development, as allowed in the Fresno County and Madera County general plans, would likely result in introducing new land uses and losses of agricultural and forestlands. Throughout the central Sierra Nevada foothill region, conversion, fragmentation, and alteration of agricultural and forestry resources would likely continue as a result of planned development.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts LUP-1 and LUP-3: Disruption and Conversion of Existing Land Uses

Implementing any of the action alternatives would result in the loss of agricultural land, including the loss of Williamson Act contracts and FSZ lands. The loss of Williamson Act contracts and FSZ lands is considered a cumulatively considerable incremental contribution to the significant cumulative impact to agricultural lands that would occur from various actions, including inundation of agricultural lands and construction and operation of the quarry and batch plant; past farmland conversions; planned future residential, commercial, and industrial development; flood control projects; and habitat restoration projects in Fresno, Madera, and Merced counties.

Implementing Mitigation Measure LUP-3 would reduce potential impacts on Williamson Act contract and FSZ lands. However, the impacts would not be reduced to a less-than-significant level because cancellation of Williamson Act contracts and conversion of FSZ lands would still occur. This analysis assumes that reasonably foreseeable probable future projects would develop and adopt mitigation to minimize the significance of the impacts on agricultural resources to the extent feasible. Nonetheless, it may not be feasible to fully

mitigate all impacts on agricultural resources from numerous projects, including the selected alternative plan. Therefore, implementing any of the action alternatives would result in a **cumulatively considerable incremental contribution to a significant cumulative impact** on existing land uses and agricultural resources.

Impact LUP-2: Conflict with Adopted Plans

The implementation of reasonably foreseeable future projects might result in a variety of physical impacts related to consistency with adopted land use plans. Inconsistencies with adopted land use plans or policies and zoning generally would not combine to result in cumulative impacts. As described in Appendix G of the State CEQA Guidelines, an impact related to this issue would be significant if implementing an alternative would conflict with any applicable land use plan or policy adopted for the purpose of avoiding or mitigating environmental impacts.

As described in Chapter 17, “Land Use Planning and Agricultural Resources,” BLM’s proposed RMP would establish 5.4 miles of the San Joaquin River from the Kerckhoff Dam downstream to the Kerckhoff Powerhouse as eligible and suitable for designation as a Federal Wild and Scenic River based on its free-flowing character and ORV. The proposed RMP would establish a corridor along this portion of the river wherein future actions that would alter the free-flowing nature, diminish the stream’s ORVs, or otherwise modify the level of watershed development to a degree that would change the classification would require Congressional approval. Implementing any of the action alternatives would result in inconsistency with the proposed RMP, particularly the determination that the San Joaquin River downstream from Kerckhoff Dam is suitable and eligible for wild and scenic river status and likely preclude Congressional approval of this status. Likewise, Congressional approval of the designation of the corridor along this portion of the river as a Federal Wild and Scenic River would likely preclude implementation of the action alternatives. The inconsistency between the action alternatives and the BLM RMP involves a conflict of policies to protect the ORVs maintained by the free-flowing San Joaquin River. If implementing any of the action alternatives occurs before Congressional approval of the wild and scenic designation then the additive effect would be the removal of a designated river from the Wild and Scenic River system list and loss of its values across the wild and scenic river system.According to the National Wild and Scenic Rivers

System, “as of April 2012, the National System protects 12,598 miles of 203 rivers in 39 states and the Commonwealth of Puerto Rico; this is a little more than one-quarter of one percent of the nation's rivers. By comparison, more than 75,000 large dams across the country have modified at least 600,000 miles, or about 17%, of American rivers” (Wild and Scenic Rivers System 2014). Implementing any of the action alternatives would result in less than a 1 percent increase to this total. Therefore, implementing any of the action alternatives would result in a **cumulatively considerable incremental contribution to a significant cumulative impact** related to conflict with adopted plans.

Impact LUP-4: Conversion of Forest Land

Implementing any of the action alternatives would result in a loss of forest land within the reservoir inundation zone and in areas to be used for project features. The permanent conversion of these forest lands to other uses would result in a cumulatively considerable incremental contribution to the significant cumulative impact to forest lands that would occur from various reasonably foreseeable future actions, including residential, commercial, and industrial development projects, flood control projects, and habitat restoration projects in Fresno, Madera, and Merced counties.

No feasible mitigation measures are available to reduce this impact to a less-than-significant level. Although it is assumed that other reasonably foreseeable future projects would develop and adopt mitigation measures to minimize the significance of impacts on forest land to the extent feasible, full mitigation may not be possible. Therefore, implementing any of the action alternatives would result in a **cumulatively considerable incremental contribution to a significant cumulative impact** on forest land.

Extended Study Area

Within the extended study area, implementing any of the action alternatives would not result in impacts on land use planning and agricultural and forestry resources because water deliveries would remain within their historic range and would not result in changes that could lead to increased agricultural production, development, conflicts with adopted land use policies or programs, conversion of agricultural lands to other uses, or conversion of forestry resources. The action alternatives would not have a cumulative impact on land use planning, agricultural lands, or forestry resources in the extended study area.

Noise and Vibration

Actions of past and present projects that have resulted in new noise sources in the primary and extended study areas include:

- New development and infrastructure,
- Development and infrastructure related construction
- Development and infrastructure related traffic
- Recreation on Millerton Lake

Past and present actions have added to existing ambient noise environment in the primary study area. The existing ambient noise is consistent with that of typical rural areas and is defined primarily by human (e.g., people walking and talking, yard maintenance equipment, dogs barking) and natural sounds, (e.g., wind, birds), but is also affected by local roadway traffic and boats in Millerton Lake. These past and present actions have resulted in significant adverse impacts on noise-sensitive land uses, which generally include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose.

As discussed in Chapter 18, “Noise and Vibration,” and shown in Table 27-15, the action alternatives could result in direct and/or indirect impacts in the primary study area; no impacts would occur in the extended study area.

Table 27-15. Direct, Indirect, and Cumulative Impacts to Noise and Vibration

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
NOI-2: Construction-Generated Ground Vibration	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
NOI-4: Long-Term Operational Stationary- and Area-Source Noise	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
NOI-5: Long-Term Increases in Traffic Noise	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

A number of reasonably foreseeable probable future projects in the vicinity of the primary study area have the potential to introduce new construction-related and operational noise sources, including noise-generating vehicle trips, which could affect noise-sensitive receptors areas that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects (e.g., under the Friant Ranch Specific Plan in Fresno County and the North Fork Village project in Madera County) and hydroelectric projects (e.g., Pacific Gas and Electric Company Kerckhoff Licensing, Big Creek Facilities Relicensing). In addition, buildout of the Fresno County and Madera County general

plans would result in additional construction and operational noise sources.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction

For all of the action alternatives, it was determined that adherence to Mitigation Measure NOI-1 would not be sufficient to avoid significant construction noise impacts. This is because some construction activities would need to occur during the non-exempt times of day, and possibly on Sundays. Also, the feasibility of installing temporary sound barriers is not certain at this time. Because the action alternatives could result in construction noise impacts to sensitive receptors (Impact NOI-1), even with implementation of Mitigation Measure NOI-1, they could make a **cumulatively considerable incremental contribution to the overall significant cumulative impact**.

Impact NOI-2: Construction-Generated Ground Vibration

Groundborne vibration generated during the construction phases under the action alternatives would not result in exceedence of applicable vibration level standards (i.e., FTA's maximum acceptable vibration standard of 80 VdB or the perception threshold of 0.1 inches/second PPV established by Madera County General Plan Policy 7.A.9) at off-site sensitive receptors (Impact NOI-2). While construction activity associated with other projects in or near the primary study area may generate ground vibration that adversely affects nearby sensitive receptors, it is very unlikely that ground vibration from these projects would affect the same receptors as those that could be potentially affected by construction under the action alternatives. This is due to the localized nature of ground vibration. Hence, the action alternatives would not make a cumulatively considerable incremental contribution to overall significant cumulative impacts associated with sources of groundborne vibration.

Impact NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise

Under all of the action alternatives, construction-generated traffic would contribute to traffic noise levels along affected roadways. With regard to the SEL levels near residences that could be created by truck passbys during construction of the action alternatives, it was determined that limiting

construction-related haul truck trips on some key roadway segments to the less noise-sensitive daytime hours, as required by Mitigation Measure NOI-3, would be sufficient to minimize awakenings by truck passbys and avoid significant impacts. While the SELs from construction-related truck passbys would be considered less than significant with implementation of Mitigation Measure NOI-3, there is no guarantee that truck trips generated by other projects in the area would not pass near noise-sensitive receptors during noise-sensitive nighttime hours. Therefore, significant cumulative SEL impacts associated with truck passbys could occur. However, because the action alternatives would not result in truck passbys during noise-sensitive nighttime hours with implementation of Mitigation Measure NOI-3, they would not contribute to any related cumulative SEL impacts.

Under Options B and C, it was determined that the addition of construction-related vehicle trips to affected roadways would not result in traffic noise increases that exceed applicable L_{dn} standards or standards regarding the incremental increase in L_{dn} noise levels from traffic (Impact NOI-3).Under Option A traffic noise levels would increase by more than 5 dBA L_{dn} during the construction period along the segment of County Road 211 between North Fork Road and Hildreth Road and the segment of County Road 210 County Road 211 and Haul Road #1. Regardless of which Option is implemented, however, the construction and/or operation of other development in the region could add vehicle trips to many of the same roadways and result in traffic noise levels that exceed applicable standards of Fresno County and/or Madera County. Therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on traffic noise in the primary study area for the duration of the construction period.

Impact NOI-4: Long-Term Operational Stationary- and Area-Source Noise

Long-term operational stationary- and area-source noise generated under the action alternatives, including operation of the new powerhouse, recreational boating activity on Temperance Flat RM 274 Reservoir, and corona noise from the new and relocated electrical transmission lines, would not expose any noise-sensitive receptors to levels of noise that exceed applicable noise standards of Fresno and Madera counties (Impact NOI-4). While operational noise sources associated with other development in or near the primary study area—such as development under the Friant Ranch Specific

Plan in Fresno County and the North Fork Village project in Madera County—may introduce new noise stationary and area noise sources, it is not anticipated that noise from these projects would affect the same receptors as those that could be potentially affected by noise sources that would operate under the action alternatives. This is largely due to the fact that noise effects are generally localized because noise levels are not directly additive, and attenuate rapidly with distance. Therefore, the action alternatives would not cause a cumulatively considerable incremental contribution to the overall significant cumulative impacts associated with operational stationary and area noise sources.

Impact NOI-5: Long-Term Increases in Traffic Noise

For all of the action alternatives, it was determined that the addition of vehicle trips to the segment of Wellbarn Road north of Auberry Road and the segment of Smalley Road west of Power House Road would result in traffic noise increases that exceed applicable Fresno County's incremental increase traffic noise standard and thereby be a significant and unavoidable impact. The same analysis determined, however, that long-term traffic noise increases along other modeled roadway segments would not exceed applicable L_{dn} standards or Fresno County's standards for incremental increases in traffic noise. Development growth in the region, including projects such as the Friant Ranch Specific Plan near Friant in Fresno County and North Fork Village Specific Plan in Madera County, would contribute vehicle trips to many, if not all, of the same roadways segments affected by operations under the action alternatives. (It is not known at this time whether other development projects in the area would also contribute traffic to Wellbarn Road and Smalley Road.) If the combined increases in traffic noise exceed the L_{dn} standard established by Fresno or Madera counties or result in traffic noise increases that exceed applicable increase standards then they would be cumulatively significant and long-term traffic noise increases resulting from the vehicle trips associated with the action alternatives would be cumulatively considerable. Because the magnitude, specific timing, and location of additional traffic associated with related projects cannot be known at this time, no feasible mitigation can be identified to reduce this impact. Therefore, the action alternatives could cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** on long-term increases in traffic noise in the primary study area.

Extended Study Area

The action alternatives would not result in any impacts related to noise and vibration in the extended study area.

Paleontological Resources

Actions of past and present projects that have resulted in cumulative impacts to paleontological resources in the primary and extended study areas include:

- Construction and operations of Friant Dam and Millerton Lake
- Development of infrastructure
- Residential, commercial, and industrial development
- Resource extraction (including gold and gravel mining)

As discussed in Chapter 19, "Paleontological Resources," and shown in Table 27-16, the action alternatives could result in direct and/or indirect impacts in the primary study area; no impacts would occur in the extended study area. The action alternatives would not combine with past, present, or reasonably foreseeable future projects to cause overall significant cumulative impacts on paleontological resources in the study areas.

Table 27-16. Direct, Indirect, and Cumulative Impacts to Paleontological Resources

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
PAL-1: Potential for Damage to or Destruction of Unique Paleontological Resources	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
NI = no impact
LTS = less than significant
NC = no contribution

Primary Study Area

A number of reasonably foreseeable future projects that would be located in the vicinity of the primary study area have the potential to affect paleontological resources that also may be affected by implementing any of the action alternatives. Examples of these projects include development projects, such as Brighton Crest/Eagle Springs Golf Course and Country Club, and local plans, such as the BLM Bakersfield Proposed RMP, and the Business Plan for the San Joaquin River Gorge Special Recreation Management Area.

The following describes potential cumulative effects to the identified project-related impact in the primary study area.

Impact PAL-1: Potential for Damage to or Destruction of Unique Paleontological Resources

Fossil discoveries resulting from excavation and earthmoving activities associated with development and the construction of infrastructure are occurring with increasing frequency throughout California. The value or importance of different fossil groups varies depending on the age and depositional environment of the rock unit that contains the fossils; the fossils' rarity; the extent to which they have already been identified and documented; and the ability to recover similar materials under more controlled conditions, such as part of a research project. Unique, scientifically important fossil discoveries are relatively rare, and the likelihood of encountering them is specific to each site and is based on the type of specific geologic rock formations that are present. These geologic formations vary from location to location.

A portion of the new transmission line route that would be located south of Millerton Lake is underlain by the Mehrten Formation, which is paleontologically sensitive. Thus, the potential exists to encounter unique paleontological resources during construction-related earthmoving activities.

As described in Chapter 28, "Other NEPA and CEQA Considerations," project-related activities on Federal and State lands are required to conform to several plans, policies, regulations, and laws intended to protect paleontological resources. Other projects that are undertaken by local jurisdictions on private land are required to conform to general plans and policies contained therein that require the protection of paleontological resources. Therefore, because any project involving development that would take place in a paleontologically sensitive rock formation would be required to

implement appropriate mitigation measures, implementing these projects would not result in a significant impact related to damage to or destruction of unique paleontological resources.

Implementing Mitigation Measure PAL-1 would reduce the impact of any of the action alternatives on previously undiscovered paleontological resources to a less-than-significant level. Because project site evaluations and mitigation measures to protect paleontological resources are required by the Federal, State, and local laws and plans for both the Investigation and reasonably foreseeable future projects, a significant cumulative impact from damage to or destruction of unique paleontological resources would not occur. The project also would not make a cumulatively considerable incremental contribution to a significant cumulative impact on paleontological resources.

Extended Study Area

The action alternatives would not result in any impacts related to paleontological resources in the extended study area. Therefore, none of the action alternatives would make a cumulatively considerable incremental contribution to a cumulative impact associated with existing or reasonably foreseeable projects in the extended study area.

Power and Energy

Actions of past and present projects that have resulted in cumulative impacts to power and energy in the primary and extended study areas include:

- Licensing of PG&E Kerckhoff Hydroelectric Project
- Licensing of Friant Dam powerhouses
- Licensing/Relicensing of other hydropower facilities in California
- Increased renewable energy generation (e.g., wind, solar)
- CVP and SWP operations and local water development actions

- Population growth and associated development of infrastructure and energy demands

Past and present actions have substantially altered power and energy facilities operations and constrained or enhanced hydropower energy and ancillary services. Within the primary study area, licensing the Kerckhoff Hydroelectric Project and the various Friant Dam powerhouses increased energy and ancillary services to the region. Within the extended study area, licensing various Federal, State, and local hydropower generation projects increased energy and ancillary services to the region. Additional renewable energy generators have increased energy, but have also required additional ancillary service facilities. Federal, State, and local water supply operations have both enhanced and constrained hydropower in both the primary and extended study areas by augmenting or decreasing dam releases, reservoir elevations, and water supply conveyance pumping requirements.

Table 27-17. Direct, Indirect, and Cumulative Impacts to Power and Energy

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
PWR-2: Change in Energy Generation at Friant Dam Powerhouses	Primary Study Area	All	Beneficial	BC
	Extended Study Area	All	NI	NC
PWR-3: Change in Energy Generation and Use Within the Friant Division of the CVP Water Service Area	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	NC

Table 27-17. Direct, Indirect, and Cumulative Impacts to Power and Energy (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
PWR-4: Decrease in CVP System Energy Generation	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
PWR-5: Decrease in SWP System Energy Generation	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
PWR-6: Increase in CVP System Pumping Energy Use	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
PWR-7: Increase in SWP System Pumping Energy Use	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
LTS = less than significant
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

No reasonably foreseeable future projects have or would decrease energy generation or ancillary services at the Kerckhoff Hydroelectric Project. Construction and operation of the New Friant River Outlet Powerhouse would increase energy generation capacity at Friant Dam.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services

All action alternatives would have significant and unavoidable impacts in the primary study area related to the decrease in Kerckhoff Project energy generation. No feasible mitigation is available to reduce the severity of Impact PWR-1; therefore, all action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** related to the decrease in Kerckhoff Hydroelectric Project energy generation.

Impact PWR-2: Change in Energy Generation at Friant Dam Powerhouses

Impact PWR-2 would be beneficial for all of the action alternatives. Under the action alternatives, there would be an increase in simulated average annual generation. Construction and operation of the New Friant River Outlet Powerhouse would further increase energy generation capacity at Friant Dam. Therefore this impact would result in a **beneficial contribution to the overall significant cumulative impact** related to energy generation at Friant Dam powerhouses.

Extended Study Area

Other reasonably foreseeable future projects, including the SLWRI and Oroville Facilities FERC relicensing, will lead to changes in CVP and SWP system energy generation and use, either directly or through affecting flows in the Sacramento River, San Joaquin River, or Delta, which in turn influence reservoir operations. These projects would decrease (due to relicensing restrictions), maintain, or increase CVP and SWP system energy generation and use. The following describes potential cumulative effects to the identified project-related impact in the extended study area.

Impacts PWR-3 Through PWR-7: Changes in CVP and SWP System Energy Generation and Use

Impact PWR-3 would be less than significant and beneficial for all of the action alternatives. Under the action alternatives, there would be an increase in simulated average annual generation at Madera Canal powerhouses owned and operated by Madera Chowchilla Water and Power Authority compared to the No Action Alternative. Additionally, there would be a decrease in pumping energy use through increases in surface water deliveries. When any of the action alternatives are combined with other present and reasonably foreseeable projects, river flows and reservoir elevations would be likely to change, but not considerably. The action alternatives would not

cause substantial changes in energy generation in the CVP (increases and decreases of less than 1 percent) (Impact PWR-4, less than significant and beneficial) or the SWP (increases of less than 2 percent) (Impact PWR-5, less than significant and beneficial) systems. The action alternatives also would not cause substantial changes in energy use in the CVP (increases of less than 2 percent) (Impact PWR-6) or SWP (increases of less than 3 percent) (Impact PWR-7) systems. The increases in energy use anticipated under the action alternatives would exceed energy generation, but would remain a small portion of the overall energy generation and use in the CVP and SWP systems, while reasonably foreseeable future projects such as the SLWRI and the New Friant River Outlet Powerhouse are expected to increase energy generation in the CVP and SWP. Therefore, the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact on power generation and consumption.

Public Health and Hazards

Actions of past and present projects in in the primary and extended study areas that have resulted in risks to human health and safety include:

- Population growth and associated development of socioeconomic resources and infrastructure
- Conversion of natural vegetation to agricultural and developed land uses
- Agricultural practices (including the application of pesticides, herbicides, and fertilizers)
- Conversion of natural vegetation to agricultural and developed land uses
- Resource extraction (e.g., gravel mining, gold mining, and timber harvesting)

These projects and actions have led to risks including exposure of people to unacceptable levels of toxic substances in soil or water, such as gasoline and pesticides; of people to hazardous materials associated with utility poles, transformers, and associated electric power transmission facilities; of people to West Nile virus or vector-borne illnesses and valley fever; and

of people or structures to a significant risk of loss, injury, or death involving wildland fires. Public health and hazards impacts associated with the past or current uses of a project site usually occur on a project-by-project basis, and are generally limited to the specific project site; in this case, the immediate area located in the vicinity of project features and nearby roadways.

Table 27-18. Direct, Indirect, and Cumulative Impacts to Public Health and Hazardous Materials

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
HAZ-1: Potential for Exposure to Hazardous Materials	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-2: Potential Emission of Hazardous Materials within 0.25 Mile of a School	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-3: Increase Hazards from a Known Hazardous Materials Contamination Site	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-4: Interfere with Evacuation Routes and Emergency Vehicle Access	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-5: Locate Electrical Transmission Facilities near a School	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
HAZ-6: Increase Hazards of Wildland Fires	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Table 27-18. Direct, Indirect, and Cumulative Impacts to Public Health and Hazardous Materials (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
HAZ-7: Increase Hazards of West Nile Virus	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-8: Increase Hazards of Valley Fever	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-9: Increase Exposure to Damage from Acts of Terrorism	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
HAZ-10: Increase Exposure to Hazards Associated with Abandoned Mine Sites	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
HAZ-11: Increase Potential for Blast-Related Injury during Construction	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Key:
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

Reasonably foreseeable future projects in the primary study area that would result in temporary construction-related activities and long-term operational activities in Fresno and Madera counties include the Millerton New Town Specific Plan, the Brighton Crest subdivision, and the Ventana Hills Estates Annexation. These projects involve constructing residential and commercial land development. Other large-scale planned and approved developments in the vicinity of the primary study area in Fresno and Madera counties include the Friant Ranch Specific Plan, in Fresno County, and the Gunner Ranch West Area Plan, Gateway Village, and Rio Mesa Plan Area in Madera County.

Reasonably foreseeable future projects would all involve the storage, use, disposal, and transport of hazardous materials to varying degrees during construction and operation; generate construction-related and operational-related traffic on regional and local roadways, including SR 99, SR 41, SR 145, Friant Road, Lake Road, Millerton Road, Sky Harbour Road, Auberry Road, North Fork Road, Road 206, Road 208, Road 210, Wellbarn Road, and Powerhouse Road; increase the potential for wildland fires; create sources of standing water that provide aquatic habitats for mosquitos and other vector species; and involve soil-disturbing activities that increase the risk of exposure to valley fever. Projects that could result in impacts on public health and hazards in the primary study area will be required to comply or provide mitigation in compliance with regulations established by the EPA; California Environmental Protection Agency; the Department of Toxic Substances Control; the State Water Board; CHP; Caltrans; and other applicable local, State, and Federal statutes.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact HAZ-1: Potential for Exposure to Hazardous Materials

Construction and operation of the action alternatives and reasonably foreseeable future projects would involve the storage, use, disposal, and transport of hazardous materials (such as asphalt, fuel, lubricants, and solvents) to varying degrees during construction, and demolition of structures may contain asbestos, lead-based or lead-containing paint, PCBs, and mercury. The storage, use, disposal, and transport of hazardous materials are extensively regulated by various local, State, and Federal agencies, and therefore construction companies and businesses that would handle any hazardous substances would be required by law to implement and comply with these existing hazardous-materials regulations (also see Chapter 2, “Alternatives,” for further discussion of environmental commitments designed to minimize or avoid discharge of materials to surface waters). Any reasonably foreseeable future projects that occur simultaneously would be required to implement and comply with the same existing hazardous-materials regulations. Therefore, a cumulatively significant impact would not occur, and the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact associated with hazardous materials storage and transport.

Impact HAZ-2: Potential Emission of Hazardous Materials within 0.25 Mile of a School

There are no schools located within 0.25 mile of the primary study area. However, Foothill Middle School and Auberry Elementary are located 2.5 miles east of the proposed Temperance Flat RM 274 Reservoir site along Auberry Road, which is a designated truck route for this project. Accidental releases during the transport of hazardous materials or attributable to other equipment or maintenance failure could result in an inadvertent spill or release that could pose a potentially significant hazard to nearby school occupants.

Implementing Mitigation Measure HAZ-2 would reduce the project's potentially significant impact to a less-than-significant level by requiring coordination with the Fresno County Fire Protection District, Madera County Fire Department, the County Sheriff's Offices, California Department of Transportation, the California Highway Patrol, and representatives from Foothill Middle School and Auberry Elementary, and compliance with CHP and Caltrans regulations. Current and reasonably foreseeable future projects would also be required to comply with various local, State, and Federal agencies that regulate the transport of hazardous materials. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to the potential emission of hazardous materials within 0.25 mile of a school.

Impact HAZ-3: Increase Hazards from a Known Hazardous Materials Contamination Site

The primary study area contains underground storage tanks that are located between 50 feet and 600 feet from the proposed inundation area (see Chapter 21, "Public Health and Hazards"). Inundation of existing underground storage tanks could contaminate water in Millerton Lake and downstream in the San Joaquin River. Implementing Mitigation Measure HAZ-3 would reduce the project's potentially significant impact to a less-than-significant level by removing aboveground and underground storage tanks from areas that are subject to inundation and coordinating with Madera County and Fresno County environmental management departments responsible for hazardous site identification and closure.

Reasonably foreseeable future related project sites could contain existing aboveground or underground storage tanks; however, if storage tanks are located on a project site, the

associated impacts would be localized to those projects and would not be additive to construction of the action alternatives. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to expose to the general public to known hazardous materials.

Impact HAZ-4: Interfere with Evacuation Routes and Emergency Vehicle Access

Regional and local roadways listed above would likely be affected intermittently during construction activities resulting in decreased emergency access and response times. These additional trips would be temporary and would cease after construction is completed. Implementing Mitigation Measure HAZ-4 would reduce the project's potentially significant impact to a less-than-significant level by preparing and implementing a TMP in coordination with local emergency service providers that would ensure unimpeded emergency vehicular access and passage, develop detours to ensure acceptable traffic flow through and/or around the construction zone, and minimize traffic congestion. In addition, no specific future projects have been identified that would overlap spatially or temporally with affected roadways that could combine with construction of the proposed project to cause a cumulatively significant affect related to decreased emergency access and response times. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to interference with emergency access and response times during construction.

Recreation-related changes associated with implementing any of the action alternatives—specifically, the improved conditions at Millerton Lake and the creation of the new Temperance Flat RM 274 Reservoir—would, however, lead to an increase in long-term traffic volumes. It is estimated that during peak use, 672 vehicle trips per day would be added to area roadways as a result of increased recreational activity at Millerton Lake and Temperance Flat RM 274 Reservoir. However, the action alternatives' recreation-related contribution to traffic on area roadways would be substantially less than the traffic contribution from the combination of past, present, and reasonably foreseeable future projects; therefore, the action alternatives' recreation-related contribution would not make a cumulatively considerable incremental contribution to a significant cumulative impact on traffic from increased recreational activities at Millerton Lake and the proposed

Temperance Flat RM 274 Reservoir (see the Transportation, Circulation, and Infrastructure section of this chapter for further discussion).

Impact HAZ-5: Locate Electrical Transmission Facilities near a School

New transmission lines and other power facilities would be constructed as part of the action alternatives; therefore, EMF levels would increase and there could be some potential for increased exposure to school occupants at Foothill Middle School and Auberry Elementary. However, none of the project components would be within one-quarter mile of an existing or proposed school and no impact would occur. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to siting of transmission facilities near a school.

Impact HAZ-6: Increase Hazards of Wildland Fires

Temperance Flat RM 274 Dam site and surrounding areas are located in moderate to high fire hazard severity zones. The use of construction equipment, increased human activity, storage and use of potentially flammable materials, and presence of charged utility lines increase the potential for fire ignition in the primary study area. Operation of motor vehicles on designated access roads and haul roads and throughout the region, particularly when vegetation adjacent to roadways is dry, imparts a certain level of fire potential from accidental combustion (e.g., sparks), hot metal (e.g., tail pipes, motors), or traffic accidents, which could result in fire. Relevant safety standards/procedures related to fire prevention would be incorporated into the project design, and would be used during construction activities and project operation and maintenance. Applicable safety standards and procedures include the CBSC; the Fresno County and Madera County fire plans; USFS safety requirements regarding fire hazards; and CPUC General Order 95, which provides procedures for proper removal, disposal, and placement of poles, wires, and associated infrastructure. In addition, Chapter 2, “Alternatives,” identifies environmental commitments to minimize the risk of wildfire and the potential threat to workers, property, and the public.

No specific future projects have been identified that would overlap spatially or temporally with affected roadways that could in combination with construction of the proposed project to cause a cumulatively significant affect related to decreased emergency access and response times. Any reasonably

foreseeable future projects that occur simultaneously would be required to implement and comply with the same existing safety standards and procedures. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the significant cumulative impact related to interference with emergency access and response times during construction.

Impact HAZ-7: Increase Hazards of West Nile Virus

Implementing the action alternatives would create structures, ground depressions, excavation pits, and other features and establish a new reservoir that holds permanent sources of standing water, resulting in an additional source of vector-borne illness from West Nile virus. Implementing Mitigation Measure HAZ-7 would reduce the action alternatives' potentially significant impact to a less-than-significant level by implementing a project-specific health and safety plan that specifies measures to be taken during construction to dewater, fill, or apply an approved treatment capable of eradicating identified mosquito populations.

There are no other projects located or proposed in the primary study area that would either result in increased mosquito breeding or introduce a new human population that could be subject to increased risk of West Nile virus exposure. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact associated with the increased risk of West Nile virus in the primary study area.

Impact HAZ-8: Increase Hazards of Valley Fever

Ground-disturbing activities associated with the proposed Temperance Flat RM 274 Dam and Reservoir, new and relocated transmission line corridors, and construction of other reservoir-related project features would increase fugitive dust emissions that could lead to valley fever exposure if spores are present. Implementing Mitigation Measure HAZ-7 would reduce the action alternatives' potentially significant impact to a less-than-significant level by implementing a project-specific health and safety plan that is designed to test for presence of valley fever spores in the soil, and provide actions to minimize worker exposure. In addition, Chapter 2, "Alternatives," identifies environmental commitments to reduce fugitive dust emissions.

Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution

to a significant cumulative impact associated with the potential health-related impacts from soil-disturbing activities and exposure to valley fever.

Impact HAZ-9: Increase Exposure to Damage from Acts of Terrorism

While the potential for a terrorist attack exists for any critical infrastructure system, Temperance Flat RM 274 Dam is not considered a high-priority target for acts of terrorism, and the potential threat would be no greater than for other dams of similar scale located throughout the country. Impacts associated with exposure to the public and damage to the environment from acts of terrorism from implementing the action alternatives would be less than significant. There are no other projects located or proposed in the vicinity of the Temperance Flat RM 274 Dam that would provide optimal targets for terrorist acts. Therefore, the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact related to exposure to the public and damage to the environment from acts of terrorism.

Impact HAZ-10: Increase Exposure to Hazards Associated with Abandoned Mine Sites

Three abandoned mine sites are located within the Temperance Flat Reservoir area, including the Patterson Mine (formerly known as the Diana Mine), San Joaquin Mine, and the Sullivan Mine Group. Potential hazards associated with abandoned mines include undetonated explosives, decomposed support timber, unstable ground and rocks, obscure vertical workings, and water-filled excavations. These hazards pose potential risks to casual entrants. Because none of the project features or recreational facilities would be located in the vicinity of these mine sites, the action alternatives would not expose construction workers or the general public to hazards associated with abandoned mine sites. There are no other projects located or proposed in the vicinity of the Patterson Mine, San Joaquin Mine, and the Sullivan Mine Group that would expose construction workers or the general public to hazards associated with abandoned mine sites. Therefore, the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact related to exposure to hazards associated with abandoned mine sites.

Impact HAZ-11: Increase Potential for Blast-Related Injury during Construction

Blasting may be required for excavation and removal of rock during construction of the diversion tunnel. Blasting entails the placement of explosive materials into a borehole, which is then ignited. The subsequent explosion generates air blasts and seismic waves that fracture the surrounding rock. Reasonably foreseeable accidents associated with blasting include accidental discharge and expulsion of materials beyond the expected distance (i.e., flyrock). There are no other projects located or proposed in the vicinity of the blasting activities that would expose construction workers or the general public to hazards associated with blasting. Therefore, the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact related to exposure to hazards associated with abandoned mine sites.

Extended Study Area

The extended study area extending from Friant Dam to the confluence with the Merced River, San Joaquin River from Merced River to the Delta, and the Delta is now subject to changed instream flows associated with implementing the SJRRP. However, these changes in water flow would have no impacts on, nor would they be affected by, anthropogenic factors, valley fever, naturally occurring asbestos, wildland fire, aircraft safety, or EMF.

Public health and hazards associated with West Nile virus do not pertain to the extended study area because implementing any of the action alternatives would not result in modifying land uses or provide increases in water supply that exceed historic amounts. The delivery of water supplies generated by implementing any of the action alternatives and delivering water supplies to the SOD CVP and SWP water service areas would not modify physical conditions that would increase mosquito habitat or associated mosquito populations that could pose an increased risk of West Nile virus. Changes in San Joaquin River flows associated with operations of the action alternatives would remain within the historic flow range and would not be substantially different from no action conditions. Mosquito habitats and populations in the extended study area would not substantially vary from conditions under the No Action Alternative. Implementing any of the action alternatives therefore would not make a cumulatively considerable incremental contribution to a significant cumulative impact to

the existing or future potentially significant cumulative risk of exposure to West Nile virus.

Therefore, the action alternatives would not make a cumulatively considerable incremental contribution to a significant cumulative impact on public health and hazards in the extended study area.

Recreation

Actions of past and present projects that have resulted in cumulative impacts to recreation in the primary and extended study areas include:

- Construction and operations of Friant Dam and Millerton Lake, and Kerckhoff Dam and Reservoir
- Construction of recreation facilities around Millerton Lake
- Establishment of parks and recreational resources throughout the extended study area, including the San Joaquin River Parkway, NWRs, county parks, SRAs, and reservoirs with public access

Past and present projects have formalized recreation opportunities and access throughout the Study Area compared to historical conditions.

As described in Chapter 22, "Recreation," and shown in Table 27-19, the action alternatives could result in direct and/or indirect impacts on recreation in the primary and extended study areas.

Table 27-19. Direct, Indirect, and Cumulative Impacts to Recreation

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
REC-1: Permanent Loss or Closure of a Recreation Facility	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC

Table 27-19. Direct, Indirect, and Cumulative Impacts to Recreation (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
REC-2: Permanent Loss of a Resource Used for Recreation	Primary Study Area	All	SU	NC
	Extended Study Area	All	LTS	NC
REC-3: Substantial or Long-Term Reduction or Elimination of Recreation Opportunities or Experiences	Primary Study Area	All	SU	NC
	Extended Study Area	All	LTS	NC
REC-4: Loss of Access to a Locally Important Recreation Site or Area	Primary Study Area	All	SU	NC
	Extended Study Area	All	LTS	NC
REC-5: Increased Use of Existing Neighborhood and Regional Parks or Other Recreation Facilities such that Substantial Physical Deterioration of the Facilities Would Occur or Be Accelerated	Primary Study Area	All	LTS	NC
	Extended Study Area	All	LTS	NC
REC-6: Impacts Associated with New or Expanded Recreation Facilities	Primary Study Area	All	Beneficial	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
NI = no impact
LTS = less than significant
SU = significant and unavoidable
NC = no contribution

Primary Study Area

For environmental impacts occurring in the primary study area that are associated with implementing the action alternatives, the geographic context for the cumulative impacts analysis consists of the Millerton Lake SRA and SJRG SRMA. A number of reasonably foreseeable future projects that would be located in the vicinity of the primary study area have the

potential to affect recreation facilities, opportunities, experiences, and access that also may be affected by implementing any of the action alternatives. These projects include FERC hydroelectric project relicensing actions; implementation of the BLM Bakersfield Proposed RMP, *Business Plan for the San Joaquin River Gorge Special Recreation Management Area* (BLM 2010); and the Millerton Lake RMP/General Plan (Reclamation and State Parks 2010).

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts REC-1, REC-2, REC-3, REC-4 and REC-6: Recreation Impacts

The Big Creek and Kerckhoff FERC relicensing projects are located upstream from the primary study area. Implementing any of the action alternatives would have a direct impact on the operation and power production of the Kerckhoff Hydroelectric Project; however, no impact on the existing recreation facilities and uses at these upstream facilities would occur.

Implementing any of the action alternatives would result in inconsistencies with recreational provisions defined in the BLM Bakersfield Proposed RMP, *Business Plan for the San Joaquin River Gorge Special Recreation Management Area*, and the Millerton Lake RMP/General Plan. The inconsistencies, as described in impacts REC-1, REC-3, and REC-4, are associated with the displacement of existing recreation facilities, opportunities, and access to locally important recreational sites and areas, which would affect recreation activities and management objectives and policies within the SRA and SJRG SRMA.

Foreseeable projects have the potential to alter CVP and SWP operations, which may, in turn, have an impact on the operation of Millerton Lake and Temperance Flat RM 274 Reservoir thus affecting recreation within the primary study area. These projects include the BDCP, Delta Plan, changes in CVP and SWP water rights, and SLWRI. A change in Friant Dam or Temperance Flat RM 274 Dam operations due to these other projects would likely not alter recreation facilities or access within the primary study area, but could affect the timing and seasonal availability of recreation opportunities and the quality of recreation experiences both at Millerton Lake and Temperance Flat RM 274 Reservoir. However, it is speculative to assume that these projects would substantially alter operation of either water storage facility. Therefore,

although implementing any of the action alternatives would have a significant and unavoidable direct impact on recreation; it would not cause a cumulatively considerable incremental contribution to overall significant cumulative impacts on recreation.

Impact REC-5: Increased Use of Existing Neighborhood and Regional Parks or Other Recreation Facilities such that Substantial Physical Deterioration of the Facilities Would Occur or Be Accelerated

Within the primary study area implementing any of the action alternatives would result in a less-than-significant impact on recreation because multiple facilities for displaced visitors are available within primary study area. It is expected that displaced recreational users would visit a variety of locations, slightly increasing the use of any particular facility. Such an increase would not cause or accelerate substantial physical deterioration of these other facilities.

The reasonably foreseeable projects that would affect the primary study area are not anticipated to significantly impact recreation. Millerton Lake SRA, SJRG SRMA, BLM Bakersfield Proposed RMP, *Business Plan for the San Joaquin River Gorge Special Recreation Management Area,* and the Millerton Lake RMP/General Plan would generally enhance recreation and are not anticipated to result in substantial impacts on fishing, boating, and swimming opportunities in the reservoir. Therefore, creation of Temperance Flat RM 274 Reservoir would not result in a cumulatively considerable incremental contribution to existing significant cumulative impacts on recreation in the primary study area.

Extended Study Area

The geographic area being considered in the cumulative impacts analysis of the extended study area is the San Joaquin River below Friant Dam to the Merced River confluence. Implementing any of the action alternatives would not substantially affect recreation opportunities or experiences, and would not result in the loss of recreation facilities or access within the CVP and SWP water service areas, the Delta, or along the San Joaquin River downstream from the Merced River confluence. Therefore, these areas are not included in the geographic extent of this cumulative impacts analysis.

The following describes potential cumulative effects to the identified project-related impact in the extended study area.

Impacts REC-1, REC-2, REC-3, REC-4, and REC-5: Recreation Impacts

Within the San Joaquin River downstream from Friant Dam to the Merced River confluence, implementing any of the action alternatives would result in a less-than-significant impact on recreation because of higher flows in the San Joaquin River discharged from Friant Dam. The action alternatives would have higher flows, particularly in April, and could potentially affect the ability of users to fish, boat, and swim in the river.

The reasonably foreseeable projects that would affect the San Joaquin River downstream from Friant Dam are not anticipated to significantly impact recreation. Full restoration flows being implemented by the SJRRP are already included within the CalSim II modeling data used to evaluate changes to flows downstream from Friant Dam. Increased San Joaquin River flows downstream from Friant Dam resulting from implementing any of the action alternatives would not exceed full restoration flows. Other projects such as the Lost Lake Park Master Plan and General Plan would generally enhance recreation and are not anticipated to result in substantial impacts on fishing, boating, and swimming opportunities along the river. Therefore, changes to San Joaquin River flows below Friant Dam would not result in a cumulatively considerable incremental contribution to existing significant cumulative impacts on recreation in the extended study area.

Socioeconomics, Population, and Housing

Actions of past and present projects that have resulted in cumulative impacts to socioeconomics, population, and housing in the primary and extended study areas include:

- Population growth and associated development of infrastructure both in the Sierra foothills and the Central Valley
- Residential, commercial, and industrial development
- Construction and operations of Friant Dam and Millerton Lake, and Kerckhoff Dam and Reservoir

Past and present projects have substantially altered socioeconomics, population, and housing throughout the study area compared to historical conditions.

As described in Chapter 23, "Socioeconomics, Population, and Housing," and shown in Table 27-20, the action alternatives could result in direct and/or indirect impacts in the primary and extended study areas.

Table 27-20. Direct, Indirect, and Cumulative Impacts to Socioeconomics, Population, and Housing

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
SOC-1: Temporary Increases in Employment and Personal Income Resulting from Construction	Primary Study Area	All	LTS and Beneficial	BC
	Extended Study Area	All	NI	NC
SOC-2: Temporary Increases in Population and Housing Demand Resulting from Construction	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
SOC-3: Temporary Increases in Business Income and Local Sales Tax Revenue Resulting from Construction	Primary Study Area	All	LTS and Beneficial	BC
	Extended Study Area	All	NI	NC
SOC-4: Increases in Employment and Personal Income Resulting from Operations and Maintenance	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
SOC-5: Increases in Spending, Employment, and Personal Income from Increased Recreational Visitation	Primary Study Area	All	LTS and Beneficial	BC
	Extended Study Area	All	NI	NC
SOC-6: Increases in Population and Housing Demand Resulting from Operations and Maintenance	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Table 27-20. Direct, Indirect, and Cumulative Impacts to Socioeconomics, Population, and Housing (contd.)

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
SOC-7: Increases in Business Income and Local Sales Tax Revenue Associated with O&M and Recreation Visitation	Primary Study Area	All	LTS and Beneficial	BC
	Extended Study Area	All	NI	NC
SOC-8: Decreases in Property Tax Revenue from Acquisition of Privately Owned Land	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	CU
SOC-10: Increases in Population and Housing Demand Within the CVP and SWP Water Service Areas	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS	NC
SOC-11: Increases in Business Income and Local Sales Tax Revenue Within the CVP and SWP Water Service Areas	Primary Study Area	All	NI	NC
	Extended Study Area	All	LTS and Beneficial	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
BC = beneficial contribution
CU = considerable and unavoidable contribution
CVP = Central Valley Plan
LTS = less than significant
NC = no contribution
NI = no impact
SWP = State Water Project

Primary Study Area

Future implementation of planned and approved urban development in Fresno and Madera counties would result in temporary construction-related jobs and income in Fresno County and Madera County. Within the primary study area, the Millerton New Town Specific Plan, the Brighton Crest subdivision, and the Ventana Hills Estates Annexation involve construction of residential and commercial land uses. Other large-scale planned and approved developments in Fresno and

Madera counties include the Friant Ranch Specific Plan, immediately south of Millerton Lake in Fresno County, and the Gunner Ranch West Area Plan, Gateway Village, and Rio Mesa Plan Area in Madera County. Implementing these projects would result in construction of residential, commercial, and industrial land uses. Additional infill development and urban development would occur in accordance with the Fresno County and Madera County general plans and city general plans within those counties. Commercial and industrial development associated with these projects would also provide permanent employment opportunities and generate new economic activity in Fresno and Madera counties.

These identified projects vary in size and would establish different amounts of residential, commercial, and industrial development. Construction of these projects could potentially generate a temporary increase in employment in Fresno County and Madera County.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts SOC-1, SOC-3, SOC-5, and SOC-7: Socioeconomic Impacts

Implementing any of the action alternatives would create an incremental cumulative contribution to local employment and economic activity. As discussed in Chapter 23, "Socioeconomics, Population, and Housing," substantial employment and personal income in Fresno County and Madera County would be generated from construction-related activities and increased recreational use of Millerton Lake and the new Temperance Flat RM 274 Reservoir. These new jobs would be expected to provide employment opportunities to many unemployed workers, and increases in personal income would result in new local economic activity in Fresno and Madera counties. In addition, implementing any of the action alternatives would also result in a substantial increase in business income and local sales tax revenue in Fresno and Madera counties from spending of personal income. Therefore, implementing any of the action alternatives would result in beneficial and less-than-significant socioeconomic impacts in Fresno County and Madera County and, when combined with the economic activity generated by the other projects, would make a **beneficial contribution to the overall significant cumulative impact.**

Impacts SOC-2 and SOC-6: Increases in Population and Housing Demand

Construction of any of the action alternatives would take place over an 8-year period, and related projects would be constructed during various periods over the next 30 years or more, minimizing the potential overlap of action alternative construction with construction of other future projects. Even if the action alternative and related projects were constructed simultaneously, the supply of general construction labor in Fresno and Madera counties would likely meet the demand associated with constructing both the selected action alternative and the other projects. Within Fresno County and Madera County, the 2010 unemployment rates exceeded 16 percent and 15 percent, respectively. Given the high rate of unemployment, these jobs would provide temporary employment opportunities to many unemployed workers. Therefore, implementing any of the action alternatives would not result in a cumulatively considerable incremental contribution to a significant cumulative impact on population growth or increased housing demand.

Impact SOC-4: Increases in Employment and Personal Income Resulting from Operations and Maintenance

Implementing any of the action alternatives would result in increases in employment and personal income in Fresno and Madera counties as a result of O&M of the Temperance Flat RM 274 Dam, intake structure, powerhouse, valve house, and permanent access roads. In combination with other reasonably foreseeable projects, an incremental cumulative increase in employment and associated personal income could result. However, this increase from O&M-related activities would be small in comparison to the regional economy. Therefore, implementing any of the action alternatives would not result in a cumulatively considerable incremental contribution to a significant cumulative impact on employment or personal income.

Impact SOC-8: Decreases in Property Tax Revenue from Acquisition of Privately Owned Land

Implementing any of the action alternatives would require acquiring privately owned land in the primary study area in Fresno and Madera counties for project purposes. Although a decrease in property tax revenue would occur with implementation of any of the action alternatives, the decrease, even when combined with decreases caused by other past, present, and reasonably foreseeable future projects, would be small in comparison to the total property tax revenue generated

in these counties. Therefore, the reduction in tax revenues associated with the permanent acquisition of private property for the project would be minor and would not contribute to a significant cumulative impact on property tax revenue.

Extended Study Area

Reasonably foreseeable future projects in the extended study area include planned development in city and county general plans; construction of levee improvement and flood control projects, including those proposed in the Central Valley Flood Protection Plan; construction of pipelines, including those proposed in the Bay Delta Conservation Plan; reservoir enlargements, such as the Los Vaqueros Reservoir Expansion Project and Shasta Lake Water Resources Investigation; and habitat restoration projects, such as those included in the Bay Delta Conservation Plan and SJRRP.

The following describes potential cumulative effects to the identified project-related impacts in the extended study area.

Impact SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas

Agricultural land conversions would occur through the reasonably foreseeable projects listed above. These projects have the potential to affect surface water supply reliability to agricultural water users in the CVP and SWP water service areas, which could result in providing additional water supplies for existing agricultural land uses. Implementing any of the action alternatives would improve surface water supply reliability to agricultural producers in the CVP and SWP water service areas, resulting in less temporary crop idling, increasing agricultural production on existing agricultural lands, improving agricultural economic value, and generating new economic activity from agriculture-related income and spending. This increase in water supply reliability would contribute to reducing this significant cumulative impact; however, this reduction would not be sufficient to reduce this impact to a less-than-significant level.

The actual amount of agricultural land that might be affected by the other projects is unknown; however, counties in the project region generally are converting farmland faster than land is being brought into agricultural production. Without implementation of a selected alternative plan, the losses of agricultural economic activity, jobs, and tax revenues that have occurred with implementation of past projects would continue as a result of present and planned future projects. This

conversion of agricultural lands and associated declines in agricultural economic value **would make a cumulatively considerable incremental contribution to a cumulatively significant impact**.

Impact SOC-10: Increases in Population and Housing Demand Within the CVP and SWP Water Service Areas

Implementing any of the action alternatives would generate agriculture-related employment that could potentially increase population and housing demand within the CVP and SWP water service areas. Because workers are expected to reside in nearby communities and cities in the CVP and SWP water service areas, neither substantial population growth nor an increase in housing demand would be anticipated as a result of this job generation. Furthermore, these jobs would be dispersed over a large geographical area and would not be concentrated in any one county. Therefore, impacts associated with increases in population and subsequent housing demand would be less than significant, and implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to a cumulatively significant impact on housing demand as a result of agriculture-related employment within the CVP and SWP water service areas.

Impact SOC-11: Increases in Business Income and Local Sales Tax Revenue Within the CVP and SWP Water Service Areas

As discussed in Chapter 23, “Socioeconomics, Population, and Housing,” agriculture-related income and spending represent new local economic activity and provide employment opportunities to unemployed workers in the CVP and SWP water service areas. In addition, implementing any of the action alternatives would result in a substantial increase in business income and local sales tax revenue in the CVP and SWP water service areas from spending of personal income. Implementing any of the action alternatives would result in beneficial and less-than-significant socioeconomic impacts in the CVP and SWP water service areas; therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to a cumulatively significant impact on the conversion of agricultural lands and declines in agricultural economic value.

Transportation, Circulation, and Infrastructure

Actions of past and present projects that have resulted in degradation of transportation, circulation, or infrastructure in the primary study area include:

- Population growth, land use development, and associated increases in traffic volumes to area roadways
- Construction activities and associated traffic safety hazards, and lane or road closures

As discussed in Chapter 24, "Transportation, Circulation, and Infrastructure," and shown in Table 27-21, the action alternatives could result in direct and/or indirect impacts in the primary study area. The action alternatives would have no impacts to transportation, circulation, or infrastructure in the extended study area.

Table 27-21. Direct, Indirect, and Cumulative Impacts to Transportation, Circulation, and Infrastructure

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
TRN-1: Reduce Level of Service for Designated Roads	Primary Study Area	All	LTS	LTS
	Extended Study Area	All	NI	NC
TRN-2: Increase Traffic Hazards on Local Roads	Primary Study Area	All	LTS	LTS
	Extended Study Area	All	NI	NC
TRN-3: Interfere with Emergency Access	Primary Study Area	All	LTS	LTS
	Extended Study Area	All	NI	NC
TRN-4: Decrease Performance of Bicycle or Pedestrian Facilities	Primary Study Area	All	LTS	LTS
	Extended Study Area	All	NI	NC

Key:
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

A number of reasonably foreseeable future projects that would be located in the vicinity of the primary study area have the potential to affect transportation, circulation, and infrastructure that also may be affected by implementing any of the action alternatives. Development projects (e.g., Gunner Ranch West Specific Plan, Brighton Crest, Ventana Hills Estates Annexation) and continued development, as allowed in the Fresno county and Madera county general plans, would result in additional traffic and may include roadway improvements, or modifications, such as widening for area roadways.

The proponents of development projects that would contribute to increases in traffic volumes or modifications to the transportation network will be required to identify impacts and provide mitigation in compliance with NEPA, CEQA, and other Federal, State, and local statutes. Even with compliance with regulatory requirements and implementation of mitigation, the traffic volumes generated from these reasonably foreseeable future projects may contribute to an overall significant adverse cumulative impact on roadways in the region. Additionally, these projects could result in temporary impacts to transportation, circulation, or infrastructure during construction.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact TRN-1: Reduce Level of Service for Designated Roads

Past, present, and reasonably foreseeable projects have and would increase traffic volumes along regional and local roadways within the primary study area. Construction of any of the action alternatives would contribute approximately 606 daily trips to the area roadways, and have a less-than-significant impact on the LOS for designated roads or highways (Impact TRN-1).

The traffic volumes generated from the combination of any of the action alternatives with past, present, and reasonably foreseeable projects could potentially decrease the LOS for designated roads or highways in the primary study area. If future projects are constructed simultaneously with the Temperance Flat RM 274 Dam, or would result in additional traffic after construction, the associated traffic would act cumulatively with the Temperance Flat RM 274 Dam construction traffic to affect local roadway LOS. In general,

construction activities are not considered impacts due to their temporary and limited duration. In addition, construction generated traffic would operate along designated routes and occur outside of the peak hours for commute travel, further reducing potential impacts of construction on transportation, circulation, and infrastructure. Therefore, due to the short-term and temporary nature of the construction period, the construction-related trips under the action alternatives would not contribute to any significant cumulative impacts related to the LOS for designated roads or highways in the primary study area.

Recreation-related changes associated with the action alternatives, specifically the improved conditions at Millerton Lake and the creation of the new Temperance Flat RM 274 Reservoir, would lead to an increase in long-term traffic volumes. It is estimated that during peak use, 672 vehicle trips per day would be added to area roadways as a result of increased recreational activity at Millerton Lake and Temperance Flat RM 274 Reservoir, and have a less-than-significant impact on the LOS for designated roads or highways (Impact TRN-1).

The traffic volumes generated from the combination of the project with past, present, and reasonably foreseeable projects could potentially decrease the LOS on area roadways. However, the recreation-related contribution of the action alternatives to traffic on area roadways would be substantially less than the traffic contribution from the combination of past, present, and reasonably foreseeable projects, and would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to the LOS for designated roads or highways in the primary study area.

Impact TRN-2: Increase Traffic Hazards on Local Roads

Past projects in the primary study area have required, and likely many of the present and reasonably foreseeable projects will require, roadway improvements or modifications, such as widening for area roadways. Therefore, implementing the related projects could result in a significant temporary impact from the increase in traffic safety hazards to these facilities during temporary construction activities.

The maneuvering of project construction vehicles and equipment among the general-purpose traffic on local roads could cause safety hazards. Traffic safety hazards could

increase as a result of (1) the introduction of trucks and other construction-related vehicles that could affect the minimal stopping sight distance, (2) conflicts where road width is narrowed or a roadway is closed during construction activities, or (3) increased truck traffic in general (and slower speeds and wider turning radii of trucks) during construction. The combination of any of the action alternatives with past, present, and reasonably foreseeable projects could potentially increase traffic safety hazards on local roadways.

In general, construction activities are not considered to be significant impacts due to their temporary and limited duration. Furthermore, mitigation would reduce Impact TRN-2 to a less-than-significant level by incorporating the measures identified in a TMP. Therefore, implementing any of the action alternatives would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any significant cumulative impacts related to traffic safety hazards on local roadways in the primary study area.

Impacts TRN-3 and TRN-4: Interfere with Emergency Access and Decrease Performance of Bicycle or Pedestrian Facilities

Past projects in the primary study area have included, and likely many of the present and reasonably foreseeable projects would include, roadway improvements or modifications that would require lane or road closures or roadway detours. These projects could therefore result in a significant temporary cumulative impact because lane or road closures could impair the ability of local agencies to respond to an emergency and decrease the performance or safety of bicycle or pedestrian facilities during construction activities.

Construction activities under the action alternative (e.g., temporary lane closures during installation of the new transmission line and the addition of construction-vehicles to the traffic stream) could contribute to a significant temporary cumulative impact for the same reasons identified above for present and reasonably foreseeable projects. Specifically, the action alternative could impair the ability of local agencies to respond to an emergency and decrease the performance or safety of bicycle or pedestrian facilities during construction activities.

In general, construction activities are not considered to be significant impacts due to their temporary and limited duration. Furthermore, mitigation would reduce Impact TRN-3 and

Impact TRN-4 to less-than-significant levels by incorporating the measures identified in a TMP. Therefore, implementing any of the action alternatives would not combine with the impacts of other past, present, or reasonably foreseeable future projects to contribute to any new significant cumulative impacts related to emergency access and circulation or the safety of bicycle or pedestrian facilities in the primary study area.

Extended Study Area

Reasonably foreseeable future projects in extended study area could increase traffic levels on area roadways and result in significant impacts on transportation, circulation, and infrastructure. However, these projects will be required to identify and provide mitigation in compliance with NEPA; CEQA; and other local, State, and Federal statutes. Even with compliance with regulatory requirements and implementation of mitigation, the traffic volumes generated from these reasonably foreseeable future projects may contribute to an overall significant adverse cumulative impact on roadways in the extended study area. Additionally, these projects could result in temporary impacts to transportation, circulation, or infrastructure during construction.

Implementing any of the action alternatives would have virtually no impact on transportation, circulation, and infrastructure in the extended study area because vehicular traffic generated by the action alternatives would be concentrated along designated roadways within the primary study area.

Utilities and Service Systems

Actions of past and present projects that have had impacts on utilities and service systems in the primary and extended study areas include:

- Population growth, land use, and associated development

As discussed in Chapter 25, “Utilities and Service Systems,” and shown in Table 27-22, the action alternatives could result in direct and/or indirect impacts in the primary study area. The action alternatives have no impact to utilities and service systems in the extended study areas.

Table 27-22. Direct, Indirect, and Cumulative Impacts to Utilities and Service Systems

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
UTL-1: Result in Exceeding Wastewater Treatment Requirements or Requiring New or Expanded Wastewater Treatment Facilities	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
UTL-2: Result in Exceeding Stormwater Drainage Infrastructure Capacity or Requiring New or Expanded Stormwater Drainage Facilities	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC
UTL-3: Increase in Solid Waste Generation That Exceeds Permitted Landfill Capacity	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC
UTL-4: Damage to or Disruption of Utility or Service Systems	Primary Study Area	All	LTS	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.
Key:
LTS = less than significant
NC = no contribution
NI = no impact

Primary Study Area

For environmental impacts occurring in the primary study area that are associated with implementing any of the action alternatives, the geographic context for the cumulative impacts analysis is the central Sierra Nevada foothill region. Past and present actions by humans have substantially altered the physical environment through the need for water supply, wastewater and stormwater infrastructure, and solid waste disposal.

Most projects that could result in significant impacts on utilities and service systems will be required to identify and provide mitigation in compliance with Federal ESA and CESA; CEQA; and other local, State, and Federal statutes. These requirements should alleviate impacts to the transportation system. The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impact UTL-1: Result in Exceeding Wastewater Treatment Requirements or Requiring New or Expanded Wastewater Treatment Facilities

Implementing any of the action alternatives would generate solid waste during construction that might require disposal at an off-site facility. Other existing and reasonably foreseeable future projects occurring in the landfill service area would also generate wastes requiring disposal at a landfill. The combined volume of solid waste to be disposed of at the local landfill would decrease the life expectancy to a certain undefined degree. Because the disposal of solid waste from construction of Temperance Flat RM 274 Reservoir would occur for only a short period, the reduction of life expectancy from the action alternatives would be limited. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the potentially significant cumulative impact related to solid waste disposal.

Impact UTL-3: Increase in Solid Waste Generation That Exceeds Permitted Landfill Capacity

Implementing any of the action alternatives would generate wastewater during construction that might require disposal at an off-site facility. Existing regional wastewater treatment facilities and sanitary landfill sites that serve the Fresno and Clovis metropolitan area are likely facilities with available capacity to receive this wastewater based on Wastewater Plant Criteria. Other existing and reasonably foreseeable future projects occurring in the treatment facility service area would also generate wastes requiring treatment at the wastewater facility. The combined wastewater flow would decrease available capacity of the treatment plant. If this were to cause exceedence of rated capacity or water quality limits, it would be considered a significant cumulative impact. The wastewater generated from construction of the Temperance Flat RM 274 Reservoir would be very small relative to regional wastewater generation, and treatment plant upgrades from the minor increase in wastewater would not be needed. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the potentially significant cumulative impact from wastewater generated during construction.

Wastewater generated at recreation facilities at the new reservoir is expected to be disposed of on-site, similar to existing recreation facilities located at Millerton Lake. This wastewater flow would not make a cumulatively considerable

incremental contribution to a significant cumulative impact related to wastewater generation at recreation facilities.

Impact UTL-4: Damage to or Distribution of Utility or Service Systems

Implementing any of the action alternatives would temporarily disrupt the availability of power to PG&G, but not disrupt individual utility customers. The action alternatives include relocating PG&E electric power transmission lines. The transmission lines currently connect the generators at the Kerckhoff and Kerckhoff No. 2 powerhouses with the electrical grid. The existing transmission lines would be removed and reconstructed outside of the reservoir inundation area. New transmission lines would also be installed to connect the new powerhouse located on Millerton Lake. Therefore, implementing any of the action alternatives would not make a cumulatively considerable incremental contribution to the potentially significant cumulative impact related to the distribution of utility or service systems.

Extended Study Area

No impacts to utilities or service systems would occur in the extended study area.

Visual Resources

Actions of past and present projects that have resulted in cumulative impacts to visual resources in the primary and extended study areas include:

- Construction and operations of Friant Dam and Millerton Lake, and Kerckhoff Dam and Reservoir
- Construction of residences and recreation facilities around Millerton Lake
- Conversion of natural vegetation to agricultural and developed land uses
- Population growth and associated development of infrastructure both in the Sierra foothills and the Central Valley
- Construction and operations of flood management facilities (including the Chowchilla, Eastside, and

Mariposa bypasses and associated diversion and drop structures)

- Construction and operations of water supply infrastructure (including Friant Dam, Millerton Lake, Mendota Dam and Pool, Sack Dam, and other dams and reservoirs; the DMC; Arroyo Canal; and other diversion facilities on the San Joaquin River and in the Delta)

- Resource extraction (including gold and gravel mining)

As discussed in Chapter 26, "Visual Resources," and shown in Table 27-23, the action alternatives could result in direct and/or indirect impacts in the primary study area; no impacts would occur in the extended study area.

Table 27-23. Direct, Indirect, and Cumulative Impacts to Visual Resources

Impact	Study Area	Action Alternative	Direct/Indirect Impact Level of Significance After Mitigation[1]	Contribution to Overall Cumulative Impact
VIS-1: Consistency with Applicable Plans	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
VIS-2: Degradation and/or Obstruction of a Scenic View	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting	Primary Study Area	All	SU	CU
	Extended Study Area	All	NI	NC
VIS-4: Impacts on a Designated Scenic Highway	Primary Study Area	All	NI	NC
	Extended Study Area	All	NI	NC

Note:
[1] Where the action alternative would have no impact, no contribution to a cumulative impact would occur, and thus the impacts are not discussed further in this section.

Key:
CU = considerable and unavoidable contribution
NC = no contribution
NI = no impact
SU = significant and unavoidable

Primary Study Area

Reasonably foreseeable projects which impact visual resource in the primary study area and which could combine with the action alternatives to contribute to a cumulative adverse impact

include development projects, such as Brighton Crest/Eagle Springs Golf Course and Country Club, Gunnar Ranch West Specific Plan, Ventana Hills Estates Annexation, and Gateway Village Specific Plan, and local plans, such as the BLM Bakersfield Proposed RMP for the SJRG SRMA.

The following describes potential cumulative effects to the identified project-related impacts in the primary study area.

Impacts VIS-1 Through VIS-3: Visual Resources Impacts

Implementing any of the action alternatives would result in impacts on visual resources that would be inconsistent with Bakersfield RMP objectives in parts of the primary study area and would degrade or obstruct scenic views, causing significant and unavoidable visual impacts (Impact VIS-1 and Impact VIS-2). Furthermore, the generation of glare from the introduction of construction equipment and exposed soils and the operation of equipment in active construction areas would be a significant and unavoidable impact (Impact VIS-3).

Mitigation Measures VIS-2 and VIS-3 would be implemented to minimize the significant impacts to the extent practical; however, these measures would not be sufficient to reduce these impacts to a less-than-significant level.

Implementing any of the action alternatives could contribute to a cumulative adverse impact where changes to the landscape occupy the same field of view or in the area of other major facilities and previously altered landscapes. The distance of the action alternatives from downstream activities and the intervening foothill topography preclude views of the new reservoir that share a common viewshed. However, the proposed Temperance Flat RM 274 Dam would be visible from locations on Millerton Lake, including KOP 4. From this observation point, both the new dam and existing Millerton Lake would be visible.

Implementing Alternative Plans 1-4 would stabilize the Millerton Lake water surface elevation, minimize reservoir drawdown, and reduce the exposure of barren side slopes. This reduction would enhance the visual appearance associated with the bathtub ring common to reservoirs in the western United States. Under Alternative Plan 5, Millerton Lake could be drawn down further during the year, increasing the exposure of barren side slopes. Under all of the action alternatives, construction and operation of Temperance Flat RM 274 Dam combined with the existing water surface of Millerton Lake

would create a substantial visual modification, as described in Chapter 26, “Visual Resources.”

The substantial visual effect of establishing a new reservoir within a relatively short stretch of the San Joaquin River would be a significant cumulative impact on visual resources on the San Joaquin River. As noted in the discussion of Impact VIS-2, transforming the riverine character to a reservoir is a major visual change. The cumulative visual effect of the downstream Friant Dam, the upstream Kerckhoff Dam, and the new dam at RM 274 (creation of a continuous flat water vista) would substantially alter the existing visual character of this segment of the San Joaquin River. Therefore, the action alternatives would cause a **cumulatively considerable incremental contribution to the overall significant cumulative impacts** related to consistency with guidelines of applicable plans (Impact VIS-1), degradation and/or obstruction of a scenic view (Impact VIS-2), and generation of increased daytime glare and/or nighttime lighting (Impact VIS-3).

Extended Study Area

None of the action alternatives would have a visual impact in the extended study area; therefore, none of these action alternatives would make a cumulatively considerable incremental contribution to the cumulative visual resource impacts associated with existing or reasonably foreseeable projects in the extended study area.

Chapter 28
Other NEPA and CEQA Considerations

Significant Adverse Effects That Cannot Be Avoided If a Project Is Implemented

Section 21100(b)(2)(A) of CEQA requires an EIR to include a detailed statement setting forth "any significant effect on the environment that cannot be avoided if the project is implemented." Chapters 4 through 7 and 9 through 27 of this Draft EIS analyze in detail all of the project's potentially significant environmental impacts, including cumulative impacts; list feasible mitigation measures that could avoid, minimize, rectify, reduce or eliminate, or compensate for the project's significant impacts; and specify whether these mitigation measures would reduce the impacts to a less-than-significant level. If no feasible mitigation measure is available to reduce a significant impact to a less-than-significant level, then the impact would be significant and unavoidable.

After consideration of actions, operations, and features to avoid, mitigate, and/or compensate for adverse impacts, implementing any of the action alternatives could result in the following potentially significant and unavoidable or significant and unavoidable direct and indirect impacts:

- **Air Quality and Greenhouse Gas Emissions Impacts –** AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations; and AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment.

- **Biological Resources – Fisheries and Aquatic Ecosystems Impacts** – FSH-1: Loss of Riverine Habitat for Lotic Fish Species, FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass, FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration,

and FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations.

- **Biological Resources – Botanical and Wetlands Impacts** – BOT-2: Loss of Riparian Habitat and Other Sensitive Communities.

- **Biological Resources – Wildlife Impacts** – WLD-3: Substantial Impact on Special-Status Raptors, and WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines.

- **Cultural Resources Impacts** – CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation; CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation; CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District; and CUL-5 Destruction or Damage to Indian Sacred Sites.

- **Geology and Soils Impacts** – GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat, and GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations.

- **Land Use Planning and Agricultural Resources Impacts** – LUP-1: Disruption of Existing Land Uses, LUP-2: Conflict with Adopted Plans, LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts, and LUP-4: Conversion of Forest Land.

- **Noise and Vibration Impacts** – NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction, NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise, and NOI-5: Long-Term Increases in Traffic Noise.

- **Power and Energy Impacts** – PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services.

- **Recreation Impacts** – REC-2: Permanent Loss of a Resource Used for Recreation, REC-3: Substantial or Long-Term Reduction or Elimination of Recreation Opportunities or Experiences, and REC-4: Loss of Access to a Locally Important Recreation Site or Area.

- **Visual Resources Impacts** – VIS-1: Consistency With Applicable Plans, VIS-2: Degradation and/or Obstruction of a Scenic View, and VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting.

Alternative Plan 5 would likely result in the following additional significant and unavoidable impacts:

- **Biological Resources – Fisheries and Aquatic Ecosystems Impacts** – FSH-10: Change in Habitat Potential for Spring-Run Chinook Salmon.

Implementing any of the action alternatives could also result in the following significant and unavoidable cumulative impacts:

- **Air Quality and Greenhouse Gas Emissions Impacts** – AQ-1: Project-Generated Construction-Related Criteria Air Pollutant and Precursor Emissions that would Violate or Contribute Substantially to an Existing or Projected Violation, or Expose Sensitive Receptors to Substantial Pollutant Concentrations; and AQ-4: Generation of Greenhouse Gas Emissions that would Significantly Impact the Environment.

- **Biological Resources – Fisheries and Aquatic Ecosystems Impacts** – FSH-1: Loss of Riverine Habitat for Lotic Fish Species, FSH-9: Loss of Spawning Habitat of American Shad and Striped Bass, FSH-11: Change in Water Temperature Conditions Supporting Juvenile Salmon and Steelhead Migration, and FSH-18: Effects on Delta Fish Habitat from Changes in Water Temperatures and Dissolved Oxygen Concentrations.

- **Biological Resources – Botanical and Wetlands Impacts** – BOT-1: Loss of Special-Status Plants and Loss or Degradation of Special-Status Plant Habitat,

BOT-2: Loss of Riparian Habitat and Other Sensitive Communities, and BOT-6: Conflict with Local or Regional Policies and Plans Protecting Wetland or Botanical Resources.

- **Biological Resources – Wildlife Impacts** – WLD-1: Substantial Impact on Special-Status Invertebrates, WLD-2: Substantial Impact on Special-Status Amphibians and Reptiles, WLD-3: Substantial Impact on Special-Status Raptors, WLD-4: Substantial Impact on Special-Status Passerines or Birds Protected by the Migratory Bird Treaty Act, WLD-5: Substantial Impact on Ringtail, WLD-6: Substantial Impact on American Badger, WLD-7: Substantial Impact on San Joaquin Pocket Mouse, WLD-8: Substantial Impact on Special-Status Bat Species, WLD-9: Substantial Impact on Migratory and Wintering Deer Herds, and WLD-10: Potential Conflict with Fresno County and Madera County General Plan Objectives and Guidelines

- **Cultural Resources Impacts** – CUL-1: Disturbance or Destruction of Known or Previously Undiscovered Prehistoric Resources Due to Construction, Inundation, and Project Operation; CUL-2: Disturbance or Destruction of Known or Previously Undiscovered Historic-Era Resources Due to Construction, Inundation, and Project Operation; CUL-3: Construction and Management of Project Components That would Cause a Substantial Adverse Change in the Significance of a Historical and/or Unique Archaeological Resource, Historic Property, or Historic District; and CUL-5 Destruction or Damage to Indian Sacred Sites.

- **Environmental Justice Impacts –** ENJ-1: Disproportionately High and Adverse Impacts on Minority and Low Income Populations.

- **Geology and Soils Impacts** – GEO-2: Alteration of Fluvial Geomorphology that would Adversely Affect Aquatic Habitat, and GEO-4: Substantial Soil Erosion or Loss of Topsoil Due to Construction and Operations.

- **Hydrology – Groundwater Impacts –** GRW-1: Change in Groundwater Levels, GRW-2: Change in Groundwater Quality.

- **Hydrology – Surface Water Quality Impacts** – SWQ-4: Long-Term Water Quality Effects that would Violate Water Quality Standards or Adversely Affect Beneficial Uses within the Primary Study Area and San Joaquin River.

- **Land Use Planning and Agricultural Resources Impacts** – LUP-1: Disruption of Existing Land Uses, LUP-2: Conflict with Adopted Plans, LUP-3: Conversion of Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts, and LUP-4: Conversion of Forest Land.

- **Noise and Vibration Impacts** – NOI-1: Exposure of Sensitive Receptors to Noise Generated by Facility Construction, NOI-3: Exposure of Sensitive Receptors in the Primary Study Area to Construction-Related Traffic Noise, and NOI-5: Long-Term Increases in Traffic Noise.

- **Power and Energy Impacts** – PWR-1: Decrease in Kerckhoff Hydroelectric Project Energy Generation and Ancillary Services.

- **Socioeconomics, Population, and Housing Impacts** – SOC-9: Impacts on Agricultural Economics in the CVP and SWP Water Service Areas.

- **Visual Resources Impacts** – VIS-1: Consistency With Applicable Plans, VIS-2: Degradation and/or Obstruction of a Scenic View, and VIS-3: Generation of Increased Daytime Glare and/or Nighttime Lighting.

Relationship between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). This involves using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare; create and maintain conditions under which humans and nature can exist

in productive harmony; and fulfill the social, economic, and other requirements of present and future generations of Americans.

All of the action alternatives analyzed in this Draft EIS would involve the construction of a new dam on the San Joaquin River at RM 274, relocating existing hydroelectric power-generating facilities and associated transmission lines, relocating or constructing new recreational facilities and access roads, and removing existing tree canopy and vegetative cover. Specific activities would require decommissioning two Kerckhoff Project powerhouses (including the powerhouse intakes in Kerckhoff Lake), modifying Kerckhoff Dam; and partially relocating transmission lines, the San Joaquin River Trail, primitive campgrounds, and a Native American interpretive exhibit.

Implementing any of the action alternatives would result in indirect and induced employment, which might support hiring in businesses that would provide materials to the construction effort; in service-related industries that would provide food, beverages, and other goods to construction workers; and in more technical industries, such as consulting firms and other businesses (see Chapter 23, “Socioeconomics, Population, and Housing”). Sales and profits for businesses that support the construction industry in the primary study area would increase over the 8-year construction period.

Habitat- and recreation-related losses caused by constructing and operating the new dam and reservoir would irreversibly affect habitats and developments near the dam inundation area. Impacts on habitat areas within the dam inundation area would be partially mitigated by preserving similar habitats elsewhere. Recreation impacts would be offset with the establishment of new or relocated recreation facilities and opportunities associated with the new reservoir, such as boating and water skiing.

Construction activities would include short-term uses of capital, fuels, and construction materials. General commitments of construction materials are irreversible because most construction materials are unsalvageable.

Potential benefits of implementing any of the action alternatives include an increase in water supply reliability and a reduction in the probability of experiencing a potential flood-related loss of resources, property, and human life. Increased

recreational use would be associated with a stabilized storage volume in Millerton Lake and the new Temperance Flat RM 274 Reservoir and facilities. Environmental uses and habitat for a variety of aquatic and terrestrial species along the San Joaquin River and waterways within the extended study area would not be affected with implementation of any of the action alternatives.

Irreversible and Irretrievable Commitments of Resources

CEQA Section 21100 (b)(2)(A) requires a discussion of the significant irreversible environmental changes that would be caused by implementing the project. In addition, an EIS prepared under NEPA must analyze irreversible and irretrievable commitments of resources, such as soils, wetlands, waterfowl habitat, and cultural resources (40 CFR, Section 1502.16).

The irreversible and irretrievable commitment of resources is the permanent loss of resources for future or alternative purposes. Irreversible and irretrievable resources are those that cannot be recovered or recycled or those that are consumed or reduced to unrecoverable forms. Implementing any of the action alternatives would result in the irreversible and irretrievable commitment of the following energy and material resources during project construction and maintenance:

- Construction materials, including soil and rock
- Land area committed to new or expanded project facilities and water inundation areas
- Energy expended in the form of electricity, gasoline, diesel fuel, and oil for equipment and transportation vehicles that would be needed for project construction, operations, and maintenance

Nonrenewable resources are expected to account for a minimal portion of the region's resources; the project's use of nonrenewable resources would not affect the availability of these resources for other needs within the region. Construction activities would not result in inefficient use of energy or natural resources. The selected construction contractors would use best available engineering techniques, construction and design practices, and equipment-operating procedures. Furthermore,

mitigation would be provided to partially offset loss of habitat areas and other land uses within the proposed dam inundation areas. Long-term project operation would not result in substantial long-term consumption of energy and natural resources, and operation of the Temperance Flat RM 274 Reservoir would result in increased energy production.

Regulatory Setting

The following section generally describes the Federal, State, and local regulatory setting for the Investigation. With the exception of NEPA (Federal) and CEQA (State), which are presented first, applicable Federal, State, and local regulations are categorized alphabetically.

Federal

National Environmental Policy Act

NEPA is the nation's broadest environmental law, applying to all Federal agencies and most of the activities they manage, regulate, or fund that affect the environment. This law requires Federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to avoid or minimize environmental impacts, and contains action-forcing procedures to ensure that Federal agency decision makers take environmental factors into account.

Antiquities Act of 1906

The Antiquities Act of 1906 (Public Law 59-209; 16 USC 431-433, 34 Statute 225) regulates the collecting "any object of antiquity," which includes fossils, on land managed by BLM, the National Park Service, the USFS, the Department of Energy, and other Federal agencies. This act also establishes criminal sanctions for unauthorized appropriation or destruction of antiquities.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act, enacted in 1940 and amended multiple times since, prohibits the taking of bald and golden eagles without a permit from the Secretary of the Interior. Similar to the ESA, the Bald and Golden Eagle Protection Act defines "take" to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 USC 668-668c). Any disturbance that would injure an

eagle, decrease productivity, or cause nest abandonment – including habitat alterations that could have these results – is considered take and can result in civil or criminal penalties.

Biological Opinions on the Long-Term Operations of the Central Valley Project and State Water Project

As described in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences," USFWS and NMFS released their BOs on the long-term operations of the CVP and SWP in 2008 and 2009, respectively (USFWS 2008, NMFS 2009). The 2008 USFWS BO and the 2009 NMFS BO included RPAs to avoid jeopardy to the species. The RPAs included conditions for revised water operations, habitat restoration and enhancement actions, and fish passage actions.

Actions were brought challenging the NMFS and USFWS BOs (2008 and 2009) under ESA and the Administrative Procedure Act concerning the effects of the CVP and SWP on endangered fish species. Despite the uncertainty resulting from the ongoing reconsultation process, the 2008 Long-Term Operations BA and the 2008 and 2009 BOs issued by the fishery agencies contain the most recent estimate of potential changes in water operations that could occur in the near future. Furthermore, it is currently anticipated that the final BOs issued by the resource agencies will contain similar RPAs.

Central Valley Project Improvement Act

Implementation of the CVPIA changed management of the CVP by making fish and wildlife protection a project purpose, equal to water supply for agricultural and urban uses. The CVPIA affects water exports from the Delta to San Luis Reservoir and increases operational pressures on the reservoir to meet SOD water demands. CVPIA Section 3406 (b)(2) authorized and directed the Secretary of the Interior, among other actions, to dedicate and manage 800 TAF of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in the CVPIA, to assist the State of California in its efforts to protect the waters of the San Francisco Bay-Delta Estuary, and to help meet obligations legally imposed on the CVP under Federal or State law following the date of enactment of the CVPIA.

CVPIA Section 3406(d)(1) required that the Secretary immediately provide specific quantities of water to the refuges, referred to as Level 2 supplies. The CVPIA requires delivery of

Level 2 water in all year types except critically dry water year conditions, when Level 2 water can be reduced by 25 percent. Section 3406(d)(2) of the CVPIA refers to Level 4 refuge water supplies, which are the quantities required for optimum habitat management of the existing refuge lands. Level 4 water supplies amount to about 163 TAF and are in addition to Level 2 water supplies. The availability of Level 4 refuge water supplies is influenced by the availability of water for transfer from willing sellers, which varies from year to year. CVPIA Section 3406(c)(1) mandated development of a comprehensive plan that is reasonable, prudent, and feasible to be presented to Congress to address fish, wildlife, and habitat concerns on the San Joaquin River. However, the San Joaquin River Restoration Settlement Act declared "that the Settlement satisfies and discharges all of the obligations of the Secretary contained in section 3406(c)(1)."

Clean Water Act

The CWA is the primary Federal legislation governing the water quality aspects of the study area. The objective of the act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the United States and gives EPA the authority to implement pollution control programs such as setting wastewater standards for industries. In certain states such as California, EPA has delegated authority to State agencies.

Section 303 Section 303 of the CWA requires states to adopt water quality standards for all surface waters of the United States. The three major components of water quality standards are designated users, water quality criteria, and antidegradation policy. Section 303(d) of the CWA requires states and authorized Indian tribes to develop a list of water-quality-impaired segments of waterways. The list includes waters that do not meet water quality standards necessary to support the beneficial uses of a waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. Only waters impaired by "pollutants" (including clean sediments, nutrients such as nitrogen and phosphorus, pathogens, acids/bases, temperature, metals, cyanide, and synthetic organic chemicals (EPA 2002)), not those impaired by other types of "pollution" (e.g., altered flow, channel modification), are to be included on the list.

Section 303(d) of the CWA also requires states to maintain a list of impaired water bodies so that a TMDL can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct impairment. It establishes the allowable pollutant loadings or other quantifiable parameters (e.g., pH, temperature) for a water body and thereby provides the basis for establishing water quality-based controls. The calculation for establishing TMDLs for each water body must include a margin of safety to ensure that the water body can be used for the purposes of State designation. Additionally, the calculation also must account for seasonal variation in water quality (EPA 2002). The Central Valley Water Board develops TMDLs for the San Joaquin River (see discussion on the Porter-Cologne Water Quality Control Act below).

Section 401 Under CWA Section 401, applicants for a Federal license or permit to conduct activities that may discharge a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate. If appropriate, the certification must be obtained from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a Federal component and may affect state water quality (including projects that require approval from a Federal agency, such as issuance of a Section 404 permit) must also comply with CWA Section 401.

In California, the authority to grant water quality certification has been delegated to the State Water Board. Applications for water quality certification under CWA Section 401 are typically processed by the regional water quality control board with local jurisdiction – in this case, the Central Valley Water Board. For a project to receive water quality certification, the project's potential impacts must be evaluated in light of water quality standards and CWA Section 404 criteria that govern discharges of dredged and fill materials into waters of the United States.

Section 402 Section 402 of the CWA creates the National Pollutant Discharge Elimination System (NPDES) permit program. This program covers point sources of pollution discharging into a surface water body.

Section 404 Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands."

Waters of the United States are wetlands and lakes, rivers, streams, and their tributaries. Waters of the United States are defined for regulatory purposes, at 33 CFR 328.3, as follows:

> *(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.*

CWA Section 404(b) requires that USACE process permits in compliance with guidelines developed by the EPA. These guidelines (the CWA Section 404(b)(1) Guidelines) require the analysis of available alternatives that meet the project's overall purpose and need, including those alternatives that avoid and minimize discharges of dredged or fill materials in waters. Once alternatives deemed to be practicable have been identified, the only action that USACE can permit must be the least environmentally damaging practicable alternative, based on costs, logistics, and technology.

The ROD for the CALFED PEIS/R includes a CWA Section 404 memorandum of understanding signed by Reclamation, EPA, USACE, and DWR. Under the terms of the memorandum of understanding, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the programmatic EIS/EIR. Reclamation will provide USACE and EPA project-specific information summarizing the findings of this Draft EIS to allow the agencies to will focus on the project-level alternatives that are consistent with the CALFED PEIS/R when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision (CALFED 2000).

Coordinated Operation Agreement

The COA between Reclamation and DWR governs the coordinated operations of the CVP and SWP (Reclamation and DWR 1986) in the Delta. With the goal of using coordinated management of reservoir releases and surplus flows in the Delta to improve Delta export and conveyance capability, the COA received congressional approval in 1986 and became Public Law 99-546. As modified by interim agreements, the COA coordinates operations between the CVP and SWP, and provides for equitable sharing of surplus water entering the Delta.

Council on Environmental Quality Guidance

The CEQ issued guidance in 1997 entitled, *Environmental Justice: Guidance under the National Environmental Policy Act*, that established the role of EO 12898 as it relates to actions subject to NEPA. The guidance also established the criteria for identifying environmental justice populations and how to consider the involvement of environmental justice groups throughout phases of the NEPA process.

Criteria Air Pollutants

At the Federal level, the EPA implements national air quality programs. EPA's air quality mandates are drawn primarily from the CAA, which was enacted in 1970 and most recently amended in 1990.

The CAA required EPA to establish primary and secondary national ambient air quality standards, as shown in Table 4-2 of Chapter 4 – Air Quality and Greenhouse Gas Emissions. The CAA also required each state to prepare an air quality control plan referred to as a State implementation plan (SIP). The Federal Clean Air Act Amendments of 1990 (CAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA reviews all SIPs to determine whether they conform to the mandates of CAA and its amendments, and whether implementation will achieve air quality goals. If EPA determines a SIP to be inadequate, a Federal implementation plan that imposes additional control measures may be prepared for the nonattainment area. Failure to submit an approvable SIP or to implement the plan within the mandated time frame may result in the application of sanctions to transportation funding and stationary air pollution sources in the air basin. Section 112

of the CAA defines “hazardous air pollutants” and sets threshold limits. Asbestos-containing substances are regulated by EPA under the CAA.

Endangered Species Act

USFWS and NMFS share responsibility for implementing the ESA. Generally, USFWS manages terrestrial and freshwater species, while NMFS manages marine and anadromous species, such as Chinook salmon. Both agencies ensure that ESA requirements are followed and evaluate projects that may affect the continued existence of a Federally listed (threatened or endangered) species.

Section 9 of the ESA prohibits the take of Federally listed species. “Take” is defined under the ESA, in part, as killing, harming, or harassing. Under Federal regulations, take is further defined to include habitat modification or degradation where it actually results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns – breeding/rearing, feeding, or sheltering.

Section 7 of the ESA outlines procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitat. Section 7(a)(2) requires Federal agencies to consult with USFWS to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species. NMFS also ensures that projects will not adversely affect essential fish habitat, as defined in the 1996 Sustainable Fisheries Act (Public Law 104-297). The goal is to stop or reverse the continued loss of fish habitats by protecting, conserving, and enhancing habitat.

Environmental Compliance Memoranda No. ECM 95-3

The U.S. Department of the Interior, Office of Environmental Policy and Compliance, in a letter responding to an earlier request by the Secretary of the Interior, confirms the requirement of EO 12898 for the Department of the Interior to consider impacts on minority and low-income populations and communities. The memorandum states, “[H]enceforth, all environmental documents should specifically analyze and evaluate the impacts of any proposed projects, actions or decisions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risks of those decisions.”

Executive Order 11988, Flood Hazard Policy

EO 11988 is a flood hazard policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires that Federal agencies take necessary action to reduce the risk of flood loss; restore and preserve the natural and beneficial values served by floodplains; and minimize the impacts of floods on human safety, health, and welfare.

Executive Order 11990, Protection of Wetlands

EO 11990 is an overall wetlands policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires that Federal agencies follow avoidance, mitigation, and preservation procedures with public input before they propose new construction in wetlands. EO 11990 can restrict the sale of Federal land containing wetlands; however, it does not apply to Federal discretionary authority for non-Federal projects (other than funding) on non-Federal land.

Executive Order 12898, Environmental Justice Policy

EO 12898 requires Federal agencies to identify and address the disproportionately high and adverse human health and environmental effects of Federal programs, policies, and activities on minority and low-income populations. The requirements of EO 12898 apply to all Federal actions that are located on Federal lands, sponsored by a Federal agency, or funded with Federal monies and may affect minority or low-income populations.

Executive Order 13007, Indian Sacred Sites and April 29, 1994 Executive Memorandum

EO 13007 (May 24, 1996) requires Federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, Federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, executive memorandum, “Government-to-Government Relations with Native American Tribal Governments.”

Executive Order 13112, National Invasive Species Management Plan

EO 11312 directs all Federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts. EO 11312 established the national Invasive Species Council, made up of Federal agencies and departments, and the supporting Invasive Species Advisory Committee, composed of state, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the EO, including preparation of a national invasive-species management plan.

Executive Order 13186, Migratory Bird Conservation

EO 13186 (January 10, 2001) directs Federal agencies that have, or are likely to have, a measurable negative impact on migratory bird populations to develop and implement a memorandum of understanding (MOU) with USFWS promoting the conservation of migratory bird populations. Implementation actions and reporting procedures identified in the MOU shall be included in each agency's formal planning process, such as resource management plans and fisheries management plans.

Executive Order 13443, Management of Game Species and Habitats

EO 13443 (August 16, 2007) directs Federal agencies that have programs and activities that have a measurable impact on public land management, outdoor recreation, and wildlife management to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Farmland Protection Policy Act

The Farmland Protection Policy Act requires that a Federal agency examine the potential impacts of a proposed action on Prime Farmland and Unique Farmland, as defined by the National Resource Conservation Service (NRCS). If the action would adversely affect farmland preservation, the Federal agency must consider alternatives to lessen the adverse effects.

Federal Aviation Administration

Under FAA Title 14 CFR, Part 77, Objects Affecting Navigable Airspace, Section 13(2)i requires an applicant to notify the FAA of the construction of structures within 20,000 feet of the nearest point of the nearest runway of an airport

with at least one runway longer than 3,200 feet. Under Title 14, Part 17, Section 17 requires an applicant to submit a Notice of Proposed Construction or Alteration (FAA Form No. 7460-1) to the FAA for construction within 20,000 feet of the nearest runway of an airport with at least one runway longer than 3,200 feet. 14 CFR 77.21, 77.23, and 77.25 outline the criteria used by the FAA to determine whether an obstruction would create an air navigation conflict. No airports are within 20,000 feet of the primary study area; therefore, these requirements are not applicable. The absence of airports in the vicinity of the primary study area also is discussed in Chapter 21, "Public Health and Hazards."

Federal Cave Resources Protection Act

The Federal Cave Resources Protection Act of 1988 was established to inventory, protect, and maintain significant cave resources to the extent practical. The act requires that a permit be obtained for collection or removal of cave resources and identifies penalties for prohibited acts, including knowingly destroying, disturbing, defacing, removing, or harming any significant cave or altering the free movement of any animal or plant life into or out of any significant cave located on Federal lands without prior authorization.

Federal Clean Air Act

The CAA was enacted to protect and enhance the nation's air quality to promote public health and welfare and the productive capacity of the nation's population. The CAA requires that Federal actions be evaluated to determine their potential impacts on air quality in the project region. California has a corresponding law, which also must be considered during the EIS/EIR process. Local air pollution control districts, such as the SJVAPCD, develop plans and implement control measures in their areas.

For specific projects, Federal agencies must coordinate with the appropriate air quality management district and EPA. This coordination determines whether the project conforms to the CAA and the state implementation plan. The primary study area, and much of the extended study area, is located within the SJVAB. The SJVAPCD implements programs and regulations required by the CAA.

Section 176 of the CAA prohibits Federal agencies from engaging in or supporting an action or activity that does not conform to an applicable state implementation plan. Actions and activities must conform to the plan's purposes of

eliminating or reducing violations of national ambient air quality standards, reducing the severity of violations, and attaining those standards expeditiously.

Federal Energy Regulatory Commission

The FERC was established in 1977 under the Department of Energy Organization Act. FERC's legal authority comes from the Federal Power Act and major amendments made to it by Congress. Additional responsibilities were authorized under the Public Utilities Regulatory Policy Act of 1978 and the Energy Policy Act of 2005. FERC's mission is to regulate and oversee energy industries in interests of the American public. FERC regulates nearly 2,000 non-Federal dams in the United States, with responsibilities that include issuing licenses for the construction of new projects, relicensing existing projects, and overseeing all ongoing project operations, including dam safety inspections and environmental monitoring. All FERC hydropower licenses or projects identified herein are subject to FERC oversight and the conditions of their current licenses. FERC's oversight of mandatory reliability standards extends to Federal powerplants, transmission lines and appurtenant facilities.

Under the action alternatives, the top of active storage level of Temperance Flat RM 274 Reservoir would inundate the Kerckhoff Hydroelectric Project powerhouses. The Kerckhoff Hydroelectric Project would be decommissioned and its FERC license would be surrendered and then terminated in accordance with FERC regulations.

Federal Land Policy and Management Act

Sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (43 USC 1711–1712) and the regulations in 43 CFR 1600 provide guidance and direction for implementing federal land use planning requirements, as established by RMPs. The RMPs and subsequent planning decisions are the basis for every on-the-ground action undertaken by federal agencies.

Federal Transit Administration

To address the human response to ground-borne vibration, the FTA has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses (FTA 2006):

- 65 vibration decibels for land uses where low ambient vibration is essential for interior operations (e.g.,

hospitals, high-tech manufacturing, and laboratory facilities)

- 80 vibration decibels for residential uses and buildings where people normally sleep
- 83 vibration decibels for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, and offices)

Standards have also been established to address the potential for ground-borne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bio Acoustics, and Bio Mechanics at the request of EPA (FTA 2006). For fragile structures, this committee recommends a maximum limit of 0.25 inch per second peak particle velocity (FTA 2006). (Peak particle velocity is a measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.)

Federal Water Project Recreation Act

The Federal Water Project Recreation Act requires that Federal agencies with authority to approve water projects include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project. The act states that "consideration shall be given to the opportunities, if any, which the project affords for outdoor recreation and for fish and wildlife enhancement…wherever any such project can reasonably serve either or both of these purposes consistently" (Title 16, Section 460l-12 of the U.S. Code (16 USC 460l-12)).

Fish and Wildlife Coordination Act

Coordination under the Fish and Wildlife Coordination Act is intended to promote conservation of fish and wildlife resources by preventing their loss or damage. It also provides for development and improvement of fish and wildlife resources in connection with water projects. Federal agencies that undertake water projects must fully consider recommendations made by USFWS, NMFS, and the appropriate State fish and wildlife agency – in this case, CDFW – in their project reports and include measures to reduce impacts on fish and wildlife in project plans. Reclamation would consider and incorporate the recommended measures where feasible.

Greenhouse Gases

Mandatory Greenhouse Gas Reporting Rule On September 22, 2009, EPA issued a final rule for mandatory reporting of GHGs from large GHG emissions sources in the United States. In general, this national reporting requirement will provide EPA with accurate and timely GHG emissions data from facilities that emit 25,000 MTs or more of CO_2 per year. This publicly available data will allow the reporters to track their own emissions, compare them to similar facilities, and aid in identifying cost-effective opportunities to reduce emissions in the future. An estimated 85 percent of the total GHG emissions in the United States, from approximately 10,000 facilities, are subject to this final rule.

Permitting Requirements on Large Industrial Facilities On May 13, 2010, EPA issued the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailor Rule (EPA 2014). This final rule sets thresholds for GHG emissions that define when permits under the New Source Review Prevention of Significant Deterioration and Title V Operating Permit programs are required for new and existing industrial facilities.

Supreme Court Ruling and Endangerment Finding The U.S. Supreme Court ruled on April 2, 2007 that CO2 is an air pollutant as defined under the CAA, and that EPA has the authority to regulate emissions of GHGs. On December 7, 2009, EPA adopted its Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the CAA (Endangerment Finding). EPA found that atmospheric concentrations of GHGs endanger the public health and welfare within the meaning of Section 202(a) of the CAA. The evidence supporting this finding consists of human activity resulting in “high atmospheric levels” of GHG emissions, which are very likely responsible for increases in average temperatures and other climatic changes. Therefore, GHGs were found to endanger the public health and welfare of current and future generations. EPA’s final findings respond to the 2007 U.S. Supreme Court decision that GHGs fit within the CAA definition of air pollutants.

Hazardous Air Pollutants

Air quality regulations also focus on TACs, or in Federal parlance, HAPs. In general, for those TACs that may cause cancer, there is no concentration that does not present some risk. In other words, there is no threshold level below which adverse health effects may not be expected to occur. This contrasts with the criteria air pollutants, for which acceptable

levels of exposure can be determined and for which the ambient standards have been established. Instead, EPA and the ARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum available control technology or best available control technology for toxics to limit emissions. These statutes and regulations establish the regulatory framework for TACs.

EPA has programs for identifying and regulating HAPs. Title III of the CAAA directed EPA to promulgate national emissions standards for HAPs. National emissions standards for HAPs vary depending on the pollutant source type. The national emissions standards for HAPs for major stationary sources of HAPs could therefore be different than those for area sources. Major sources are defined as stationary sources with potential to emit more than 10 tons per year of any HAP or more than 25 tons per year of any combination of HAPs; all other sources are considered area sources. The emissions standards were to be promulgated in two phases. In the first phase (1992 to 2000), EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring maximum available control technology. For area sources, the standards may be different, based on generally available control technology. In the second phase (2001 to 2008), EPA was required to promulgate health risk–based emissions standards, where deemed necessary, to address risks remaining after implementation of the technology-based national emission standards for HAPs standards.

The CAAA also required EPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions of benzene and formaldehyde at a minimum. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 required the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

Indian Trust Assets

The characterization and application of the United States trust relationship have been defined by case law that interprets congressional acts, EOs, and historic treaty provisions. All Federal agencies have a responsibility to protect Indian trust assets. Indian trust assets are legal interests in assets held in trust by the Federal government for Native American tribes or

individuals. Assets may be owned property, physical assets, intangible property rights, a lease, or the right to use something. Typically, they include lands, minerals, water rights, hunting and fishing rights, natural resources, money, and claims. The BIA provides services to tribes and administers and manages ITAs, including coordination with Federal agencies in identifying potential effects of Federal actions on ITAs.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (commonly known as Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires Federal agencies to consult with NMFS regarding actions or proposed actions permitted, funded, or undertaken that may adversely affect "essential fish habitat." Essential fish habitat is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Magnuson-Stevens Act states that migratory routes to and from the spawning grounds of anadromous fish are considered essential fish habitat. The phrase "adversely affect" refers to the creation of any impact that reduces the quality or quantity of essential fish habitat.

The concept of essential fish habitat is similar to that of "critical habitat" under the ESA; however, measures recommended by NMFS to protect essential fish habitat are advisory, not prescriptive. Federal activities that occur outside of essential fish habitat but that may nonetheless affect waters and substrate that constitute essential fish habitat must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the *Pacific Salmon Fishery Management Plan* must also be considered. The Magnuson-Stevens Act states that where appropriate, consultation regarding essential fish habitat should be consolidated with the interagency consultation, coordination, and environmental review procedures required by other Federal statutes, such as NEPA, the Fish and Wildlife Coordination Act, the CWA, and the ESA.

Migratory Bird Treaty Act

The MBTA, first enacted in 1918, implements domestically a series of treaties between the United States and Great Britain

(on behalf of Canada), Mexico, Japan, and the former Soviet Union that provide international protection of migratory birds. The act authorizes the Secretary of the Interior to regulate the taking of migratory birds. It is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird…" (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in the direct loss of birds, nests, or eggs. To avoid take of migratory birds, exclusion practices or vegetation removal are typically implemented before the nesting season.

Several hundred species, essentially including all native birds, are currently protected by the MBTA. The act offers no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of nongame migratory birds.

National Forest Management Act

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired nonnative species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands.

A key requirement of the National Forest Management Act is preparation of land and resource management plans that establish the goals, objectives, and standards and guidelines for managing the lands and resources of National Forest System lands managed by the various National Forests.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 and its implementing regulations (36 CFR Part 800, as amended in 2004) requires Federal agencies to consider the effects of their actions, or those they fund or permit, on properties that are listed or eligible for listing in the NRHP. The NRHP is a register of districts, sites, buildings, structures, and objects of significance in American history, architecture, archaeology, engineering, and culture. The regulations provided in 36 CFR Part 60.4 describe the criteria to evaluate cultural resources for inclusion in the NRHP. Cultural resources can be significant on the national, state, or local level. Properties may be listed in the NRHP if they possess integrity of location, design, setting, materials, workmanship,

feeling, and association, and meet any one of the following criteria:

1. Are associated with events that have made a significant contribution to the broad patterns of our history

2. Are associated with the lives of persons significant in our past

3. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction

4. Have yielded, or may be likely to yield, information important in prehistory or history

Generally, properties are not considered eligible for the NRHP if they have achieved significance within the past 50 years. Certain exceptions are made in the regulation, such as a religious property deriving primary significance from its architectural distinction, or a grave of a historical figure of outstanding importance if there is no appropriate site directly associated with his productive life.

Archaeological Resources Protection Act The purpose of the Archaeological Resources Protection Act of 1979 (Public Law 95-96 – October 31, 1979) is to protect archaeological resources and sites that are located on public lands and Indian lands, and to foster increased cooperation between governmental authorities, the professional archaeological community, and private individuals in possession of archaeological resources. The act makes it unlawful to excavate, remove or deface archaeological resources, to sell, purchase, or exchange those resources without applicable permit, and establishes criminal and civil penalties for any such violation.

Archaeological and Historic Preservation Act This act was formerly known as the Reservoir Salvage Act of 1960, followed by the Moss-Bennet Act (Archaeological Recovery Act). The act can be found under 16 USC 469, and is intended to prevent irreparable loss or destruction of significant scientific, prehistorical, historical, or archeological data involving activities in connection with any Federal construction project or federally-licensed project, activity, or

program through the recovery, protection, and preservation of such data, including preliminary survey or other investigation as needed.

Native American Graves Protection and Repatriation Act
Native American burials are also protected by Federal law. The Native American Graves Protection and Repatriation Act (Public Law 101-601; 25 USC 3001-3013) protects Native American burial sites and controls the removal of human remains, funerary objects, sacred objects, and items of cultural patrimony on Federal and tribal lands.

American Indian Religious Freedom Act The American Indian Religious Freedom Act (42 USC Section 1996) states that it is the policy of the United States to "protect and preserve for American Indians their inherent right of freedom to exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites." The provisions of American Indian Religious Freedom Act guarantee access to traditional sites on Federal lands and noninterference with religious practices. Consultation under American Indian Religious Freedom Act with American Indian groups can simultaneously satisfy the requirements of NEPA as well.

National Recreation Trail Act
The National Recreation Trail Act of 1968 (Public Law 90-543) authorized creation of a national trail system composed of National Recreation Trails, National Scenic Trails, and National Historic Trails. While National Scenic Trails and National Historic Trails may only be designated by an act of Congress, National Recreation Trails may be designated by the Secretary of the Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance (American Trails 2013).

National Wild and Scenic Rivers Act
The National Wild and Scenic Rivers Act of 1968, as amended (Public Law 90-542; 16 USC 1271–1287), established the NWSRS. This system identifies distinguished rivers of the nation that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The National Wild and Scenic Rivers Act preserves the free-flowing condition of designated rivers and protects their local environments. Section 5(d)(1) of the act

requires Federal agencies to consider potential national wild, scenic, and recreational river areas when planning for the use and development of water and related land resources. Wild, scenic, and recreational river areas are defined as follows:

- *"Wild" river areas* are rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

- *"Scenic" river areas* are rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible by roads in places.

- *"Recreational" river areas* are rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Designation as a National Wild and Scenic River explicitly prohibits the Federal government from licensing or permitting new hydroelectric dams or major diversions on these rivers. Federal agencies are also prohibited from assisting any water resource projects that may directly affect the resources for which the river was designated. Public lands within a corridor averaging one-quarter mile on both sides of the rivers are managed to protect resources designated as outstandingly remarkable for their scenic, recreational, historical/cultural, fish, wildlife, ecological, geological, or hydrologic value.

National Wildlife Refuge Complex Comprehensive Conservation Plans

The USFWS San Luis NWR Complex includes the San Luis NWR, Merced NWR, San Joaquin River NWR, and Grasslands WMA. These refuges are comprised of wetlands, grasslands, riparian habitats, and agricultural fields. The management goals and objectives for each refuge are set forth in 15-year CCPs prepared by USFWS pursuant to the National Wildlife Refuge System Improvement Act of October 1997. CCP goals that are applicable to botanical and wetland resources are as follows.

- Conserve and protect the natural diversity of migratory birds, resident wildlife, fish, and plants through

restoration and management of riparian, upland, and wetland habitats on refuge lands.

- Contribute to the recovery of threatened/endangered species, as well as the protection of populations of special-status wildlife and plant species and their habitats.

Occupational Safety and Health Act

The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), is responsible at the Federal level for ensuring worker safety. OSHA sets Federal standards for implementing workplace training, exposure limits, and safety procedures for the handling of hazardous substances (as well as other hazards). OSHA also establishes criteria by which each state can implement its own health and safety program.

Paleontological Resources Preservation Act of 2009

The Paleontological Resources Preservation Act (PRPA) is part of the Omnibus Public Land Management Act of 2009 (Public Law 111-011, Title VI Subtitle D). This act directs the Secretary of the Interior or the Secretary of Agriculture to manage and protect paleontological resources on Federal land using scientific principles, and to develop plans for inventorying, monitoring, and deriving the scientific and educational use of such resources. The PRPA affirms the authority for many of the policies the Federal land managing agencies already have in place for the management of paleontological resources such as issuing permits for collecting paleontological resources, curation of paleontological resources, and confidentiality of locality data. The statute establishes criminal and civil penalties for fossil theft and vandalism on Federal lands. The PRPA also includes provisions allowing for casual or hobby collecting of common invertebrate and plant fossils without a permit on Federal lands managed by BLM and the USFS, under certain conditions.

Recovery Plan for Upland Species of the San Joaquin Valley, California

This plan focuses on 34 species of plants and animals that occur in the San Joaquin Valley and that are either federally listed as threatened or endangered or are candidates for Federal listing or species of concern. The ultimate goal of the recovery plan is to delist the 11 endangered and threatened species addressed in the plan and ensure the long-term conservation of the other 23 species. The plan provides for both an ecosystem approach and a community-level strategy.

While not regulatory in nature, the recovery plan needs to be taken into consideration when analyzing potential impacts on upland natural community habitats in the San Joaquin Valley to ensure that projects do not prevent or impair the plan's future long-term implementation success. It is also used by USFWS to determine recommendations and requirements during endangered species consultation for these species.

Resource Conservation and Recovery Act

At the Federal level, the principal agency regulating the generation, transport, and disposal of hazardous substances is the EPA, under the authority of the RCRA. The RCRA established an all-encompassing Federal regulatory program for hazardous substances that is administered by EPA. Under the RCRA, EPA regulates the generation, transportation, treatment, storage, and disposal of hazardous substances. The RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments of 1984, which specifically prohibits the use of certain techniques to dispose of various hazardous substances. The Federal Emergency Planning and Community Right to Know Act of 1986 imposes hazardous-materials planning requirements to help protect local communities in the event of accidental release of hazardous substances. EPA has delegated much of the RCRA requirements to the California Department of Toxic Substances Control (DTSC). Storage of explosives and blasting agents is regulated by the Bureau of Alcohol, Tobacco and Firearms (27 CFR Part 55, Commerce in Explosives).

Safe Drinking Water Act

The Safe Drinking Water Act mandates that EPA establish regulations to protect human health from contaminants in drinking water. This law authorizes EPA to develop national standards for drinking water and to create a joint Federal/state/tribal system to ensure compliance with these standards. The law also directs EPA to protect underground sources of drinking water by controlling the underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its Safe Drinking Water Act authority. EPA and authorized states and tribes enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public supplies of drinking water. The primary standards consist of two elements: goals for maximum contaminant levels, which are nonenforceable health-based goals; and maximum contaminant levels, which

are enforceable limits set as close to the maximum contaminant level goals as possible, considering the cost and feasibility of attainment.

San Joaquin River Restoration Settlement Act

This act authorized and directed the Secretary of the Interior to implement the terms and conditions of the Settlement in cooperation with the State.

U.S. Army Corps of Engineers – Reservoir Regulation for Flood Control at Friant Dam and Millerton Lake

Friant Dam and Millerton Lake are operated for flood control in accordance with rules and regulations prescribed by the CFR Title 33, Part 208, and Report on Reservoir Regulation for Flood Control, Friant Dam and Millerton Lake, San Joaquin River, California (USACE 1955). The regulations set limitations on storage space in Millerton Lake and flow releases from Friant Dam for flood control. These limitations impact generation potential for the FPA, Orange Cove ID, and Madera-Chowchilla Water and Power Authority.

Water Right Decision 1641

D-1641 and Water Right Order 2001-05 contain the current water right requirements to implement the 1995 WQCP. D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, Reclamation and/or DWR have the responsibility to meet water quality objectives in the Delta. D-1641 also authorizes the CVP and SWP to use JPODs in the south Delta, and recognizes the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards. The additional exports allowed under the JPODs could result in additional degradation of water quality for water users in the south and central Delta, including CCWD. The JPODs also could impact water levels in the south Delta and endangered fish species.

In February 2006, State Water Board issued notice to Reclamation and DWR that each agency is responsible for meeting water quality objectives in the interior south Delta, as described in D-1641. The State Water Board order requires Reclamation and DWR to comply with a detailed plan and time schedule to ensure compliance with their respective permit and license requirements for meeting interior south Delta salinity objectives by July 1, 2009. The State Water Board order also

revised the previously issued (July 1, 2005) *Water Quality Response Plan* (State Water Board 2005) approval governing Reclamation's and DWR's use of each other's respective points of diversion in the south Delta. Additionally, the order specifies that JPOD operations are authorized pursuant to the 1995 WQCP, and that Reclamation and DWR may conduct JPODs, provided that both agencies are in compliance with all conditions of their respective water right permits and licenses at the time the JPODs would occur. As previously mentioned, ongoing legal challenges may result in changes in CVP and SWP operational constraints.

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

The 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (State Water Board 1995) established water quality control measures that contribute to protecting beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives.

The 1995 WQCP was developed as part of the December 15, 1994, Bay-Delta Accord, which committed the CVP and SWP to new Delta habitat objectives. Since these new beneficial objectives and water quality standards were more protective than those of the previous D-1485, the new objectives were adopted by amendment in 1995 through a Water Right Order for operation of the CVP and SWP. One key feature of the 1995 WQCP was the estuarine habitat ("X2") objectives for Suisun Bay and the west Delta. X2 represents the geographic location of the 2 ppt near-bottom salinity isohaline in the Delta, which is measured in distance upstream from the Golden Gate Bridge in Suisun Bay. The X2 objective required specific daily or 14-day surface EC criteria, or 3-day averaged outflow requirements to be met for a certain number of days each month, February through June. These requirements were designed to provide improved shallow water habitat for fish species in spring. Because of the relationship between seawater intrusion and interior Delta water quality, the X2 criterion also improved water quality at Delta drinking water intakes. Other new elements of the 1995 WQCP included I:E ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, and San Joaquin River EC and flow standards.

Following review of the 1995 WQCP, workshops, and public comment period, the State Water Board amended the 1995 WQCP with only minor changes and adopted the 2006 WQCP (State Water Board 2006). No changes were made to the beneficial uses, and water quality objective implementation dates were updated. The 2006 WQCP also included several directives and recommendations for water quality control planning activities to address emerging issues related to pelagic organism decline, climate change, Delta and Central Valley salinity, and San Joaquin River flows (State Water Board 2006).

State

California Environmental Quality Act

Prompted by the passage of NEPA in 1969, CEQA was signed into law in 1970 as California's counterpart to NEPA. CEQA requires State and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The objectives of CEQA are to do all of the following:

- Disclose to decision makers and the public the significant environmental effects of proposed activities
- Identify ways to avoid or reduce environmental damage
- Prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures
- Disclose to the public the reasons for agency approval of projects with significant environmental effects
- Foster interagency coordination in the review of projects
- Enhance public participation in the planning process

Alquist-Priolo Earthquake Fault Zoning Act

California's Alquist-Priolo Earthquake Fault Zoning Act (PRC Section 2621 et seq.), was originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act, and renamed in 1994. This act is intended to reduce the risk to life and property from surface fault ruptures during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active

faults, and strictly regulates construction in the corridors along active faults (earthquake fault zones).

Assembly Bill 32, California Global Warming Solutions Act of 2006

Signed in September 2006, Governor Arnold Schwarzenegger signed AB 32, the California Global Warming Solutions Act of 2006. AB 32 establishes regulatory, reporting, and market mechanisms to achieve quantifiable reductions in GHG emissions statewide. AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on GHG emissions that went into effect in 2012. ARB was charged with implementing AB 32. In December 2008, ARB adopted its Climate Change "Scoping Plan", which describes the strategies California will implement to achieve the mandated reductions. The Scoping Plan does not include specific GHG reduction requirements for local governments. ARB is in the process of updating the Scoping Plan and expects to complete that process during 2014. The Discussion Draft of the updated Scoping Plan was released in October 2013, and final is to be adopted at the end of May 2014.

Assembly Bill 3030, Groundwater Management Act

The Groundwater Management Act (Assembly Bill (AB) 3030) is found in CWC Sections 10750–10756 and provides a systematic procedure for an existing local agency to develop a GMP. AB 3030 gives the local agency the authority to develop a GMP in groundwater basins defined in DWR Bulletin 118 and to raise revenue to pay for facilities to manage the basin (extraction, recharge, conveyance, quality [DWR 1975]). AB 3030 consists of 12 technical components, but others may be identified in the GMP. An AB 3030 plan can be developed after a public hearing, and adoption of a resolution of intention to adopt a GMP. According to DWR (2003), GMPs have been adopted for several Friant Division contractors, including Arvin-Edison WSD, Chowchilla WD, Fresno ID, Gravelly Ford WD, Lower Tule River ID, Orange Cove ID, Porterville ID, Saucelito ID, Stone Corral ID, Shafter-Wasco ID, Terra Bella ID, and Tulare ID. GMPs have also been developed for a number of counties, cities, and other private districts in the San Joaquin Valley Groundwater Basin. Only AB 3030 GMPs acknowledged on DWR's Web site are listed in Chapter 13, "Hydrology – Groundwater."

CALFED Environmental Justice Statement

CALFED states that potential impacts of water management changes may accrue to rural communities and that public health and economic impacts may accrue to minorities and disadvantaged people throughout the Delta and vicinity as a result of water quality program actions (CALFED 2007). Specifically, CALFED identifies three overall guiding principles regarding environmental justice.

California Accidental Release Prevention Program

The goal of the California Accidental Release Prevention Program is to reduce the likelihood and severity of consequences of extremely hazardous materials releases. Any business that handles regulated substances (chemicals that pose a major threat to public health and safety or the environment because they are highly toxic; flammable; or explosive, including ammonia, chlorine gas, hydrogen, nitric acid, and propane) is required to prepare a risk management plan. A risk management plan describes current and past practices and releases, what the impact of releases may be, and what the business does or plans to do to prevent releases and minimize their impact if they occur.

California Building Standards Code

California's minimum standards for the design and construction of buildings, associated facilities, and equipment are given in the CCR, including standards dependent on local geology and soils. Many of the applicable standards are found in CCR Title 24, also known as the CBSC. Other standards applicable to buildings are given in CCR Titles 8, 19, 21, and 25. Design and construction must satisfy CCR requirements.

California Cave Protection Act

Section 594-625c of the California Penal Code establishes that performing certain acts that damage cave features or result in disturbance or removal of resources is a misdemeanor.

California Clean Air Act

The California Clean Air Act (CCAA), which was adopted in 1988, required ARB to establish California ambient air quality standards, and requires nonattainment areas to achieve and maintain the State ambient air quality standards by the earliest practicable date. The act specifies that local air districts should particularly focus on reducing emissions from transportation and areawide sources, and authorizes districts to regulate indirect sources. Among ARB's other responsibilities are to oversee local air district compliance with California and

Federal laws; approve local air quality plans; submit SIPs to EPA; monitor air quality; determine and update area designations and maps; and set emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

California Department of Education

The Department of Education enacted regulations that require minimum distances between a new school and the edge of a transmission line right-of-way. The setback distances are 100 feet from the edge of the transmission line right-of-way for 50- to 133- kV lines, 150 feet from the edge of the transmission line ROW for 220- to 230-kV lines, and 350 feet from the edge of the transmission line right-of-way for 500- to 550-kV lines. These distances were not based on specific biological evidence, but on the fact that electromagnetic fields from power lines decline to near-background levels at those distances.

California Department of Transportation

Caltrans manages interregional transportation, including management and construction of the California highway system. In addition, Caltrans is responsible for permitting and regulating the use of State roadways. SR 99, SR 145, and SR 41, which are located near the primary study area, fall under Caltrans' jurisdiction.

Caltrans prepares various planning documents for its transportation facilities throughout the state. The goals established for specific highways are documented in a transportation concept report (TCR). A TCR is a system planning document and tool that also includes an analysis of a transportation corridor. It establishes a 20-year transportation planning concept that is consistent with Caltrans' goals as set forth in the District System Management Plan. A TCR also establishes the future concept of LOS for segments along the route and broadly identifies the nature and extent of the improvements needed to attain a particular LOS. A deficiency (need for improvement) is triggered when the actual LOS falls below the concept LOS. Operating conditions for each corridor are projected for 10- and 20-year horizons. Beyond the 20-year planning period, a TCR identifies the Ultimate Transportation Corridor to ensure that adequate right-of-way is preserved for future transportation facility projects.

The *State Route 99 Transportation Concept Report* (Caltrans 2003) contains the 20-year improvement concept for SR 99. The concept presented for the section between the south

junction of SR 99 with SR 41 and north junction of SR 99 with SR 41 within Fresno County is an eight-lane freeway. The concept presented for the section between just north of Avenue 13 and the junction of SR 99 with SR 145 in Madera County is a six-lane freeway. The concept LOS is D for both of these segments.

The *State Route 145 Transportation Concept Report* (Caltrans 2006) contains the 20-year improvement concept for SR 145. The concept presented for the section between Road 400 and SR 41 within Madera County is a four-lane conventional highway. The concept LOS is D for this segment.

No TCR is available for SR 41. An LOS standard of D is applied to SR 41 within Fresno and Madera counties because this approach maintains consistency with concept LOS standards found within the TCRs for SR 99 and SR 145.

Caltrans' construction practices require temporary traffic control planning "during any time the normal function of a roadway is suspended" (Caltrans 2012b). In addition, Caltrans has the discretionary authority to issue special permits for the movement of vehicles/loads exceeding statutory limitations on the size, weight, and loading of vehicles contained in Division 15 of the *2014 California Vehicle Code* (State of California 2014). Requests for such special permits require the completion of an application for a transportation permit.

California Endangered Species Act

Pursuant to the CESA, a permit from CDFW is required for projects that could result in the take of a plant or animal species that is State-listed as threatened or endangered. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the CESA definition of take does not include "harming" or "harassing," as the Federal ESA definition does. As a result, the threshold for take is higher under the CESA than under the ESA (i.e., habitat modification is not necessarily considered take under the CESA).

Sections 3503 and 3503.5 of the California Fish and Game Code state that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, or to take, possess, or destroy any raptors (i.e., species in the orders Falconiformes and Strigiformes), including their nests or eggs. Destruction of active nests caused by removal of vegetation in which the nests are located is a typical violation of these codes. Violation of

Section 3503.5 could also include failure of active raptor nests that results from disturbance of nesting pairs by nearby project construction. This statute does not provide for the issuance of any type of incidental take permit.

California Environmental Protection Agency Intra-Agency Environmental Justice Strategy

Pursuant to PRC Sections 71110–71113, Cal/EPA has developed the intra-agency (agency-wide) strategy to identify and address gaps in existing programs, policies, and activities that may impede the achievement of environmental justice. The strategy is the overarching environmental justice vision document, and it sets forth the Cal/EPA's environmental justice vision, mission, core values, goals, and objectives. The goals of the intra-agency strategy include (Cal/EPA 2004):

- Ensuring meaningful public participation and promoting community capacity-building to allow communities to effectively participate in environmental decision-making processes
- Integrating environmental justice into the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies
- Improving research and data collection to promote and address environmental justice related to the health and environment of communities of color and low-income populations
- Ensuring effective cross-media coordination and accountability in addressing environmental justice issues

California Fish and Game Code

Fully Protected Species Protection of fully protected species is described in Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code. These statutes prohibit take or possession of fully protected species. CDFW is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by those species. CDFW has informed non-Federal agencies and private parties that they must avoid take of any fully protected species in carrying out projects.

Protection of Birds Section 3503 of the California Fish and Game Code states that it is unlawful to take, possess, or

needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically states that it is unlawful to take, possess, or destroy any raptors (i.e., eagles, hawks, owls, and falcons), including their nests or eggs. Section 3513 provides for adoption of MBTA provisions. It states that it is unlawful to take or possess any migratory nongame bird, as designated in the MBTA, or any part of such migratory nongame bird. These State codes offer no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of nongame, migratory birds. Typical violations include destruction of active raptor nests resulting from removal of vegetation in which the nests are located. Violation of Sections 3503.5 and 3513 could also include disturbance of nesting pairs that results in failure of an active raptor nest.

Section 1602, Streambed Alteration All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by CDFW under Section 1602 of the California Fish and Game Code. Federal projects do not require a Section 1602 permit from CDFW, however, close coordination with CDFW is recommended so that measures are in place to minimize impacts that could harm State protect resources. Additionally, for some projects, a Section 1602 permit application is an effective way for Federal agencies to comply with requirements under FWCA and/or CVPIA.

Under Section 1602, it is unlawful for any person, governmental agency, or public utility to do the following without first notifying CDFW:

> *…substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.*

A stream is defined as a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports fish or other aquatic life. This definition includes watercourses with a surface or subsurface flow that supports or has supported riparian vegetation. CDFW's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife.

Sections 1900–1913 Sections 1900–1913 of the California Fish and Game Code codify the Native Plant Protection Act, which is intended to preserve, protect, and enhance endangered or rare native plants in the State. The act directs CDFW to establish criteria for determining which native plants are rare or endangered. Under Section 1901, a species is endangered when its prospects for survival and reproduction are in immediate jeopardy from one or more causes. A species is rare when, although not threatened with immediate extinction, it is in such small numbers throughout its range that it may become endangered if its present environment worsens. Under the act, the Fish and Game Commission may adopt regulations governing the taking, possessing, propagation, or sale of any endangered or rare native plant.

The California Native Plant Society (CNPS) has developed and maintains lists of plants of special concern in California, as described above under "Special-Status Species." CNPS-listed species have no formal legal protection, but the values and importance of these lists are widely recognized. Plants listed on CNPS Lists 1A, 1B, and 2 meet the definitions of Section 1901 of the California Fish and Game Code and may qualify for State listing. Therefore, for purposes of this analysis, they are considered rare plants pursuant to Section 15380 of CEQA.

California Government Code Section 65040.12

For the purposes of the Section 65040.12, environmental justice is defined as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." Section 65040.12 requires the Office of Planning and Research to take the following actions:

- Consult with the Secretaries of Cal/EPA, the California Natural Resources Agency (formerly, the California Resources Agency), and the Business, Transportation and Housing Agency, the Working Group on Environmental Justice established pursuant to Section 72002 of the PRC, any other appropriate State agencies, and all other interested members of the public and private sectors in the State.

- Coordinate the office's efforts and share information regarding environmental justice programs with the Council on Environmental Quality, the EPA, the General Accounting Office, the Office of Management and Budget, and other Federal agencies.

- Review and evaluate any information from Federal agencies that is obtained as a result of their respective regulatory activities under Federal EO 12898, and from the Working Group on Environmental Justice established pursuant to Section 72002 of the PRC.

Section 65040.12 also requires the Office of Planning and Research to establish guidelines for addressing environmental justice issues in city and county general plans, including planning methods for the equitable distribution of public facilities and services, industrial land uses, and the promotion of more livable communities.

California Harbors and Navigation Code

The California Harbors and Navigation Code details the jurisdiction of the California Department of Boating and Waterways, which is focused on the development of public access to waterways, the safety of vessels and boating facilities, and on-the-water safety.

California Release Response Plans and Inventory Law of 1985

The California Hazardous Materials Release Response Plans and Inventory Law of 1985 (Business Plan Act) requires preparation of hazardous materials business plans and disclosure of hazardous materials inventories. A business plan includes an inventory of hazardous materials handled, facility floor plans showing where hazardous materials are stored, an emergency response plan, and provisions for employee training in safety and emergency response procedures (California Health and Safety Code, Division 20, Chapter 6.95, Article 1). Statewide, DTSC has primary regulatory responsibility for managing hazardous materials, with delegation of authority to local jurisdictions that enter into agreements with the State. Local agencies administer these laws and regulations.

California Land Conservation Act of 1965 (Williamson Act)

The California Land Conservation Act of 1965, commonly known as the Williamson Act, is the principal method for encouraging preservation of agricultural lands in California. The Williamson Act enables local governments to enter into contracts with private landowners that restrict specific parcels of land to agricultural or related open-space use for 10 years. In return, landowners receive property tax assessments that are based on farming and open space uses rather than full market value. Local governments receive an annual subvention

(subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural uses and other compatible uses. When establishing such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land use for at least 10 years. In return, the landowner is guaranteed a relatively stable tax base, founded on the value of the land for agricultural/open space use only and unaffected by its development potential.

Cancelling a Williamson Act contract requires the landowner to undergo an extensive review and approval process and pay fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in Section 51282 of the California Government Code.

California Multi-Hazard Mitigation Plan

Cal EMA issued the *2010 State of California Multi-Hazard Mitigation Plan* (Cal EMA 2010) in October 2010. The Federal Disaster Mitigation Act required all State emergency services agencies to issue such plans by November 1, 2004, for the states to receive Federal grant funds for disaster assistance and mitigation under the Stafford Act (44 CFR 201.4).

California Native Plant Protection Act

In addition to the CESA, the California Native Plant Protection Act provides protection to endangered and rare plant species, subspecies, and varieties of wild native plants in California. The definitions of "endangered" and "rare" in the California Native Plant Protection Act closely parallel the CESA definitions of "endangered" and "threatened" plant species.

California Native Plant Society Species Designations

The CNPS is a statewide nonprofit organization that seeks to increase understanding of California's native flora and to preserve this rich resource for future generations. The organization has developed and maintains lists of vascular plants of special concern in California. Species listed by the CNPS have no formal legal protection, but the values and importance of these lists are widely recognized, as described above.

California Occupational Safety and Health Administration

California Occupational Safety and Health Administration (Cal/OSHA) assumes primary responsibility for developing and enforcing workplace safety regulations in California. Cal/OSHA regulations pertaining to the use of hazardous materials in the workplace (Title 8 of the CCR) include requirements for safety training, availability of safety equipment, accident and illness prevention programs, hazardous substance exposure warnings, and preparation of emergency action and fire prevention plans.

California Public Resources Code, Section 5096 et seq.

The California Public Resources Code contains several sections relevant to the alternative plans. Some examples include PRC Section 5096.225 (the California Park and Recreational Facilities Act of 1984), PRC Section 5094 (the Federal Water Project Recreation Act), and the CWA.

PRC Section 5097.5 prohibits excavation or removal of any "vertebrate paleontological site, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands and specifies that State agencies may undertake surveys, excavations, or other operations as necessary on publicly owned lands to preserve or record paleontological resources." Public lands are defined to include lands owned by or under the jurisdiction of the State or any city, county, district, authority, or public corporation, or any agency thereof. Section 5097.5 states that any unauthorized disturbance or removal of archaeological, historical, or paleontological materials or sites located on public lands is a misdemeanor.

California Public Utilities Commission

The California Public Utilities Commission (CPUC) was established in 1911, with additional responsibility and name changes in 1912 and 1946. The CPUC regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. CPUC maintains several O&M standards to which hydroelectric power supplies must comply. General Order No. 167, Subsections 8.2 and 15.1.1, requires filing of the Initial Certification of Compliance with the Operation Standards for each generating unit and recertification every other year. General Order No. 167, Subsections 7.2 and 15.1.1, requires filing of the Initial Certification of Compliance with the Maintenance Standards for each generating unit and

recertification every other year. General Order No. 167, Subsections 6.3 and 15.1.1, requires filing of the Hydroelectric Logbook Verified Statement for each generating unit and recertification every other year.

In 1993, the CPUC authorized regulated investor-owned utilities to implement "no and low-cost EMF avoidance measures" in the construction of new and upgraded utility projects. CPUC Decision 06-01-042 in 2006 affirmed and updated the CPUC 1993 decision. To provide low-cost mitigation, the CPUC continues to use the benchmark of 4 percent of transmission and substation project costs for EMF design modifications, and to combine linked transmission and substation projects. In addition, the CPUC adopted rules and policies to improve utility design guidelines for reducing EMF levels near areas of human habitation; these guidelines include use of alternative sites, increased ROW, placement of facilities underground, and similar methods to reduce EMF levels at transmission, distribution, and substation facilities by increasing the distance between people and facilities.

California Natural Resources Agency Environmental Justice Policy

All departments, boards, commissions, conservancies, and special programs of the California Natural Resources Agency, such as DWR, the California Department of Conservation, and CDFW, must consider environmental justice in their decision-making process if their actions have an impact on the environment, environmental laws, or policies. Such actions that require environmental justice consideration may include:

- Adopting regulations
- Enforcing environmental laws or regulations
- Making discretionary decisions or taking actions that affect the environment
- Providing funding for activities affecting the environment

The California Natural Resources Agency defines "environmental justice" in a manner consistent with the State as "the fair treatment of people of all races, cultures and income with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." The agency states that its

environmental justice policy is that the fair treatment of all people shall be considered during the planning, decision making, development, and implementation of its programs. The California Natural Resources Agency intends for its policy "to ensure that the public, including minority and low-income populations, are informed of opportunities to participate in the development and implementation of all Natural Resources Agency programs, policies and activities, and that they are not discriminated against, treated unfairly, or caused to experience disproportionately high and adverse human health or environmental effects from environmental decisions" (California Natural Resources Agency 2013).

California Scenic Highway Program

California's Scenic Highway Program was created by the California Legislature in 1963. Its purpose is to protect and enhance the natural scenic beauty of California highways and adjacent corridors through special conservation treatment. The State laws governing the Scenic Highway Program are found in the Streets and Highways Code, Sections 260–263.

When a city or county nominates an eligible scenic highway for official designation, it must identify and define the scenic corridor of the highway. Scenic corridors consist of land that is visible from the highway right-of-way and are composed primarily of scenic and natural features. Topography, vegetation, viewing distance, and/or jurisdictional lines determine the corridor boundaries. The city or county must also adopt ordinances, zoning, and/or planning policies to preserve the scenic quality of the corridor or document such regulations that already exist in various portions of local codes. These regulations provide a concise strategy for maintaining the scenic character of the corridor. These ordinances and/or policies make up the Corridor Protection Program.

There are few designated State scenic highways within the area surrounding the primary and extended study areas. Several eligible highways in the region have not yet been designated. SR 168 is eligible for designation; however, as discussed in the National Forest Scenic Byways Program section, travelers cannot see the primary or extended study area while on this road. Only one of the scenic byways (I-5/I-580 Westside Freeway) would potentially be within the viewshed of Reaches 1 through 5 of the San Joaquin River in the extended study area. No other officially designated or eligible State scenic highways are located near the primary or extended study area.

California State Lands Commission Environmental Justice Policy

The California State Lands Commission (CSLC) developed an Environmental Justice Policy to ensure equity and fairness in its own processes and procedures, and in October 2002, it adopted an amended policy. The policy ensures that "environmental justice is an essential consideration in its processes, decisions and programs and that all people who live in California have a meaningful way to participate in these activities." The CSLC implements the policy, in part, by identifying and communicating with relevant populations that could be adversely and disproportionately affected by CSLC projects or programs, and by ensuring that a range of reasonable alternatives is identified to minimize or eliminate environmental impacts affecting such populations. This discussion is provided in this Draft EIS consistent with and in furtherance of the CSLC's Environmental Justice Policy. Under the agency's adopted environmental justice policy, CSLC's staff is required to report back to the CSLC on how environmental justice is integrated into its programs, processes, and activities (CSLC 2010).

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (SMARA) (PRC Section 2710 et seq.) addresses surface mining. Among the activities subject to SMARA are the mining of minerals, gravel, and borrow material. SMARA requires mitigation to reduce adverse impacts on public health, property, and the environment. Because Temperance Flat RM 274 Reservoir would require borrow material for construction from sites not previously permitted, Reclamation must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through permitting ordinances developed by local government "lead agencies" that provide the regulatory setting under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

The Office of Mine Reclamation (under the DOC) provides assistance to cities, counties, state agencies and mine operators for reclamation planning, and strives to reclaim mined lands to a beneficial end-use through implementing SMARA.

California Water Rights

A water right is a legally granted and protected right to take possession of water and put it to beneficial use. As authorized by the California Water Code, the State Water Board allocates surface water rights and permits the diversion and use of water throughout the state. Through its Division of Water Rights, the State Water Board issues permits to divert water for new appropriations, change existing water rights, or store water for a certain length of time. The State Water Board attaches conditions to these permits to ensure that the water user prevents waste, conserves water, does not infringe on the rights of others, and puts the State's water resources to the most beneficial use in the best interest of the public.

Central Valley Flood Control Act of 2008

In 2007, the Governor signed five interrelated bills (flood legislation) aimed at addressing the problems of flood protection and liability and helping to direct use of the voter approved bond funds provided by 2006 Propositions 1E and 84. These included Senate Bill (SB) 5 and 17, and AB 5, 70, and 156. A sixth bill passed in 2007, AB 162, required additional consideration of flood risk in local land use planning throughout California. These bills, effective January 1, 2008, collectively added or amended sections in the California Government Code, Health and Safety Code, PRC, and CWC. Together, these bills outline a comprehensive approach to improving flood management at the State and local levels, with elements to address both the chance of flooding and the consequences when flooding does occur.

The major piece of the flood legislation is the Central Valley Flood Protection Act of 2008, enacted by SB 5. In June 2012, the Central Valley Flood Protection Board (CVFPB) adopted the Central Valley Flood Protection Plan (CVFPP). The CVFPP establishes a system-wide approach to improving flood management in areas currently receiving some amount of flood protection from existing facilities of the Federal-State flood management system. The flood legislation also establishes the 200-year flood event (flood with a 1-in-200 chance of occurring in any year) as the minimum level of flood protection to be provided in urban and urbanizing areas in the Sacramento-San Joaquin Valley. Work is currently underway on the 2017 CVFPP.

Central Valley Flood Protection Board Encroachment Permit

Under CCR Title 23, the Central Valley Flood Protection Board (formerly called the State of California Reclamation Board) issues encroachment permits to maintain the integrity and safety of flood control project levees and floodways that were constructed according to the flood control plans adopted by the board or the California Legislature.

Criteria Air Pollutants

The CCAA, which was adopted in 1988, required ARB to establish California ambient air quality standards. The CCAA requires that all local air districts in the state endeavor to achieve and maintain California ambient air quality standards by the earliest practical date. The act specifies that local air districts should particularly focus on reducing emissions from transportation and areawide sources, and authorizes districts to regulate indirect sources. Among ARB's other responsibilities are to oversee local air district compliance with California and Federal laws; approve local air quality plans; submit SIPs to EPA; monitor air quality; determine and update area designations and maps; and set emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Emergency Response to Hazardous Materials Incidents

California has developed an emergency response plan to coordinate emergency services provided by Federal, State, and local governments and private agencies. Response to hazardous material incidents is one part of this plan. The plan is managed by the California Emergency Management Agency, which coordinates the responses of other agencies, including the Cal/EPA, California Highway Patrol, CDFW, and the Central Valley Water Board.

Executive Order S-3-05

EO S-3-05, which was signed by Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra Nevada snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea level. To combat those concerns, the EO established total GHG emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050. This EO is binding only on state agencies, and has no force of law for local governments; however, the signing of S-3-05 sent a clear signal

to the California Legislature about the framework and content for legislation to reduce GHG emissions.

Farmland Security Zones

FSZs, also known as Super Williamson Act lands, were authorized by a 1998 amendment to the Williamson Act with the same general intent as Williamson Act contracts. Under FSZ provisions, the landowner agrees to keep land that is threatened by development in agricultural use for at least 20 years; in return, the landowner receives the benefits of lower property tax bills, parcel tax exemptions, annexation exemptions, and exemptions from school use. Accordingly, FSZs increase both the duration and the protection of Williamson Act status. An FSZ must be located in an agricultural preserve (an area designated as eligible for a Williamson Act contract). Agricultural landowners in FSZs must enter into contracts with counties for a minimum term of 20 years that are also renewed automatically each year, and are ensured an additional 35 percent tax benefit over and above the standard Williamson Act contract (DOC 2010). The FSZ program has been adopted by 25 counties, including Fresno and Madera counties, although not all of those counties have executed contracts.

Government Code Section 65962.5, Cortese List

The provisions of Government Code Section 65962.5 are commonly referred to as the “Cortese List” (after the legislator who authored the legislation that enacted it). The Cortese List is a planning document used by State and local agencies to comply with CEQA requirements in providing information about the location of hazardous materials release sites. Government Code Section 65962.5 requires Cal/EPA to develop an updated Cortese List annually at minimum. DTSC is responsible for a portion of the information contained in the Cortese List. Other California State and local government agencies are required to provide additional hazardous material release information for the Cortese List.

Hazardous Materials Transport

The DOT regulates transportation of hazardous materials between states. State agencies with primary responsibility for enforcing Federal and State regulations and responding to hazardous materials transportation emergencies are the CHP and Caltrans. Together, these agencies determine container types used and license hazardous waste haulers for transportation of hazardous waste on public roads.

The DOT Federal Railroad Administration enforces the hazardous materials regulations, which are promulgated by the Pipeline and Hazardous Materials Safety Administration for rail transportation. These regulations include requirements that railroads and other transporters of hazardous materials, including shippers, have and adhere to security plans and train their employees involved in offering, accepting, or transporting hazardous materials on both safety and security matters.

Municipal and Industrial Water Quality Objectives

In the 1978 WQCP, the State Water Board set two objectives that it believed provided reasonable protection for M&I beneficial use of Delta waters from the effects of salinity intrusion. The first objective established a year-round maximum mean daily chloride concentration measured at five Delta intake facilities, including CCWD's Pumping Plant No. 1, of 250 mg/L for the reasonable protection of municipal beneficial use. The second objective established a maximum mean daily chloride concentration of 150 mg/L (measured at either CCWD Pumping Plant No.1 or the San Joaquin River at the Antioch water works intake) for the reasonable protection of industrial beneficial use (specifically, the manufacture of cardboard boxes by Gaylord Container Corporation in Antioch).

Oak Woodlands Conservation Act

The Oak Woodlands Conservation Act, SB 1134 (California Public Resources Code Section 21083.4), requires that a county must determine whether or not a project will result in a significant impact on oak woodlands and, if it is determined that a project may result in a significant impact on oak woodlands, then the county shall require one or more of the following mitigation measures:

- Conserve oak woodlands through the use of conservation easements
- Plant an appropriate number of trees, including maintenance of plantings and replacement of failed plantings
- Contribute funds to the Oak Woodlands Conservation Fund for the purpose of purchasing oak woodlands conservation easements
- Implement other mitigation measures developed by the county

Despite the act's deferral to counties, it is inherent in the act that loss of oak woodlands should be evaluated in environmental documents to determine whether a project may result in a significant impact and if a significant impact would result, that impact should be mitigated.

Porter-Cologne Water Quality Control Act

Under the Porter-Cologne Water Quality Control Act, "waters of the State" fall under the jurisdiction of the appropriate regional water quality control board (in this case, the Central Valley Water Board). Under the act, the regional water quality control board must prepare and periodically update basin plans. Each basin plan sets forth water quality standards for surface water and groundwater, and actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Projects that affect wetlands or waters must meet the regional water quality control board's waste discharge requirements, which may be issued in addition to a water quality certification under Section 401 of the CWA.

Renewables Portfolio Standards

Established in 2002 under SB 1078, California's RPS was accelerated in 2006 under SB 107 by requiring that 20 percent of electricity retail sales be served by renewable energy resources by 2010. Subsequent recommendations in California energy policy reports advocated a goal of 33 percent by 2020, and on November 17, 2008, Governor Arnold Schwarzenegger signed EO S-14-08 requiring that "...[a]ll retail sellers of electricity shall serve 33 percent of their load with renewable energy by 2020." The following year, EO S-21-09 directed the California Air Resources Board, under its AB 32 authority, to enact regulations to achieve the goal of 33 percent renewables by 2020.

In the ongoing effort to codify the 33 percent by 2020 goal, SB X1-2 was signed by Governor Edmund G. Brown, Jr., in April 2011. This RPS codifies California Air Resources Board's 33 percent Renewable Electricity Standard and applies to all electricity retailers in the State, including POUs, investor-owned utilities, electricity service providers, and community choice aggregators. These entities must adopt the new RPS goals of 20 percent of retails sales from renewables by the end of 2013, 25 percent by the end of 2016, and the 33 percent requirement being met by the end of 2020. As of February 2014, these entities were on pace to meet the 20 percent by 2013 requirement; however, due to the large number of

transactions conducted at the end of 2013, reporting was not complete at that time (CPUC 2014).

The addition of significant amounts of intermittent, non-dispatchable renewable resources such as wind and solar to meet the 33 percent RPS makes hydropower more valuable because of its fast-ramping capabilities to allow firming and reliable operation of the electric grid.

Sacramento-San Joaquin Delta Reform Act

In November 2009 the Sacramento-San Joaquin Delta Reform Act was passed. It established state policy of coequal goals for the Delta and created the Delta Stewardship Council as a new, independent state agency that will delineate exactly how to meet these goals through development and implementation of the Delta Plan.

The Council's principal task is to develop and implement the Delta Plan, a legally enforceable document that will include all the actions necessary to ensure the state's coequal goals for the Delta are met (Delta Stewardship Council 2010).

Senate Bill 97, Amendments to CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions

As directed by SB 97, the California Natural Resources Agency adopted Amendments to the CEQA Guidelines in December of 2009 for the mitigation of GHG emissions or the effects of GHG emissions.

Senate Bill 375, Sustainable Communities and Climate Protection Act of 2008

Signed in September 2008, SB 375 aligns regional transportation planning efforts, regional GHG reduction targets, and land use and housing allocation. SB 375 requires each Metropolitan Planning Organization (MPO) adopt a Sustainable Communities Strategy as part of the MPO's Regional Transportation Plan that sets land use allocation and transportation investments necessary to meet GHG emission reduction targets for the region. ARB provided each affected MPO with reduction targets for GHGs emitted by passenger cars and light trucks for 2020 and 2035. The ARB-issued targets for the San Joaquin Valley jurisdiction are a 5 percent reduction in GHG emissions per capita by 2020 relative to 2005 and a 10 percent reduction by 2035 (ARB 2011).

Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (AB 1807 (Statutes of 1983)) and the Air Toxics Hot Spots Information and Assessment Act (AB 2588 (Statutes of 1987)). AB 1807 sets forth a formal procedure for ARB to designate substances as TACs. Research, public participation, and scientific peer review must be completed before ARB can designate a substance as a TAC. To date, ARB has identified more than 21 TACs and has adopted EPA's list of HAPs as TACs. Most recently, diesel PM was added to the ARB list of TACs.

Once a TAC is identified, ARB adopts an airborne toxics control measure for sources that emit that particular TAC. If a safe threshold exists for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If there is no safe threshold, the measure must incorporate best available control technology to minimize emissions.

AB 2588 requires facilities that emit toxic substances above a specified level to do all of the following:

- Prepare a toxic emissions inventory
- Prepare a risk assessment if emissions are significant
- Notify the public of significant risk levels
- Prepare and implement risk reduction measures

Regional and Local

This Draft EIS analyses the alternatives for consistency with the general plan policies of the relevant counties and cities, and resource management plans in the primary study area and throughout the extended study area. These applicable plans are discussed in Section 3.2.9.

Air Quality Attainment Plans

SJVAPCD prepares and submits air quality attainment plans (AQAP) to ARB in compliance with the requirements set forth in the CCAA. ARB incorporates these plans into the SIP and forwards SIP revisions to EPA for approval and publication in the Federal Register. The CCAA also requires that air quality management districts and air pollution control districts conduct a triennial assessment of the extent to which air quality has improved and emissions have been reduced through the use of

control measures. As part of the assessment, the AQAPs must be reviewed and, if necessary, revised to correct deficiencies in progress and to incorporate new data or projections. Because the SJVAB is a nonattainment area for certain pollutants, SJVAPCD is also required to submit rate-of-progress milestone evaluations in accordance with the CAAA. These milestone reports include demonstrations that the requirements for the nonattainment area have been met. The AQAPs and reports present comprehensive strategies to reduce emissions of ROGs, NO_X, and PM_{10} from stationary, area, mobile, and indirect sources. Such strategies include the adoption of rules and regulations; enhancement of CEQA participation; implementation of a new and modified indirect-source review program; adoption of local air quality plans; and development of stationary-, mobile-, and indirect-source control measures. Table 28-1 summarizes SJVAPCD's current AQAPs.

Table 28-1. Summary of the San Joaquin Valley Air Pollution Control District's Air Quality Attainment Plans

Pollutant	Plan Title	Date	Status
Ozone	*Extreme Ozone Attainment Demonstration Plan, San Joaquin Valley Air Basin Plan Demonstrating Attainment of Federal 1-Hour Ozone Standards*	October 2004, Amended October 2005	Adopted by SJVAPCD and ARB in October 2004. Clarifications adopted by SJVAPCD in August 2008. Approved by EPA in march 2010.
	8-Hour Ozone Attainment Demonstration Plan for the San Joaquin Valley	June 2007	Adopted by SJVAPCD in April 2007. Approved by ARB on June 14, 2007.
Carbon monoxide (CO)	*2004 Revision to the California State Implementation Plan for Carbon Monoxide Updated Maintenance Plan for the Federal Planning Areas*	July 2004	Adopted by ARB July 2004.
Respirable and fine particulate matter (PM_{10} and $PM_{2.5}$)	*2007 PM_{10} Maintenance Plan and Request for Redesignation*	September 2007	EPA redesignated SJVAB to attainment for the PM_{10} NAAQS and approved the PM_{10} Maintenance Plan in September 2008.
	2008 $PM_{2.5}$ Plan	April 2008	Adopted by SJVAPCD in April 2008. Submitted to ARB.
	Natural Events Action Plan for High Wind Events in the San Joaquin Valley	February 2006	Adopted by SJVAPCD in February 2006. Submitted to ARB.

Source: ARB 2004; SJVAPCD 2010; SJVAPCD 2006; SJVAPCD 2007;SJVAPCD 2008
Key:
ARB = California Air Resources Board
EPA = U.S. Environmental Protection Agency
NAAQS = National Ambient Air Quality Standards
PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less
$PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less
SJVAB = San Joaquin Valley Air Basin
SJVAPCD = San Joaquin Valley Air Pollution Control District

California Government Code General Plan Requirement

California Government Code Section 65300 et seq. requires California cities and counties to adopt and implement general plans. A general plan is a comprehensive, long-term strategy document that sets forth the expected location and general type of physical development expected in the city or county preparing the document. The general plan also may consider land outside its boundaries that, in the judgment of the city or county government in the city's or county's judgment, may affect land use activities within its borders. The general plan addresses a broad range of topics, including, at a minimum, land use, circulation, housing, conservation, open space, noise, and safety. In addressing these topics, the general plan identifies goals, objectives, policies, principles, standards, and plan proposals that support a city's or county's vision for the area. The general plan is a long-range document that typically addresses development over a 20-year period.

County Plans

As required by State law, counties in the study area have developed their own general plans. At a minimum, these documents must address the topics of land use, transportation, housing, conservation, open space, noise, and safety. These documents serve as statements of county goals, policies, standards, and implementation programs for the physical development of a county, and include the Fresno County General Plan Policy Document (2000), the Madera County General Plan Policy Document (1995), and the Merced County Year 2000 General Plan (1990).

Fresno County General Plan The following goals and policies from the *Fresno County General Plan* (Fresno County 2000) related to public health and hazards are relevant to the alternatives.

Goal HS-B: To minimize the risk of loss of life, injury, and damage to property and natural resources resulting from fire hazards.

- **Policy HS-B.1** – T he County shall review project proposals to identify potential fire hazards and to evaluate the effectiveness of preventive measures to reduce the risk to life and property.

- **Policy HS-B.2** – The County shall ensure that development in high fire hazard areas is designed and constructed in a manner that minimizes the risk from

fire hazards and meets all applicable State and County fire standards. Special consideration shall be given to the use of fire-resistant construction in the underside of eaves, balconies, unenclosed roofs and floors, and other similar horizontal surfaces in areas of steep slopes.

- **Policy HS-B.3** – The County shall require that development in high fire hazard areas have fire-resistant vegetation, cleared fire breaks separating communities or clusters of structures from native vegetation, or a long-term comprehensive vegetation and fuel management program. Fire hazard reduction measures shall be incorporated into the design of development projects in fire hazard areas.

- **Policy HS-B.5** – The County shall require development to have adequate access for fire and emergency vehicles and equipment.

Goal HS-E: To minimize the exposure of the public to high noise levels and safety hazards through land use controls and policies for property in the vicinity of airports; and to limit urban encroachment around airports to preserve the safety of flight operations and the continued viability of airport facilities.

- **Policy HS-E.2** – The County shall ensure that new development, including public infrastructure projects, does not create safety hazards such as glare from direct or reflective sources, smoke, electrical interference, hazardous chemicals, or fuel storage in violation of adopted safety standards.

Goal HS-F: To minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.

- **Policy HS-F.1** – The County shall require that facilities that handle hazardous materials or hazardous wastes be designed, constructed, and operated in accordance with applicable hazardous materials and waste management laws and regulations.

- **Policy HS-F.4** – For redevelopment or infill projects or where past site uses suggest environmental impairment, the County shall require that an investigation be performed to identify the potential for soil or

groundwater contamination. In the event soil or groundwater contamination is identified or could be encountered during site development, the County shall require a plan that identifies potential risks and actions to mitigate those risks before, during, and after construction.

- **Policy HS-F.7** – The County shall ensure that the mining and processing of minerals in the County is conducted in compliance with applicable environmental protection standards.

Madera County General Plan The following goals and policies from the *Madera County General Plan Policy Document* (Madera County 1995) related to public health and hazards are relevant to the alternatives.

Goal 5.I: To encourage commercial mining operations within areas designated for such extraction, where environmental, aesthetic, and adjacent land use compatibility impacts can be adequately mitigated, and to provide for the timely rehabilitation and reuse of mining sites.

- **Policy 5.I.1** – The County shall require new mining operations to be designed to provide a buffer between existing or likely adjacent uses, minimize incompatibility with adjacent uses, and adequately mitigate their environmental and aesthetic impacts. The buffer area shall be zoned Agricultural, Rural, Exclusive-20 Acre or -40 Acre (ARE-20 and ARE-40).

- **Policy 5.I.6** – The County shall require that all mining operations prepare and implement mining plans and reclamation plans that mitigate environmental impacts and incorporate adequate security to guarantee proposed reclamation.

Goal 6.C: To minimize the risk of loss of life, injury, and damage to property and watershed resources from unwanted fires.

- **Policy 6.C.1** – The County shall ensure that development in high-fire-hazard areas is designed and constructed in a manner that minimizes the risk from fire hazards and meets all applicable state and county fire standards.

- **Policy 6.C.4 –** The County shall review project proposals to identify potential fire hazards and prevent or mitigate such hazards to acceptable levels of risk.

- **Policy 6.C.5 –** The County shall require development to have adequate access for fire and emergency vehicles and equipment.

Goal 6.D: To minimize the risk of loss of life, injury, damage to property, and economic and social dislocations resulting from airport hazards.

- **Policy 6.D.1 –** The County shall ensure that development around airports does not create safety hazards such as lights from direct or reflective sources, smoke, electrical interference, hazardous chemicals, or fuel storage in violation of adopted safety standards.

Goal 6.G: To minimize the risk of loss of life, injury, serious illness, damage to property, and economic and social dislocations resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous materials wastes.

- **Policy 6.G.1 –** The County shall ensure that the use and disposal of hazardous materials in the county complies with local, state, and federal safety standards.

- **Policy 6.G.2 –** The County shall encourage source reduction, recycling, and on-site treatment of hazardous wastes to reduce hazardous waste generation and disposal.

- **Policy 6.G.4 –** The County shall review all proposed development projects that manufacture, use, or transport hazardous materials for compliance with the County's *Hazardous Waste Management Plan*.

- **Policy 6.G.5 –** The County shall strictly regulate the storage of hazardous materials and wastes.

Fresno County Congestion Management Process

The Fresno Council of Governments (formerly the Council of Fresno County Governments) serves as the CMA of Fresno County. As the county's CMA, it is authorized to set State and Federal funding priorities for transportation improvements affecting the Fresno County Regionally Significant Road

System as contained within the *Fresno County Congestion Management Process* (Council of Fresno County Governments 2009).

The CMP specifies a system of highways and roadways for which traffic LOS standards are established. The CMP system includes all freeways, State highways, and the Regionally Significant Road System. The following roads in the primary study area are included as part of the CMP: SR 99, SR 41, Friant Road, Auberry Road, and Millerton Road. The LOS standard for the roadways within the CMP system is based on the standards set by the jurisdiction the roadway falls under. Caltrans has jurisdiction over SR 99 and SR 41, and Fresno County has jurisdiction over Friant Road (outside Fresno city limits), Auberry Road, and Millerton Road.

Madera County 2011 Regional Transportation Plan

The Madera County Transportation Commission is required to update the Regional Transportation Plan consistent with the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users compliance guidelines to reflect the transportation system through FY 2035. The Regional Transportation Plan ensures that the county's transportation system and implementation policies/programs through FY 2035 will safely and efficiently accommodate future growth within the cities of Chowchilla and Madera and Madera County as envisioned in the Land Use Elements.

The Madera County 2011 Regional Transportation Plan (Madera County Transportation Commission 2010) includes programs and policies for congestion management, transit, bicycles and pedestrians, roadways, freight, and finances. It must be revised at least every 4 years because the county is designated as nonattainment of Federal air quality standards.

The Regional Transportation Plan's primary use is as a regional long-range plan for Federally funded transportation projects. It also serves as a comprehensive, coordinated transportation plan for all the governmental jurisdictions within the region. The jurisdictions with transportation implementation responsibilities under the Regional Transportation Plan are Caltrans, Madera County, and the cities of Chowchilla and Madera.

Pacific Forest and Watershed Lands Stewardship Council Land Conservation Plan

In December 2003, the CPUC and PG&E settled a range of issues related to the PG&E bankruptcy. *The Opinion Modifying the Proposed Settlement Agreement of Pacific Gas & Electric Company, PG&E Corporation, and the Commission Staff, and Approving the Modified Settlement Agreement* and the associated *Stipulation Resolving Issues Regarding the Land Conservation Commitment* required that PG&E commit to protecting the lands associated with its hydroelectric system, plus the 655-acre Carrizo Plain in San Luis Obispo County, through conservation easements and donations of lands in fee subject to conservation easements. This land conservation commitment is intended to enhance the existing environmental and economic benefits through the following broad range of beneficial public values:

- Protection of the natural habitat of fish, wildlife and plants
- Preservation of open space
- Protection and creation of outdoor recreational opportunities
- Preservation of sustainable forestry and agricultural uses
- Protection of historic values

The land conservation commitment is implemented through either: (1) PG&E's donation of conservation easements restricting development of the lands so as to protect and preserve their beneficial public values; and/or (2) PG&E's donation of the lands in fee to one or more public entities or qualified nonprofits, whose ownership would be consistent with these conservation objectives. Furthermore, for lands that are donated in fee, those donated parcels would be made subject to conservation easements, except in limited circumstances where appropriate protection can be otherwise provided.

As a result of the CPUC and PG&E settlement, the Pacific Forest and Watershed Lands Stewardship Council was established in 2004 and tasked with preparing a land conservation plan (LCP) to implement PG&E's land conservation commitment. In 2007, the Board adopted the LCP

to provide for the permanent conservation of over 140,000 acres of lands currently owned and managed by PG&E that are primarily in the Sierra Nevada and Cascade Mountain range watersheds. Approximately half of the PG&E properties are generally associated with hydroelectric facilities and operations, and operate under licenses granted by FERC.

Pacific Forest and Watershed Lands Stewardship Council recommends that the land and land uses at Kerckhoff Lake be preserved and enhanced by protecting cultural resources, wildlife habitat, and agricultural uses and enhancing recreational experiences. The following recommended objectives in the LCP are applicable to land use planning and agricultural resources (Pacific Forest and Watershed Lands Stewardship Council 2007).

- **Objective** – Preserve open space to protect natural and cultural resources, viewsheds, and agricultural land uses.

- **Objective** – Preserve and enhance grazing to support associated economic benefits, as well as to protect open space and habitat resources.

San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

The San Joaquin County Multi-Species Habitat Conservation and Open Space Plan, approved and adopted in November 2000, includes compensation measures to offset the effects of development on special-status plant, fish, and wildlife species throughout San Joaquin County (SJCOG 2000), downstream from the Restoration Area, and including portions of the lower San Joaquin River.

San Joaquin Valley Air Pollution Control District

SJVAPCD seeks to improve air quality conditions in the SJVAB through a comprehensive program of planning, regulation, enforcement, technical innovation, and promotion of the understanding of air quality issues. The clean-air strategy of SJVAPCD includes preparing plans and programs for the attainment of ambient air quality standards, adopting and enforcing rules and regulations, and issuing permits for stationary sources. SJVAPCD also inspects stationary sources, responds to citizen complaints, monitors ambient air quality and meteorological conditions, and implements other programs and regulations required by the CAA, CAAA, and CCAA.

As mentioned above, SJVAPCD adopts rules and regulations. All projects are subject to SJVAPCD rules and regulations in effect at the time of construction. The specific rules discussed below are applicable to the construction of the proposed project.

Fugitive Dust PM10 Prohibitions Fugitive Dust PM_{10} Prohibitions: Rules 8011–8081 are designed to reduce PM_{10} emissions (predominantly dust and dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations. Compliance with Regulation VIII is mandatory, so compliance by Reclamation is assumed in this analysis. Compliance with Regulation VIII contains, but is not limited to, the following actions:

- Pre-water site sufficient to limit visible dust emissions (VDE) to 20 percent opacity.
- Phase work to reduce the amount of disturbed surface area at any one time.
- During active operations, apply water or chemical/organic stabilizers/suppressants sufficient to limit VDE to 20 percent opacity.
- During active operations, construct and maintain wind barriers sufficient to limit VDE to 20 percent opacity.
- During active operations, apply water or chemical/organic stabilizers/suppressants to unpaved haul/access roads and unpaved vehicle/equipment traffic areas sufficient to limit VDE to 20 percent opacity and meet the conditions of a stabilized unpaved road surface.
- An owner/operator shall limit the speed of vehicles traveling on uncontrolled unpaved access/haul roads within construction sites to a maximum of 15 miles per hour.
- An owner/operator shall post speed limit signs that meet State and Federal Department of Transportation standards at each construction site's uncontrolled unpaved access/haul road entrance. At a minimum, speed limit signs shall also be posted at least every 500

feet and shall be readable in both directions of travel along uncontrolled unpaved access/haul roads.

- When handling bulk materials, apply water or chemical/organic stabilizers/suppressants sufficient to limit VDE to 20 percent opacity.

- When handling bulk material, construct and maintain wind barriers sufficient to limit VDE to 20 percent opacity and with less than 50 percent porosity.

- When storing bulk materials, comply with the conditions for a stabilized surface as listed above.

- When storing bulk materials, cover bulk materials stored outdoors with tarps, plastic, or other suitable material and anchor in such a manner that prevents the cover from being removed by wind action.

- When storing bulk materials construct and maintain wind barriers sufficient to limit VDE to 20 percent opacity and with less than 50 percent porosity. If utilizing fences or wind barriers, apply water or chemical/organic stabilizers/suppressants to limit VDE to 20 percent opacity or use a 3-sided structure with a height at least equal to the height of the storage pile and with less than 50 percent porosity.

- Limit vehicular speed while traveling on the work site sufficient to limit VDE to 20 percent opacity.

- Load all haul trucks such that the freeboard is not less than 6 inches when material is transported across any paved public access road sufficient to limit VDE to 20 percent opacity.

- Apply water to the top of the load sufficient to limit VDE to 20 percent opacity.

- Cover haul trucks with a tarp or other suitable cover.

- Clean the interior of the cargo compartment or cover the cargo compartment before the empty truck leaves the site; and prevent spillage or loss of bulk material from holes or other openings in the cargo compartment's floor, sides, and/or tailgate; and load all haul trucks such that the freeboard is not less than 6

inches when material is transported on any paved public access road, and apply water to the top of the load sufficient to limit VDE to 20 percent opacity; or cover haul trucks with a tarp or other suitable cover.

- Owners/operators shall remove all visible carryout and trackout at the end of each workday.
- An owner/operator of any site with 150 or more vehicle trips per day, or 20 or more vehicle trips per day by vehicles with three or more axles shall take the actions for the prevention and mitigation of carryout and trackout.
- Within urban areas, an owner/operator shall prevent carryout and trackout, or immediately remove carryout and trackout when it extends 50 feet or more from the nearest unpaved surface exit point of a site.
- Within rural areas, construction projects 10 acres or more in size, an owner/operator shall prevent carryout and trackout, or immediately remove carryout and trackout when it extends 50 feet or more from the nearest unpaved surface exit point of a site.
- For sites with paved interior roads, an owner/operator shall prevent and mitigate carryout and trackout.
- Cleanup of carryout and trackout shall be accomplished by manually sweeping and picking-up; or operating a rotary brush or broom accompanied or preceded by sufficient wetting to limit VDE to 20 percent opacity; or operating a PM_{10}-efficient street sweeper that has a pick-up efficiency of at least 80 percent; or flushing with water, if curbs or gutters are not present and where the use of water would not result as a source of trackout material or result in adverse impacts on storm water drainage systems or violate any National Pollutant Discharge Elimination System permit program.
- An owner/operator shall submit a Dust Control Plan to the Air Pollution Control Officer (APCO) before the start of any construction activity on any site that will include 10 acres or more of disturbed surface area for residential developments, or 5 acres or more of disturbed surface area for non-residential development, or will include moving, depositing, or relocating more

than 2,500 cubic yards per day of bulk materials on at least three days. Construction activities shall not commence until the APCO has approved or conditionally approved the Dust Control Plan. An owner/operator shall provide written notification to the APCO within 10 days before the commencement of earthmoving activities via fax or mail. The requirement to submit a dust control plan shall apply to all such activities conducted for residential and non-residential (e.g., commercial, industrial, or institutional) purposes or conducted by any governmental entity.

If a nonresidential project is 5.0 or more acres in area, a dust control plan must be submitted as specified in Section 6.3.1 of Rule 8021. Therefore, Reclamation is required to submit a dust control plan, and construction activities would not commence until SJVAPCD has approved the plan.

- **Rule 2010—Permits Required** – This rule applies to anyone who plans to or does operate, construct, alter, or replace any source operation that may emit air contaminants or may reduce the emission of air contaminants. The proposed project would be subject to SJVAPCD permitting requirements for stationary sources such as boilers or back-up generators. If SJVAPCD permits are required, permit applications should be submitted as soon as possible to avoid project delays.

- **Rule 2201—New and Modified Stationary Source Review Rule** – This rule applies to all new stationary sources and all modifications of existing stationary sources. They are subject to SJVAPCD permit requirements if, after construction, they emit or may emit one or more affected pollutant.

- **Rule 2550—Federally Mandated Preconstruction Review for Major Sources of Air Toxics** – This rule applies to applications to construct or reconstruct a major air toxics source with Authority to Construct issued on or after June 28, 1998.

- **Rule 3135—Dust Control Plan Fee** – This rule requires applicants to submit a fee in addition to a dust control plan. The purpose of this fee is to recover SJVAPCD's cost for reviewing such plans and conducting compliance inspections.

- **Rule 4002—National Emissions Standards for Hazardous Air Pollutants** – This rule applies to all sources of hazardous air pollution and requires them to comply with the standards, criteria, and requirements set forth therein.

- **Rule 4101—Visible Emissions** – This rule prohibits emissions of visible air contaminants to the atmosphere and applies to any source operation that emits or may emit air contaminants.

- **Rule 4102—Nuisance** – This rule applies to any source operation that emits or may emit air contaminants or other materials. If such emissions create a public nuisance, the owner/operator could be in violation and be subject to enforcement action by SJVAPCD.

- **Rule 4601—Architectural Coatings** – This rule limits volatile organic compounds from architectural coatings by specifying storage, cleanup, and labeling requirements for architectural coatings.

- **Rule 4641—Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations** – This rule applies to the manufacture and use of the aforementioned asphalt types for paving and maintenance operations.

- **Rule 9510—Indirect Source Review (ISR)** – This rule was adopted to reduce the impacts of growth in emissions from all new development in the San Joaquin Valley. The purposes of Rule 9510 are to (1) fulfill SJVAPCD's emissions reduction commitments in the PM_{10} and ozone attainment plans, (2) reduce emissions from development projects through design features and on-site measures, and (3) reduce emissions from development projects through off-site measures.

The application of Rule 9510 depends on the type and size of a development project. The rule would apply to correctional facilities that exceed 9,000 square feet or more upon full buildout. Projects that exceed their respective screening level must file an Air Impact Assessment (AIA) application with SJVAPCD. The AIA lists all the attributes of a project, including on-site mitigation measures, so that SJVAPCD can estimate its emissions and assess the appropriate ISR fee for off-setting project-related emissions.

Rule 9510 requires applicants to provide information that enables SJVAPCD to quantify construction, area-source, and operational NO_X and exhaust PM_{10} emissions. Rule 9510 requires emissions of construction exhaust to be reduced by 20 percent for NO_X and 45 percent for PM_{10} when compared to the statewide fleet average. For operations, emissions of NO_X must be reduced by 33.3 percent and emissions of exhaust PM_{10} must be reduced by 50 percent; the reductions may occur over 10 years. The applicant may reduce both the construction emissions and the operations emissions by implementing on-site measures and/or by paying an off-site fee. However, if the initial calculation shows that emissions would be less than 2 tons per year of NO_X or exhaust PM_{10}, then emission reduction measures are not required.

On-site measures to mitigate construction emissions may include using cleaner fuels, retrofitting equipment on engines and exhaust systems, and using new, low-emissions engine types. Measures to reduce operational emissions include designing buildings for energy efficiency and planning sites to reduce the generation of vehicle trips.

Climate Change Action Plan SJVAPCD's Governing Board adopted its Climate Change Action Plan in 2008, which directed SJVAPCD to develop guidance for land use and permitting agencies to address GHG emissions impacts (SJVAPCD 2009). As part of this process, SJVAPCD published a staff report in December 2009 called *Addressing Greenhouse Gas Emissions Impacts under the California Environmental Quality Act* (SJVAPCD 2009). The guidance relies on the use of performance based standards, otherwise known as BPSs to assess the significance of project-specific GHG emissions on global climate change during the environmental review process, as required by CEQA. Use of BPS is a method of streamlining the CEQA process of determining significance and is not a required emission reduction measure. Projects implementing BPS would be determined to have a less-than-significant cumulative impact. Otherwise, demonstration of a 29 percent reduction in GHG emissions, from business-as-usual, is required to determine that a project would have a less-than-significant cumulative impact. The guidance does not limit a lead agency's authority to establish its own process and guidance for determining significance of project related impacts on global climate change.

Guide for Assessing and Mitigating Air Quality Impacts
In January 2002, SJVAPCD released a revision to a previously adopted guidelines document. The revised Guide for Assessing and Mitigating Air Quality Impacts (SJVAPCD 2002) is an advisory document that provides CEQA lead agencies, consultants, and project applicants with uniform procedures for addressing air quality in environmental documents. The guide contains the following applicable components:

- Criteria and thresholds for determining whether a project may have a significant adverse air quality impact,
- Specific procedures and modeling protocols for quantifying and analyzing air quality impacts,
- Methods available to mitigate air quality impacts, and
- Information for use in air quality assessments that will be updated more frequently such as air quality data, regulatory setting, climate, and topography.

Other Local Permits and Requirements
Several other local permits and requirements may apply to the Investigation. Fresno and Madera counties and their public works departments will require compliance with local plans and ordinances, such as the county general plan, zoning ordinances, grading plan, and various use permits. Utility easements and various encroachments also may be required.

Local surface water regulations can include water supply master plans, general plans, IRWMPs, habitat and conservation plans, and land-use ordinances, with many of these regulations, including goals, objectives, and policies, pertaining to the primary and extended study areas. Examples of relevant local water supply master plans include Fresno's *Final Urban Water Management Plan* (City of Fresno 2008), Merced's *Urban Water Management Plan* (City of Merced 2011), Modesto's *Joint Urban Water Management Plan 2005 Update* (City of Modesto and Modesto Irrigation District 2007), and Stockton's Water Master Plan (City of Stockton 2008). Local water supply plans typically outline future water supply/demand and provide a framework for supply diversification and conservation.

Several county and city general plans cover lands within or near the study area, including general plans for Fresno (Fresno County 2000), Madera (Madera County 1995), and Merced

(Merced County 1990) counties, and the cities of Fresno (2002), Clovis (1993), Mendota, and Firebaugh. These county and city general plans have goals, objectives, and policies oriented toward the conservation, protection, and enhancement of streams, rivers, wetlands, and riparian areas. Development and land-use ordinance decisions within these counties and cities are considered in view of their consequences to the general plan goals. General plans also have policies toward water supply protection and enhancement, and coordinate closely with their local water supply master plans. General plans are typically administered by local planning commissions or public utilities departments.

IRWMPs are statewide voluntary initiatives to foster regional water management and are intended to "ensure sustainable water uses, reliable water supplies, better water quality, environmental stewardship, efficient urban development, protection of agriculture, and a strong economy" (DWR 2005). In 2002, the State of California passed SB 1672, the Integrated Regional Water Management Planning Act, to provide bond funds to regional water management work groups statewide. The purpose of IRWM is to comprehensively address water supply, quality, flood, and ecosystem challenges through a collaborative planning and implementation framework of regional partners. Forty-eight regional water management groups now cover almost 90 percent of the State's geographic area. IRWM regions in the Investigation's extended study area include Eastern San Joaquin, Madera County, Merced County, East Stanislaus, Tuolumne-Stanislaus, Westside San Joaquin, Kaweah River Basin, Kern County, Poso Creek, Tule, and Upper Kings Basin.

Local habitat and conservation plans can be county-wide initiatives or can be implemented in response to proposed development. The main objectives of these plans are to protect natural resources, including species and habitat, provide regulatory assurances, as well as enhance coordination and collaboration of development stakeholders.

General policies require partnering with local utilities to provide adequate and cost-effective electricity, as well as identifying and designing areas of future utilities growth. Future electric utility modifications and growth are to be made with minimal impacts to the economy (e.g., agriculture) and residents (e.g., noise and visual impacts).

Compliance with Related Laws, Rules, Regulations, and Executive Orders

With the exception of NEPA (Federal) and CEQA (State) which are presented first, related laws, rules, regulations, and EOs are presented alphabetically.

Federal

National Environmental Policy Act

NEPA requires that an appropriate document be prepared to ensure that Federal agencies accomplish the act's purposes. The CEQ has adopted regulations and other guidance that provide detailed procedures for Federal agencies to follow in implementing NEPA. After this Draft EIS is finalized, Reclamation would use it to comply with Council on Environmental Quality regulations and document NEPA compliance.

Americans with Disabilities Act

The ADA is a comprehensive law prohibiting discrimination against people with disabilities in employment practices, use of public transportation, use of telecommunication facilities, and use of public accommodations. Title II of the ADA applies to government facilities and requires that reasonable modifications be made to services and programs so that they are readily accessible to and usable by people with disabilities. Reclamation would make every reasonable effort to make any new construction or improvement fully compliant with ADA requirements. If it is found to be infeasible to make a new construction or improvement element fully ADA compliant, Reclamation would obtain any required waivers or modifications to the ADA standards.

Bakersfield Resource Management Plan

BLM manages 4,036 acres of land surrounding portions of the proposed Temperance Flat RM 274 Reservoir, designated as the SJRG SRMA, through its 2012 Proposed Bakersfield RMP and Final EIS. The RMP (BLM 2012) contains the following goals and objectives that are relevant to the action alternatives.

Lands and Realty

Goal: Provide lands, interests in land, and authorizations for public and private uses while maintaining and improving resource values and public land administration.

- **Objectives** – The following objectives are intended to accomplish the lands and realty goals:

  - Meet other resource objectives through retention and/or land tenure adjustments

  - Meet public, private, and Federal agency needs for realty-related land use authorizations and land withdrawals, including those authorizations necessary for wind, solar, biomass, and other forms of renewable energy development

  - Increase public access to public lands when consistent with other resource objectives

Paleontological Resources
Goal: Identify, manage, and protect paleontological resources for scientific research, educational purposes, and public use.

- **Decision** – Implement measures to protect paleontological resources from inadvertent damage or destruction through:

  - Avoidance

  - Fencing

  - Stabilization

  - Collection or excavation and deposit in a museum repository

  - Interpretation or

  - Administrative closure

- **Decision** – Ensure that site-specific NEPA analyses (which may include a field inventory and fossil specimen recovery) implement the Potential Fossil Yield Class as a standard part of review for all surface-disturbing projects throughout the Decision Area.

- **Decision** – Minimize or prevent human-caused damage to paleontological resources through educational and interpretive outreach programs focusing use on common invertebrate and plant fossils.

Visual Resources
Goal: Public lands demonstrate a range of visual resource values that allow for development and provide opportunities for scenic appreciation.

Objectives

- Use visual resource management classes for all public lands within the decision area to preserve and enhance scenic quality for present and future generations.

- Maintain and/or enhance the scenic quality of the public lands.

- Use visual resource management classes for all public lands within the decision area to preserve and enhance scenic quality for present and future generations.

- SJRG SRMA: All actions must conform to VRM classes as follows:

  - Class I – Pa'San RMZ

  - Class II – Wu Ki'Oh RMZ

Class IV – Tahoot RMZ.While the SJRG SRMA has been inventoried as VRM Class III, BLM will manage it under the objectives for these three VRM classes. The objectives for VRM Class designations are defined by BLM (2012) as follows:

- Class I – preserves the landscape character.

- Class II – retains the existing landscape character.

- Class IV – provides for management activities that require major modifications of the landscape character.

Wild and Scenic Rivers
Goal: River segments suitable for inclusion in the NWSRS would be free-flowing in nature, meet water quality standards, and continue to possess outstandingly remarkable ORVs that make them eligible.

Objectives: Determine suitable river segments for inclusion in the NWSRS. Manage those suitable river segments to maintain their free-flowing nature, water quality, ORVs, and tentative classification, pending congressional action or for the duration of the RMP.

Decisions

- Determine the following river segments as suitable and recommended for congressional designation in the NWSRS, for the classifications identified: the Lower Kern (Recreational), Chimney Creek (Wild/Recreational), North Fork of the Kaweah (Scenic), and San Joaquin River Segment 1 (Wild/Scenic).

- Establish a corridor extending 0.25 mile from each edge suitable river segment, in which the following interim protective management guidelines would apply:

  - Approve no actions altering the free-flowing nature of the suitable segment through impoundments, diversions, channeling, or riprapping.

  - Approve no actions that would measurably diminish the stream segment's identified outstandingly remarkable value(s).

  - Approve no actions that would modify the setting or level of development of the suitable river segment to a degree that would change its identified classification.

Under Alternative B (proposed plan) (BLM 2012), the Bakersfield RMP recommends the following actions:

- Designate the Millerton Lake Cave System as a significant cave resource, in accordance with the Federal Cave Resources Protection Act based on its "important significant cave resources including geological formations, resources of known cultural importance, biotic resources, and the potential for resource-based recreation" (BLM 2012).

- Designate 6,490 acres as the SJRG SRMA, established with a "community" market strategy for local communities, nearby rural areas, and the population centers of Fresno-Clovis and Madera.

- Establish three RMZs within the SJRG SRMA, each with recreation objectives, management actions, and allowable use decisions:

- **Pa'san RMZ** – Targeted recreation activities in the RMZ would include hiking, mountain biking, and horseback riding. Recreation management objectives are to provide opportunities for visitors to engage in a remote isolated recreation experience. This RMZ is managed to provide opportunities for community residents and regional visitors who use the area seasonally to engage in sustainable, primarily primitive day-use opportunities and gain appreciation of the natural setting of the San Joaquin River corridor through self-discovery and exploration. Efforts to maintain, improve, and expand a network of recreation trails in this zone are recommended.

- **Tahoot RMZ** – Targeted recreation activities in the RMZ would include interpretation, environmental education, and camping. Recreation management objectives are to provide opportunities for community residents and visitors to engage in sustainable personal discovery, interpretive programs, and educational opportunities, while protecting critical resources. Management activities include the following:

  - "Maintain, improve, and expand a network of recreational facilities including trails, campgrounds, parking areas, visitor contact locations and outdoor classrooms; establishing standard and expanded amenity fees as appropriate."

  - "Ensure that management balances the preservation of natural and cultural resources with the opportunity to provide for public recreation, interpretation, and education about the natural and cultural heritage of the area."

  - "Provide nature-based educational opportunities locally and regionally to include outdoor classroom and interpretation of natural and cultural resources" (BLM 2012).

- **Wu Ki'oh RMZ** – Targeted recreation activities include fishing, water play, gold panning, and kayaking. Recreation management objectives are to provide opportunities for community residents and

regional visitors to engage in sustainable, primarily primitive day-use opportunities and gain appreciation of the natural setting of the San Joaquin River through self-discovery and exploration. Management recommendations include restricting recreational gold prospecting activities to gold panning and sluicing within 25 feet of the current water level of the river, as well as prohibiting dry washing and disturbance to the river bank vegetation.

Bald and Golden Eagle Protection Act

USFWS has proposed new permit regulations to authorize the take of bald and golden eagles under the Bald and Golden Eagle Protection Act, generally when the take to be authorized is associated with otherwise lawful activities (72 *Federal Register* 31141–31155, June 5, 2007). With delisting of the bald eagle in 2007, the Bald and Golden Eagle Protection Act is the primary law that protects bald eagles and golden eagles. As discussed in Chapter 7, "Biological Resources – Wildlife," each of the action alternatives would have a significant and unavoidable impact on bald eagle and golden eagle. Therefore, Reclamation would consult with USFWS to implement the reasonable and prudent alternative and conservation measures to reduce impacts on bald eagle and golden eagle.

Business Plan for the San Joaquin River Gorge Special Recreation Management Area

The *Business Plan for the San Joaquin River Gorge Special Recreation Management Area* (BLM 2010a) provides information on recreation use levels and expected changes, as well as future management direction for the area. BLM expects interpretation and education program demand to increase up to 12,500 students and also expects recreation use to dramatically increase with completion of the San Joaquin River Trail corridor.

According to the management plan, existing interpretation and education facilities will be retained except for the residential structure next to the RV site east of the visitor center, which will be removed and replaced with a new storage building. Current management will be continued to preserve a variety of recreation opportunities, and the Madera County portion of the SJRG SRMA will continue to be managed as a primitive nonmotorized area.

BLM will continue pursuing land acquisition efforts to complete the San Joaquin River Trail corridor and provide public trail access to the Patterson Bend lands. BLM will coordinate with the Millerton Lake SRA to construct and maintain trail connections and may construct a loop trail opportunity for the Wuh-ki'o Trail. BLM has already completed improved trail access near Kerckhoff No. 2 Powerhouse in the western portion of the SJRG SRMA for fishing and river access via a river access trail east and west of the locked gate by the powerhouse.

Clean Water Act

Section 401 Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States. The Federal government delegates water pollution control authority under Section 401 of the CWA to the states. Refer to the Porter-Cologne Water Quality Control Act discussion below.

Section 404 A Section 404(b)(1) alternatives information package would be prepared for the action alternatives and submitted to the USACE and the EPA. In addition, Reclamation would obtain a Section 404 permit before filling any waters of the United States. USACE would issue a record of decision that addresses pertinent consideration and implementation requirements. Section 404 also requires that the Least Environmentally Damaging Practicable Alternative be identified and implemented by an authorized Federal agency.

Executive Order 11988, Flood Hazard Policy

As discussed in Chapter 12, "Hydrology – Flood Management," all of the action alternatives would have an impact on floodplains in the primary study area. Implementing any of the action alternatives would also reduce flood flow events in the extended study area along the lower San Joaquin River. None of the action alternatives would increase flood flows, and feasible mitigation would be implemented to compensate for the impact of altered flow on riparian and wetland communities.

Executive Order 11990, Protection of Wetlands

As discussed in Chapter 6, "Biological Resources – Botanical and Wetlands," a wetland delineation has been prepared for the primary study area, and a USACE Section 404 permit would be obtained before construction begins. Reclamation would avoid

and minimize impacts to the extent feasible and compensate for any losses. Implementing any of the action alternatives would result in significant and unavoidable impacts on wetlands.

Executive Order 12898, Environmental Justice Policy

As discussed in Chapter 10, “Environmental Justice,” EO 12898 requires that Federal agencies identify and address, when appropriate, “disproportionately high and adverse health or environmental impacts of its projects, policies, and activities on minority populations and low-income populations.…” The EO also established an Interagency Working Group that would establish guidelines on criteria for identifying environmental justice populations and strategies to deal with environmental justice issues.

Reclamation would comply with EO 12898 because implementing any of the action alternatives would affect the entire population of the primary study area equally regardless of race, ethnicity, or income level. Implementing any of the action alternatives would increase employment and income opportunities from construction-, operation-, and recreation-related activities and would likely benefit minority and low-income populations in the primary study area and adjacent areas. Minority and low-income populations residing in regions of the extended study area that receive CVP and SWP water supplies would also benefit from increased water supply reliability, which would be achieved with implementation of any of the action alternatives.

Executive Order 13007, Indian Sacred Sites and Memorandum of April 29, 1994, Executive Memorandum

As discussed in Chapter 9, “Cultural Resources,” EO 13007 defines a sacred site as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.

Executive Order 13007 pertains only to Federally recognized tribes and Federally managed lands. For groups that are not formally recognized, sacred areas may be listed in the Sacred Lands files of the California Native American Heritage Commission. This commission has reviewed its files and identified sacred lands within the study area. Their locations

are confidential. Tribal consultation for the Investigation is ongoing.

Executive Order 13112, National Invasive Species Management Plan

A weed management plan, which would be prepared as part of the Investigation, would identify methods for managing the spread of invasive plant species. Because the details of the weed management plan were not finalized at the time of this writing, this Draft EIS identifies preparation and implementation of a weed management plan as a mitigation measure. Developing and implementing the weed management plan as a mitigation measure demonstrates compliance with EO 13112. Reclamation would demonstrate continued compliance with this EO by implementing the methods described in the weed management plan.

Farmland Protection Policy Act

As a Federal agency preparing environmental compliance documents, Reclamation has included in its analysis a farmland assessment designed to minimize adverse impacts on Prime and Unique Farmlands and provide for mitigation as appropriate. Chapter 17, “Land Use Planning and Agricultural Resources,” evaluates potential impacts of the action alternatives on Important Farmland.

Federal Clean Air Act

As discussed in Chapter 4, “Air Quality and Greenhouse Gas Emissions,” implementing the Investigation would not result in long-term impacts on air quality. Because the impacts of the action alternatives on air quality have been evaluated and short-term impacts have been mitigated to the extent possible, implementing any of the action alternatives would comply with the Federal Clean Air Act. For specific projects, Federal agencies must coordinate with the appropriate air quality management district and EPA. This coordination determines whether the project conforms to the CAA and the state implementation plan. The primary study area, and much of the extended study area, is located within the SJVAB. SJVAPCD implements programs and regulations required by the CAA.

Federal Endangered Species Act

Reclamation has coordinated with the USFWS and NMFS regarding potential project impacts on federally listed species. The potential impacts of the Investigation on endangered and threatened species are described in Chapter 5, “Biological Resources – Fisheries and Aquatic Ecosystems;” Chapter 6,

"Biological Resources – Botanical and Wetlands;" and Chapter 7, "Biological Resources – Wildlife." Reclamation would prepare the appropriate biological assessments to address potential impacts on federally listed species and would consult with USFWS and NMFS regarding impacts of the project.

Section 9 of the ESA prohibits the take of Federally listed species. "Take" is defined under the ESA, in part, as killing, harming, or harassing. Under Federal regulations, take is further defined to include habitat modification or degradation where it actually results in death or injury to wildlife by significantly impairing essential behavioral patterns – breeding, feeding, or sheltering.

Section 7 of the ESA outlines procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitat. Section 7(a)(2) requires Federal agencies to consult with USFWS to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species. NMFS also ensures that projects will not adversely affect essential fish habitat, as defined in the 1996 Sustainable Fisheries Act (Public Law 104-297). The goal is to stop or reverse the continued loss of fish habitats by protecting, conserving, and enhancing habitat.

Federal Energy Regulatory Commission

Changes to hydroelectric facilities on the San Joaquin River, including instream flow releases and modifications to licensed structures, would necessitate a license amendment from the FERC. Reclamation would support PG&E in any application to the FERC for necessary license amendments before implementing any of the action alternatives.

Federal Land Policy and Management Act

As discussed in Chapter 1, "Introduction," BLM is a cooperating agency during preparation of this Draft EIS. As described in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences," the Federal Land Policy Management Act directs BLM to manage public lands under the principles of multiple use and sustained yield. Under the Federal Land Policy and Management Act, the use and occupancy of public lands requires authorization by a land management agency, typically under the auspices of a special-use permit. As the principal land management agency for the San Joaquin River Gorge Special Recreation Management Area, BLM may need to use the final EIS to

support issuance of authorizations to various parties under the Federal Land Policy and Management Act.

Federal Transit Administration

This Draft EIS evaluates potential groundborne-vibration impacts on sensitive receptors, including maximum acceptable vibration standard of 80 VdB. The analysis in this Draft EIS applied the human disturbance threshold of 0.1 inch/second PPV, which is more stringent than the FTA's maximum acceptable vibration standard of 80 VdB. Some construction activities associated with the action alternatives could result in groundborne vibrations exceeding 0.1 inch/second PPV. However, sensitive receptors would need to be within 130 feet of the activities to be affected, and no sensitive receptors would be within this distance. Reclamation has demonstrated consistency with this policy by evaluating the construction activities that would generate the maximum possible groundborne vibration at the highest sensitive uses.

Federal Water Project Recreation Act

Compliance with the Federal Water Project Recreation Act is achieved by documenting the consideration of recreation opportunities in USACE reports and NEPA documents. The act requires that Federal agencies with authority to approve water projects include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project. Within this Draft EIS, Reclamation has taken into consideration and addressed outdoor recreation and fish and wildlife enhancement in the primary and extended study areas.

Fish and Wildlife Coordination Act

Compliance with the FWCA involves assessing the impacts of the action alternatives on preservation, conservation, and enhancement of fish and wildlife habitat and preparing a FWCA report. Reclamation would be required to include recommendations for preserving affected habitats, mitigating their loss, and enhancing such habitats in its documentation of compliance. Documentation of compliance with the FWCA is a separate analysis of habitats of concern to USFWS, NMFS, and the CDFW, and does not replace the analysis required by Section 7 of the Federal Endangered Species Act. Reclamation would consider and incorporate the recommended measures where feasible.

The Fish and Wildlife Coordination Act Report for the Investigation will be included as an appendix to the Final EIS.

Indian Trust Assets

When adverse impacts on ITAs cannot be avoided, appropriate mitigation or compensation would be provided. ITAs consist of lands that have been deeded to tribes or on which tribes have a historical legal claim. However, no such lands are located within the primary study area. Thus, the Investigation would have no impact on ITAs. Because ITAs have been evaluated and the Investigation would have no impact on these resources, the Investigation would not conflict with any ITAs.

Lease of Power Privilege

A lease of power privilege (LOPP) is a contractual right given to a non-Federal entity to use a Reclamation facility for electric power generation consistent with Reclamation project purposes. A LOPP project must not impair the efficiency of Reclamation-generated power or water deliveries, jeopardize public safety, or negatively affect any other Reclamation project purposes. A LOPP is used when Reclamation has authority to develop power on any or all features of a Federal project.

The development of non-Federal hydroelectric powerplants on existing Reclamation facilities (e.g., dams or conduits) requires either a LOPP issued by Reclamation or a license issued by the FERC. Permitting authority is mutually exclusive; each Reclamation facility is either within Reclamation's or FERC's permitting jurisdiction. Accordingly, development proceeds through either a LOPP or FERC license – but not both.

Magnuson-Stevens Fishery Conservation and Management Act

Chapter 5, “Biological Resources – Fisheries and Aquatic Ecosystems,” discusses impacts on fisheries and fisheries habitat. Reclamation would coordinate with NMFS to ensure that recommended measures are incorporated into the selected alternative plan to minimize adverse modifications to Essential Fish Habitat.

Migratory Bird Treaty Act

Chapter 7, “Biological Resources – Wildlife,” evaluates potential impacts on migratory bird species and identifies mitigation measures to reduce impacts on birds, nests, and eggs. In addition, Reclamation would implement all feasible measures included in the FWCA report discussed above.

Reclamation would comply with the Migratory Bird Treaty Act by implementing mitigation measures described in this Draft EIS and in the pending FWCA report before and during implementation of any of the action alternatives.

National Historic Preservation Act

Under Section 106 of the National Historic Preservation Act, Federal agencies must consider impacts on eligible resources ("historic properties") from the proposed undertaking in consultation with the California SHPO and other parties. This includes affording the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. For this project, consultation between Reclamation, BLM, any other applicable Federal agencies, SHPO, and other consulting parties would include consideration of possible options for avoiding, minimizing, or mitigating adverse impacts.

Currently, there is no undertaking authorized by Congress involving the construction of Temperance Flat RM 274 Dam and Reservoir. Federal agencies may conduct nondestructive planning activities without completing Section 106, provided that the actions do not prohibit subsequent consideration of alternatives to avoid, minimize, or mitigate the undertaking's adverse effects on historic properties. This environmental document is in support of a feasibility study. Should the undertaking be authorized, Section 106 would be initiated early in that planning process (36 CFR Section 800. 1(c)).

Under Section 106, these efforts would include the following:

- A complete pedestrian survey and inventory of cultural resources within the APE of the selected alternative
- Ethnographic and ethnohistoric investigations to obtain greater detail regarding areas of importance to Native American tribes and groups
- Evaluations to determine whether cultural resources identified within the APE are eligible for inclusion in the NRHP
- Assessment of potential adverse effects to historic properties and consultation to resolve any identified adverse effects

Cultural resources are evaluated for inclusion in the NRHP based on criteria found at 36 CFR Part 60. Once a resource has been evaluated, the lead Federal agency determines eligibility in consultation with the SHPO and other consulting parties, as applicable. In this process, previous determinations of eligibility may need to be reevaluated because of the passage of time or other factors, and it is important to acknowledge the special expertise of Indian tribes when assessing the eligibility of properties to which they attach ceremonial and cultural significance. It would be possible to evaluate some cultural resources with survey-level data. However, test excavations may be necessary to accurately evaluate many archaeological resources to determine if they are, in fact, historic properties.

The lead Federal agency is required to consider the effects of any potential project on historic properties within the primary study area. The criteria for assessing adverse effects are found in 36 CFR Part 800.5(a)(1), which states that "an adverse effect is found when an undertaking may alter, directly or indirectly, any characteristic of a historic property that qualify the property for inclusion in the National Register…" Examples of adverse effects include physical destruction, alteration, a change in the property's setting, or the introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features (36 CFR Part 800.5(a)(2)).

If SHPO, Reclamation, USFS, other applicable Federal agencies, and the Council (if participating) agree to measures to resolve adverse effects to historic properties, these are formalized in an MOA. Other consulting parties may be invited to sign the MOA. The Section 106 process (36 CFR Part 800.14) is completed once the terms of the MOA have been met. Alternatively, the Federal agencies may elect to enter into a programmatic agreement (PA) that would be developed as an alternative procedure to implement the Section 106 process (36 CFR Part 800.14). In rare cases, if consultation fails to result in agreement on resolving adverse effects, consultation may be terminated pursuant to the process detailed in 36 CFR Part 800.7.

Consultation then continues among Reclamation, SHPO, and other consulting parties on possible options for avoiding, minimizing, or mitigating the adverse effects. This includes notifying the Council when adverse effects are found and inviting the Council to participate. Archaeological data recovery excavation is the most frequent way to resolve or

mitigate adverse effects on historic properties determined eligible under Criterion D. Properties determined eligible under Criteria A through C typically require more varied actions to resolve adverse effects. If SHPO, Reclamation, and the Council (if participating) agree to measures to resolve adverse effects to historic properties, these are formalized in an MOA. Other consulting parties may be invited to sign the MOA. The Section 106 process is completed once the terms of the MOA have been met. In rare cases, if consultation fails to result in agreement on resolving adverse effects, consultation may be terminated pursuant to the process detailed in 36 CFR Part 800.7.

Wild and Scenic Rivers Act

As described in Appendix J of the BLM Bakersfield Proposed RMP, "Wild and Scenic Rivers Suitability Report (2010b)," the 5.4 miles of the San Joaquin River from the Kerckhoff Dam downstream to the Kerckhoff Powerhouse was determined to be eligible and suitable for designation as a Federal Wild and Scenic River based on its free-flowing character and outstandingly remarkable values. With this finding, this section of river must be managed in a manner that protects the outstandingly remarkable values that were identified by BLM.

State

California Clean Air Act

This Draft EIS evaluates the contribution of the action alternatives to any violation of air quality standards and identifies mitigation measures to help achieve consistency with the State implementation plan's attainment goal before implementation of the alternative plan selected.

California Department of Transportation

Caltrans recommends thresholds of 0.2 inch per second peak particle velocity for normal residential buildings and 0.08 inch per second peak particle velocity for old or historically significant structures (Caltrans 2002). These standards are more stringent than the Federal standard established by the Committee of Hearing, Bio Acoustics, and Bio Mechanics, presented above under in the Federal Transit Administration section.

Caltrans is responsible for planning, designing, construction, operating, and maintaining all State-owned roadways in California. The Caltrans Highway Design Manual establishes uniform policies and procedures to carry out Caltrans's

highway design functions. The highway design criteria and policies in the manual provide a guide for applying standards in the design of projects and, rather than implementing enforceable regulations, present information and guidance.

California Environmental Quality Act

As described previously, DWR is the CEQA Lead Agency for the Investigation; however, at the time of release of this Draft EIS, DWR was unable to provide CEQA review. This Draft EIS has been prepared in accordance with CEQA, and information contained in it may be used by DWR and/or other State lead, responsible, and trustee agencies that have regulatory jurisdiction or permit authority over certain aspects of the action alternatives. The appropriate use of this information will be defined by the CEQA Lead Agency.

California Endangered Species Act

Evaluations conducted for State-listed endangered and threatened species have determined that implementing the project would affect several State-listed species. Impacts on those species are discussed in Chapter 5, "Biological Resources – Fisheries and Aquatic Ecosystems;" Chapter 6, "Biological Resources – Botanical and Wetlands;" and Chapter 7, "Biological Resources – Wildlife." Reclamation would prepare appropriate biological assessments to address potential impacts on Federally listed species. The State lead agency, when identified, would consult with CDFW regarding impacts of the project on State-listed species.

California Fish and Game Code

Fully Protected Species This Draft EIS identifies potential actions that could result in take of fully protected species, and Reclamation would work closely with CDFW to evaluate methods to avoid impacts on fully protected species.

Section 1602, Streambed Alteration A CDFW streambed alteration agreement must be obtained for any project that would result in an alteration of a river, stream, or lake. This Draft EIS identifies potential actions of the project that would require the alteration of stream features, subject to Section 1602 of the California Fish and Game Code. This document requires Reclamation or its contractor to secure an approved streambed alteration agreement before performing any actions subject to Section 1602.

Section 5937 This Fish and Game Code requires that the owner of any dam shall allow sufficient water at all times to

pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam.

California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The Farmland Mapping and Monitoring Program (FMMP) was established by the State of California in 1982 to continue the Important Farmland mapping efforts begun in 1975 by the NRCS, under the U.S. Department of Agriculture. The intent of NRCS was to produce agricultural resource maps based on soil quality and land use across the nation. The DOC sponsors the FMMP and also is responsible for establishing agricultural easements, in accordance with PRC Sections 10250–10255.

As part of mapping efforts for nationwide agricultural land use, NRCS developed a series of definitions known as Land Inventory and Monitoring (LIM) criteria. The LIM criteria classify a land's suitability for agricultural production. Suitability includes both the physical and chemical characteristics of soils as well as the actual land use. Important Farmland maps are derived from the NRCS soil survey maps using the LIM criteria and are available by county. Important Farmland is classified by DOC as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. Together, Important Farmland and Grazing Land are defined by DOC as "Agricultural Land." These designations are defined as follows (DOC 2011):

- *Prime Farmland* is land that has the best combination of physical and chemical characteristics for crop production, as well as high soil quality, appropriate growing season, and adequate moisture supply to sustained high crop yields.

- *Farmland of Statewide Importance* is land other than Prime Farmland that has a good combination of physical and chemical characteristics for crop production. The definition is similar to that for Prime Farmland except that crop production characteristics are considered good, but not the best.

- *Unique Farmland* does not meet the definition of either Prime Farmland or Farmland of Statewide Importance, but it is being used for specific crops of high economic value. This farmland type has a special combination of

soil quality, location, growing season, and moisture supply needed to produce sustained high quality or high yields of specific crops.

- *Farmland of Local Importance* is land of importance to the local economy, as defined by each county's local advisory committee and adopted by its board of supervisors. Farmland of Local Importance either is currently producing or has the capability to produce, but does not meet the definition of Prime Farmland, Farmland of Statewide Importance, or Unique Farmland.

- *Grazing Land* is land with existing vegetation that is suitable for grazing.

Additional categories used in the FMMP mapping system are Urban and Built-Up Lands, which designates land that is used for residential, industrial, commercial, institutional, and public utility structures, and for other developed purposes, and Other Lands, which is defined as lands that do not meet the criteria of the remaining categories and generally include low-density rural developments, vegetative and riparian areas not suitable for livestock grazing, confined-animal agriculture facilities, strip mines, borrow pits, and vacant and nonagricultural land surrounded on all sides by urban development.

California Harbors and Navigation Code

Significant modifications to facilities on Millerton Lake might necessitate coordination with the California Department of Boating and Waterways. Reclamation would coordinate with the agency as necessary.

California General Plan Guidelines

California has developed land-use compatibility guidelines for community-noise environments. The State of California General Plan Guidelines, published by the Governor's Office of Planning and Research (OPR) (OPR 2003), provides guidance for the acceptability of projects within specific community-noise-equivalent Ldn contours. With regard to the Investigation, water recreational uses are considered acceptable in areas where exterior noise levels do not exceed 75 A-weighted decibels community noise equivalent level/Ldn. Water recreational uses are normally unacceptable in areas exceeding 70 A-weighted decibels Ldn and clearly unacceptable in excess of 80 A-weighted decibels Ldn (further description of the these ranges and the Ldn is provided in

Chapter 18, "Noise and Vibration"). The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards that reflect the particular community's noise-control goals, sensitivity to noise, and assessment of the relative importance of noise issues.

California Land Conservation Act of 1965 (Williamson Act)

In 2011, Fresno County exceeded 1 million acres in Williamson Act contracts (DOC 2013). Williamson Act lands affected by the action alternatives are discussed in Chapter 17, "Land Use Planning and Agricultural Resources." Reclamation would need to terminate any existing Williamson Act contracts for privately owned lands that may be acquired for project purposes.

California Native Plant Protection Act

All action alternatives are evaluated in this Draft EIS for consistency with the California Native Plant Protection Act. Mitigation measures are provided, as necessary, to minimize potential take of listed and special-status plants under this act.

California State Lands Commission

The CSLC has the authority and responsibility to manage and protect the important natural and cultural resources on certain public lands in the state and the public's rights to access these lands. Two distinct types of public lands are under the commission's jurisdiction: sovereign lands and school lands. Sovereign lands encompass approximately 4 million acres. These lands include the beds of California's naturally navigable rivers, lakes, and streams, and the state's tidal and submerged lands along the coastline, extending from the shoreline out to 3 miles offshore. Construction on public lands requires review and by the CSLC and may require a land use lease. The CSLC has no authority over navigable waterways in the primary study area. The CSLC does have jurisdiction along the San Joaquin River downstream from the existing Friant Dam. No construction activities outside of the primary study area are proposed under the action alternatives.

California Surface Mining and Reclamation Act

SMARA requires that a reclamation plan be prepared and that an approved financial assurance be posted for the reclamation of the mined land. Because Temperance Flat RM 274 Dam and Reservoir would require borrow material for construction from sites not previously permitted, Reclamation must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic

yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through permitting ordinances developed by local government "lead agencies" that provide the regulatory setting under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

The Office of Mine Reclamation (under the DOC) provides assistance to cities, counties, state agencies and mine operators for reclamation planning, and strives to reclaim mined lands to a beneficial end-use through implementing SMARA. If borrow material is required from sites not previously permitted under SMARA, Reclamation would obtain either a SMARA permit or an exemption from SMARA for all borrow sites before beginning project construction.

California Water Commission

In November 2009, California enacted a comprehensive water package to improve the state's water supply reliability and restore the Sacramento- San Joaquin River Delta ecosystem. The package included California Proposition 43 (Assembly Bill 1422) which, if approved by voters in 2014, will direct the California Water Commission to develop tools and methods for the quantification of public benefits of water storage projects including CALFED surface storage, groundwater storage, conjunctive use and reservoir reoperation, and local and regional storage.

Central Valley Flood Control Act of 2008

Reclamation has developed the action alternatives in a manner consistent with the Central Valley Flood Control Act, and none of the action alternatives would inhibit development and implementation of the CVFPP.

Delta Stewardship Council

In November 2009 the Sacramento-San Joaquin Delta Reform Act was passed by the California Legislature and signed by Governor Schwarzenegger. It established state policy of coequal goals for the Delta and created the Delta Stewardship Council as a new, independent state agency that will delineate exactly how to meet these goals through development and implementation of the Delta Plan.

The Delta Stewardship Council's principal task is to develop and implement the Delta Plan, a legally enforceable document

that will include all the actions necessary to ensure the state's coequal goals for the Delta are met (Delta Stewardship Council 2010).

Millerton Lake Final Resource Management Plan

The Millerton Lake SRA is managed by State Parks through an agreement with Reclamation, the owner of most of the land in this area. Reclamation and State Parks developed a joint RMP and general plan (Reclamation and State Parks 2010) that offers guidance on how to manage the area as a whole. The purpose of the joint plan is to guide the use, development, and management of the lake and surrounding lands. The plan did not include any goals or objectives related to visual resources. Under the discussion of management actions, the plan states, "It is anticipated that any new facilities would be designed in such a way as to not diminish any visual resources in the park."

Porter-Cologne Water Quality Control Act

Action alternatives with the potential to adversely affect water quality are identified in this Draft EIS. Measures necessary for compliance with the Porter-Cologne Water Quality Control Act would need to be consistent with implementation programs under the water quality control plan for the San Joaquin River basin and with the Central Valley Water Board's waste discharge requirements. Other necessary actions likely would include application for and finalization of NPDES permits and Section 401 water quality certification.

Water Rights

Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations," describes the diversion rates and quantities and places and purposes of use of Reclamation's permitted water rights applications at Friant Dam.

By letter dated August 7, 2014, State Water Board staff informed Reclamation that Reclamation would have to seek revision of the Fully Appropriated Streams Declaration (State Water Board Order 89-25, Exhibit A) pursuant to Title 23 of the CCR, Section 871, along with submittal of a proposed application for a new water right (see: CWC Section 1202, et seq. and Title 23 of the CCR, Section 650 et seq.) for operation of a proposed project. The proposed application could not be accepted or processed until the State Water Board adopts an order changing the Declaration. This Draft EIS, including the associated modeling results, provides the complete environmental review and demonstration of requisite findings

under the CWC in order for the State Water Board to approve the water right application described above.

Regional and Local

Fresno County General Plan Policy Document, Traffic and Circulation Element

The following goal and policies from the Traffic and Circulation Element of the Fresno County General Plan Policy Document (Fresno County 2000) are relevant to the alternatives.

Goal TR-A: To plan and provide a unified, coordinated, and cost-efficient countywide street and highway system that ensures the safe, orderly, and efficient movement of people and goods.

- **Policy TR-A.1** – The County shall plan and construct County-maintained streets and roads according to the County's Roadway Design Standards. Roadway design standards for County-maintained roads shall be based on the AASHTO standards, and supplemented by Caltrans design standards and by County Public Works Department Standards.

- **Policy TR-A.2** – The County shall plan and design its roadway system in a manner that strives to meet LOS D on urban roadways within the spheres of influence of the cities of Fresno and Clovis and LOS C on all other roadways in the county.

  The County may, in programming capacity-increasing projects, allow exceptions to the level of service standards in this policy where it finds that the improvements or other measures required to achieve the LOS policy are unacceptable based on established criteria.

  In no case should the County plan for worse than LOS D on rural County roadways, worse than LOS E on urban roadways within the spheres of influence of the cities of Fresno and Clovis, or in cooperation with Caltrans and the Council of Fresno County Governments, plan for worse than LOS E on State highways in the county.

- **Policy TR-A.7** – The County shall assess fees on new development sufficient to cover the fair share portion of that development's impacts on the local and regional transportation system.

- **Policy TR-A.12** – The County, where appropriate, shall coordinate the multi-modal use of streets and highways to ensure their maximum efficiency and connectivity and shall consider the need for transit, bikeway, and recreational trail facilities when establishing the Ultimate Right-of-way Plan and Precise Plans of streets and highways.

- **Policy TR-A.13** – The County shall develop and maintain a program to construct bikeways and recreation trails in conjunction with roadway projects in accordance with the adopted Regional Bikeways Plan, the adopted Recreation Trails Plan, available dedicated funding for construction and maintenance, and a needs priority system.

Madera County General Plan Policy Document, Traffic and Circulation

The following goals and policies from the Traffic and Circulation Element of the Madera County General Plan Policy Document (Madera County 1995) are relevant to the alternatives.

Goal 2.A: To provide for the long-range planning and development of the county's roadway system, ensure the safe and efficient movement of people and goods, and provide sufficient access to existing and new development.

- **Policy 2.A.2** – Existing and new street roads shall be dedicated, widened, and constructed according to the roadway design and access standards generally defined in Part I of this *Policy Document*.

- **Policy 2.A.8** – The County shall develop and manage its roadway system to maintain a minimum Level of Service D on all State and County Roadways. For planning applications, level of service shall be measured for roadway segments and shall be based on the capacities shown in Table 2.A.8 (Table 28-2 in this Draft EIS). The facility classification in this table shall correspond to Table I-3 and Figure I-1, [in] the *Circulation Plan Diagram*. The County may also

require analysis of specific intersections when intersections are deemed to be critical for specific projects or locations; in those cases, level of service shall be computed according to the planning methodology as documented in *Circular 212, Interim Materials on Highway Capacity*, published by the Transportation Research Board In January 1980.

Table 28-2. Capacities per Hour per Lane for Various Highway Facilities

LOS	Freeways	Two-Lane Rural Highway	Multilane Rural Highway	Expressway	Arterial	Collector
A	700	120	470	720	450	300
B	1,100	240	945	840	525	350
C	1,550	395	1,285	960	600	400
D	1,850	675	1,585	1,080	675	450
E	2,000	1,145	1,800	1,200	750	500

Source: Madera County 1995
Key:
LOS = level of service

Goal 2.D: To provide a safe, comprehensive, and integrated system of facilities for non-motorized transportation to meet the needs of commuters and recreational users.

San Joaquin River Parkway Master Plan

The San Joaquin River Parkway Master Plan (SJRC 2000) is a conceptual, long-range planning document intended to help preserve, enhance, and provide for enjoyment of the natural landscape of the San Joaquin River corridor. As proposed in 1992, the parkway would include the San Joaquin River and approximately 5,900 acres of land on both sides of the river between Friant Dam and the SR 99 crossing, as well as the existing 17-acre Skaggs Bridge Park at the SR 145 crossing. Approximately 1,900 acres of the parkway would be located in Madera County and 4,000 acres in Fresno County.

Portions of the proposed parkway site are managed for recreational or natural resource protection, conservation, and education purposes, although other parts are privately owned and used for other purposes. Approximately 4,650 of the 5,900 acres in the proposed parkway site are private land. Specific goals, objectives, and policies are included in the Natural Resource Element and Recreational Element that promote preservation, restoration, and enhancement of visual resources

through the preservation and enhancement of natural areas and the sensitive design of recreational areas and trails.

San Joaquin Valley Air Pollution Control District Authority to Construct and Permit to Operate

Reclamation would obtain an Authority to Construct permit before building or installing any new emissions unit or modifying any existing emissions unit that requires a permit, if necessary. Reclamation also would obtain a Permit to Operate for emissions from new sources, if needed.

Growth-Inducing Impacts

The purpose of this section is to disclose how any of the action alternatives analyzed in this Draft EIS, if implemented, could induce growth directly or indirectly by removing an obstacle to future growth.

NEPA and CEQA Requirements

The CEQ Regulations require that an EIS analyze direct and indirect impacts of growth-inducing impacts. Direct growth-inducing impacts generally stem from the construction of new housing, businesses, or infrastructure. Indirect impacts are reasonably foreseeable impacts that may occur beyond the immediate timeframe of a proposed action or outside of the immediate vicinity of the action area. These impacts "may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate" (40 CFR 1508.8[b]).

Section 15126.2(d) of the State CEQA Guidelines states that an EIR should discuss:

> *…the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth…. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.*

Induced growth is considered a significant impact only if it directly (or indirectly) affects the ability of agencies to provide needed public services, or if it can be demonstrated that the

potential growth significantly affects the environment. The goal of this Draft EIS in this regard, therefore, is one of disclosure.

In *Napa Citizens for Honest Government v. Napa County Board of Supervisors* (2001) 91 Cal.App.4th 342, 367–371 (110 Cal.Rptr.2d 579), the California Court of Appeal, Fourth District, provided clear direction on the standards for disclosure of growth-inducing impacts in an EIR. This direction is also relevant regarding an EIS. Growth-inducing impacts are evaluated for the project alternatives in accordance with the California Court of Appeal finding in *Napa Citizens for Honest Government v. Napa County Board of Supervisors* (2001):

> *Neither CEQA itself, nor the cases that have interpreted it, require an EIR to anticipate and mitigate the effects of a particular project on growth on other areas. In circumstances such as these, it is sufficient that the final EIR (FEIR) warns interested persons and governing bodies of the probability that additional housing will be needed so that they can take steps to prepare for or address that probability. The FEIR need not forecast the impact that the housing will have on as yet unidentified areas and propose measures to mitigate that impact. That process is best reserved until such time as a particular housing project is proposed.*

Potential Growth Inducing Mechanisms

The following sections describe mechanisms that could be potentially growth inducing and analyze the potentially growth-inducing impacts of the action alternatives. The intent of the discussion is to describe the extent to which implementing an alternative plan—specifically, constructing and operating a water storage facility at RM 274 and related facilities, improving water supply reliability, enhancing water temperature and flow conditions, and reducing flood risk—could increase growth.

Facility Construction and Operation

The analysis of construction-related impacts involves determining whether the relative magnitude of temporary and permanent jobs that would be created by implementing the project would be large enough to require additional housing or

would otherwise spur economic growth in the area surrounding the primary study area.

Although project construction would be confined to the primary study area, it is the immediate area surrounding the primary study area that would potentially experience growth-inducing impacts from construction of the project—in particular, the nearby cities of Clovis and Fresno in Fresno County and the City of Madera in Madera County. These areas would likely contribute goods and services to the construction activities.

Depending on the alternative plan implemented, construction would create up to 1,656 direct, indirect, and induced jobs during the 8 years of planned construction. These new jobs are expected to have a temporary benefit by creating employment opportunities for many unemployed workers and would represent a relatively small increase (less than 2 percent) of the total labor force for Madera and Fresno counties. As discussed in Chapter 23, “Socioeconomics, Population, and Housing,” the unemployment and housing vacancies in these two counties are higher than the state average.

Given the availability of existing labor within the total labor force of Fresno and Madera counties, an adequate number of workers would be found within the local area. Therefore, jobs created by implementing any of the action alternatives would be filled largely by the local workforce. Given the availability of housing in the vicinity of Madera, Fresno, and Clovis, even if a portion of workers were to relocate from outside the local area, these workers would be readily accommodated by existing housing; therefore, the influx of these workers during project construction would not induce new housing development. (For more detail, see Chapter 23, “Socioeconomics, Population, and Housing.”)

Implementing any of the action alternatives would result in permanent increases in employment within the region as a result of operations and maintenance of the new dam, intake structure, powerhouse, valve house, and permanent access roads. Operations and maintenance would generate an estimated 38 new permanent direct, indirect and induced jobs, which represents a relatively small increase (less than 1 percent) in the total labor force in Fresno and Madera counties. It is expected that most of these new jobs would be filled from within the two counties and would therefore not induce additional growth in the area. Assuming that some or all of the

jobs were specialized and would require workers from outside of the local labor pool, given the availability of housing in the area, these workers would be readily accommodated by existing housing; therefore, the influx of these workers following project construction would not induce substantial new housing development. (For more detail, see Chapter 23, "Socioeconomics, Population, and Housing.")

A substantial increase in recreational use of Millerton Lake and the new Temperance Flat RM 274 Reservoir would occur as a result of stabilizing water storage volume in Millerton Lake and creating Temperance Flat RM 274 Reservoir. This increased recreational use is expected to generate 33–37 additional direct and indirect jobs. Employees needed to fill these long-term jobs are expected to be from the local communities, including the larger metropolitan areas of Fresno, Clovis, and Madera. No new housing is needed for these employees because these new jobs would be filled from residents within the two counties. Implementing any of the action alternatives would not induce additional growth in the area.

Increased Water Supply Reliability

As described in Chapter 1, "Introduction," the action alternatives respond to needs including water supply reliability and operational flexibility. Increasing water supply reliability for CVP contractors and SWP SOD M&I contractors within the extended study area has the potential to induce growth.

The action alternatives vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and minimum carryover storage targets) and intake feature configurations (low level or selective level). Chapter 2, "Alternatives," shows the average annual change in water deliveries for each alternative plan when compared to the No Action Alternative.

The improved water supply would benefit existing CVP and SWP water user by increasing the reliability of water supplies. The amount of additional water developed under the action alternatives, and delivered across the various water supply beneficiaries, would not be of a large enough quantity to any one area to induce growth, and the total water delivered would remain within the historical ranges.

Induced Agricultural Growth Changes in the reliability of water deliveries could affect agricultural production within the

Friant Division of the CVP, CVP SOD, and SWP SOD M&I water service areas. As described in Chapter 2, "Alternatives," implementing any of the action alternatives would improve water supply reliability for Friant Division contractors; implementing either of Alternative Plans 2-5 would improve water supply reliability for CVP SOD contractors. To the extent that the lack of sufficient, reliable water supplies poses a constraint to agricultural production, the increased amount of reliable supplies has the potential to support increased agricultural production.

As discussed in Chapter 23, "Socioeconomics, Population, and Housing," improving water supply reliability would result in less frequent idling of crops and increased agricultural production on existing agricultural lands. The additional direct, indirect, and induced agriculture-related income and spending would represent new local economic activity and provide employment opportunities to unemployed workers for the six counties within the Friant Division of the CVP (i.e., Fresno, Kern, Kings, Madera, Merced, and Tulare counties), as well as the four additional counties (Santa Clara, San Benito, San Joaquin, and Stanislaus) that serve the agriculture contractors outside of the Friant Division service area.

Under the action alternatives, new agricultural workers would be needed to support additional crop production in the Friant Division of the CVP and within the CVP SOD service area. The increase in agricultural production would enable existing employees to work for a longer period while also increasing the total number of workers needed during the growing season. Additionally, new indirect and induced job would be generated in the Friant Division of the CVP and CVP SOD service area through purchases from businesses that support the agriculture industry. The new direct, indirect, and induced agricultural related income and spending would represent new local economic activity and provide employment opportunities to many unemployed workers in the supporting counties.

The new direct, indirect and induced jobs in the Friant Division of the CVP would represent a relatively small increase in the total labor force in the six-county region (approximately 1,135,500 workers in 2010), but the employment opportunities created by implementing any of the action alternatives would represent a substantial contribution in counties that have high unemployment rates. Within the six-county area, the 2010 unemployment rates exceeded 16 percent (Table 23-16) and unemployment rates in the state exceeded 12 percent (Table

23-16). These new jobs would be expected to provide permanent employment opportunities to many unemployed workers.

Implementing any of the action alternatives is not anticipated to result in permanent increases in population and housing demand as a result of agriculture-related employment, because workers serving the project are expected to come from within the local or nearby communities. Neither substantial population growth nor an increase in housing demand in the region would be anticipated with creation of these jobs. Even if some of workers were to come from outside of this area, sufficient housing capacity (e.g., rental housing and apartment vacancies) exists in the six-county area to house these workers. Vacancy rates in the six-county region were generally higher than the state average (5.9 percent), ranging from 6.0 percent in Kings County up to 10.5 percent in Kern County (Table 23-13). Furthermore, if some nonlocal agricultural workers were employed, the seasonal nature of the work supports the conclusion that these workers would not typically change residences. Therefore, substantial impacts on population and housing in the six-county region would not be expected.

The expected long-term average annual increase in agricultural deliveries under the action alternatives is relatively small (Table 2-10). The increase would likely substitute for ongoing groundwater pumping and would be distributed across the service areas. Water provided to agriculture would likely be used primarily, if not exclusively, to return idle cropland to production. Although the new workers associated with implementing any of the action alternatives would be expected to come from nearby communities and cities within the serving counties, neither substantial population growth nor an increase in housing demand in the region would be anticipated with creation of these jobs. Therefore, none of the five action alternatives would have a growth-inducing impact attributable to improved water supply reliability for agricultural uses.

Induced M&I Growth To the extent residential development is constrained by water supply, the increased water supply reliability has the potential to remove an obstacle to future residential development. Additional M&I water supply developed under the action alternatives would be distributed across the M&I beneficiaries.

A direct or an indirect connection between changes in the availability of new water for M&I uses resulting from

implementation of any of the action alternatives and changes in growth patterns in particular jurisdictions is speculative. Although the allocations of any additional water made available by implementing the action alternatives to M&I contractors can be known, several of the M&I contractors are water wholesalers who make independent decisions about which local jurisdictions or water purveyors in their service areas would receive additional water. Furthermore, these wholesalers may make allocations that vary over time depending on available supplies and shifting demands among retailers.

Increased reliability of water for M&I is not expected to be sufficient for any one jurisdiction to reduce or eliminate an obstacle to growth. Therefore, implementing any of action alternatives would not result in growth-inducing impacts.

Enhancement of Water Temperature and Flow Conditions

The ability of action alternatives to enhance water temperature and flow conditions on the San Joaquin River downstream from Friant Dam would benefit salmon and other fish. Enhancement of water temperature and flow conditions would not have a direct or an indirect impact on future growth or housing development and, therefore, would not induce additional growth in the area.

Flood Risk Reduction

Implementing any of the action alternatives would be anticipated to provide flood risk reduction benefits to the San Joaquin River basin, but these benefits would not be growth inducing. Incidental flood storage was evaluated as the total storage between Millerton Lake and the Temperance Flat RM 274 Reservoir. The increase of incidental flood storage space by constructing a dam in upstream portion of Millerton Lake at RM 274 would provide Reclamation with greater flexibility with which to implement flood management actions, thereby increasing the storage threshold and reducing the frequency that seasonal heavy-rain events produce flood conditions downstream from Friant Dam.

The benefits of this increase in incidental flood storage and related flood management options would be most evident along the San Joaquin River downstream from Friant Dam where structures in and inhabitants in the floodplain experience the highest risk of impacts from reservoir releases during flood events. The increased flood protection would not change the existing land use or Federal Emergency Management Agency

flood zone designations within the floodplain; therefore, no large-scale or substantial development would be expected to occur. None of the action alternatives involve removing or even reducing obstacles to development; therefore, none would be anticipated to have any indirect impact on growth. (For more detail, see Chapter 14, "Hydrology – Surface Water Supplies and Facilities Operations.")

Identification of the Environmentally Preferred and Environmentally Superior Alternative

CEQ regulations require identification of an environmentally preferable alternative, and the State CEQA Guidelines require identification of an environmentally superior alternative. However, the CEQ guidelines and State CEQA Guidelines do not require adoption of the environmentally preferable/superior alternative as the preferred alternative for implementation. The Final EIS will identify a preferred alternative. The selection of the preferred alternative is independent of the identification of the environmentally preferable/superior alternative, although the identification of both will be based on the information presented in this Draft EIS.

Section 1505.2(b) of the CEQ regulations requires the NEPA lead agency to identify the environmentally preferable alternative in a ROD. The CEQ regulations define the environmentally preferable alternative as

> *…the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.*

Similar to NEPA's requirement that an environmentally preferable alternative be identified, Sections 15120 and 15126.6(e)(2) of the State CEQA Guidelines require that an environmentally superior alternative be identified. If the environmentally superior alternative is the "no project" alternative, Section 15126.6(e)(2) requires identification of an

environmentally superior alternative among the action alternatives.

Construction-related impacts would be similar for all of the action alternatives, and the significance determinations for each of the action alternatives generally are the same. Varying magnitudes of impacts generally would be related to the routing and beneficiaries of new water supplies, and enhancements to water temperature and flow conditions in the San Joaquin River downstream from Friant Dam. All of the action alternatives would provide additional opportunities for flood risk reduction, recreation, greater system operational flexibility and long-term average water supply reliability, which would benefit the Friant Division of the CVP, other CVP SOD contractors, and SWP SOD M&I contractors.

Implementing the No Action Alternative would result in one significant and unavoidable impact, whereas the action alternatives would result in several significant and unavoidable impacts. The No Action Alternative would continue to have an impact on agricultural economic activity, jobs, personal spending, and tax revenues in the CVP and SWP service areas. However, the No Action Alternative would not be capable of meeting any of the planning objectives and would not provide several benefits that would be obtained by implementing any of the action alternatives. Therefore, although selecting the No Action Alternative would avoid certain significant and unavoidable impacts of the action alternatives, the No Action Alternative is not considered the environmentally superior alternative because it fails to meet any of the planning objectives defined for the Investigation or provide several benefits associated with the action alternatives.

Because the action alternatives do not have different physical features, would not operate in a substantially different manner, and would not have substantially different environmental impacts, the action alternatives are all considered equally environmentally superior.

This Draft EIS provides a substantive portion of the environmental information necessary for Reclamation to determine the environmentally preferable alternative. However, the public and other agencies reviewing a draft EIS can assist the lead agency in developing and determining environmentally preferable alternatives by providing their views in comments on the draft EIS. Accordingly, and consistent with NEPA requirements, the environmentally

preferable alternative will be identified in the Final EIS and in the ROD. The alternative recommended for implementation, or Recommended Plan in the Final Feasibility Report, may or may not be identified as the environmentally preferable alternative.

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Chapter 29
Public Involvement, Consultation, and Coordination

This chapter summarizes completed, ongoing, and anticipated outreach and agency involvement efforts for the Investigation, including activities that satisfy NEPA requirements for public scoping and agency consultation and coordination. Efforts to engage the public, stakeholders, federally recognized tribes, other Native American tribal groups, and public agencies are an important component of the Investigation. Reclamation encourages review of this Draft EIS and will continue to solicit public and agency input on the proposed action.

The Investigation has maintained an active public and agency involvement program that has included a wide range of activities. A public involvement plan was initiated at the beginning of the Investigation that is designed to provide meaningful opportunities for stakeholder and public participation. The plan features four main objectives:

- **Stakeholder Identification** – Identifying and involving individuals, groups, and other entities that have an expressed or implied interest in the Investigation. No individual, group, or entity is to be excluded from the process, which includes complying with Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

- **Project Transparency** – Informing the public, stakeholders, and other interested parties of study results in a timely, unbiased fashion through a variety of methods, including stakeholder and/or public meetings, Web postings, mailings, and other means. This is an important practice to facilitate stakeholder understanding of the process and project.

- **Issues and Concerns Resolution** – Gaining awareness of the issues and concerns of the public, stakeholders, and other interested parties, and responding to these issues in an effective and timely manner.

- **Project Implementation** – Assisting policy-makers in understanding project purposes and benefits, and demonstrating that the project has met all necessary requirements to be implemented.

This Draft EIS, when finalized, is intended to be used by the Federal Lead Agency when considering approval of the proposed action or an alternative to the proposed action. All Cooperating agencies and other Federal, State, and local agencies with permitting or approval authority over any aspect of the proposed action are expected to use the information contained in the Final EIS to meet most, if not all, of their information needs, to make decisions and/or issue permits with respect to the proposed action.

Public Involvement through Project Scoping

Public scoping activities are conducted as part of compliance with both NEPA and CEQA. Scoping allows input from agencies, stakeholders, organizations, and other interested parties to assist in identifying resources to be evaluated, a range of reasonable alternatives to consider, potential beneficial and adverse impacts on the environment, and potential mitigation measures if adverse effects are identified. The scoping process helps with early identification of problems to be studied and also helps to eliminate issues from detailed study that are not critical to the decision at hand. Scoping also provides decision makers with insight on the issues and concerns that the public believes should be considered as part of the feasibility study. Public scoping activities performed for the Investigation NEPA process are described below.

Notice of Intent to Prepare an Environmental Impact Statement

Reclamation and DWR initiated the formal environmental analysis process of the Investigation consistent with NEPA and CEQA in February 2004 with the issuance of a Notice of Intent and Notice of Preparation, respectively. Pursuant to NEPA, the Notice of Intent notified the public of Reclamation's intent to prepare an EIS and provided notice of public scoping meetings. The Notice of Intent was published on February 3, 2004 in the Federal Register (Volume 69, pages 5184-5185). Pursuant to CEQA, an Notice of Preparation was submitted by DWR to the State Clearinghouse on February 6, 2004 and published on

March 22, 2004 in the *State Clearinghouse Newsletter* (February 1 through 15, 2004, page 41).

Public Scoping Meetings

In 2004, Reclamation and DWR convened a set of four public scoping meetings in Sacramento (March 16), Modesto (March 16), Friant (March 17), and Visalia (March 18), California to inform interested groups and individuals about the Investigation and to solicit ideas and comments. A Scoping Report was prepared consistent with Reclamation guidance and in compliance with NEPA requirements, and was released in December 2004 (Reclamation and DWR 2004).

Other Public Outreach

In addition to scoping activities, other public outreach activities have included the following:

- A series of seven workshops held during Phase 1 of the Investigation, which began in 2001. Workshops provided water agencies, counties, Federal and State agencies, water districts, environmental interest groups, and other interested parties the opportunity to hear presentation by the Investigation team, take part in discussions regarding preliminary plan formulation, and provide input about the planning process, analyses, and project documents.

- Ongoing stakeholder briefings that have been organized by Reclamation at the request of agencies and stakeholder groups to present information on study topics of interest. These briefings are used to update stakeholders on completed analyses and evaluations, upcoming efforts and studies, and overall project status and schedule. More than 30 of these briefings have taken place since the scoping process.

- Four project update public meetings held during the initial alternatives and plan formulation phases of the Investigation to discuss topics such as alternatives and geologic drilling activities. Several of the stakeholder briefings referenced were also open to the public.

- Local stakeholder interviews, performed by DWR, regarding regional, cooperative opportunities for groundwater storage and banking.

- Study area tours of Millerton Lake and alternative dam site location(s) given by the Investigation team and organized by local water resources interest groups, such as FWA, California Agricultural Irrigation Association, California Latino Water Coalition, Association of California Water Agencies, State and Federal legislators and staff, and others. During these tours, which occurred up to four times per year, the Investigation team provided updates on the Investigation's status and recent technical findings.

- Public release of major Reclamation studies and reports for the Investigation including: *Phase 1 Investigation Report* (Reclamation and DWR 2003); *Scoping Report* (Reclamation and DWR 2004); *Initial Alternatives Information Report* (Reclamation and DWR 2005); *Plan Formulation Report* (Reclamation and DWR 2008); and *Draft Feasibility Report* (Reclamation 2014).

- Project website for the Investigation (http://www.usbr.gov/mp/sccao/storage).

Consultation and Coordination

Reclamation has consulted various public agencies and organizations during the public outreach process and throughout the progression of the Investigation to obtain feedback. Consultations have assisted Reclamation in determining the scope of the EIS, developing project features and objectives, identifying the range of reasonable alternatives, and defining potential environmental impacts, impact significance, and mitigation measures.

Consultation and Coordination with Agencies

Reclamation conducts ongoing consultation and coordination efforts with agencies, including the active participation of numerous Cooperating agencies pursuant to NEPA. The Cooperating agencies for the Investigation are State Parks; FWA; Madera-Chowchilla Water and Power Authority; San Luis & Delta-Mendota Water Authority; Exchange Contractors; USACE; NMFS; BIA; BLM; USFWS; and EPA. Key elements of these coordination activities are the *Planning Aid Memorandum* and *Coordination Act Report* documents issued by USFWS and documents issued by USACE under CWA Section 404. USFWS submitted a Planning Aid

Memorandum outlining areas of potential concern to Reclamation (2007). In June 2009 and July 2011, USACE provided verification of jurisdictional determination of waters of the United States for the Temperance Flat RM 274 Reservoir Area and Area of Project Features, respectively, in accordance with CWA Section 404.

Cooperating agencies are participating in coordination meetings and have been provided opportunities to comment on Draft EIS sections while under development that are within their jurisdiction, expertise or authority. Agency consultation and involvement has occurred throughout the study to date, both informally and formally, and more than 20 agency coordination meetings have been held between scoping and this Draft EIS.

Consultation and Coordination with Tribal Governments and Native American Representatives

Sixteen groups, including those listed by the NAHC, represent Native American interests in the study area. Several tribes in the vicinity of Millerton Lake and elsewhere in the study area have expressed interest in the Investigation. Since the Investigation's initiation, representatives of the Investigation team have met periodically with Native American tribes to provide updates on progress and to receive input on issues of concern, and to tour the primary study area including potential features of alternatives and general areas of Native American significance.

One of the scoping meetings in March 2004 was held at the Table Mountain Rancheria. Since scoping, the Investigation team has held nine meetings and tours with representatives from various tribes, including Table Mountain Rancheria, North Fork Rancheria, Big Sandy Rancheria, Picayune Rancheria, Cold Springs Rancheria, Tule River Tribe, and the Tachi-Yokut Tribe (Santa Rosa Rancheria). In-person visits were also made to tribal members to collect information. These initial interviews with local Native Americans have provided insight into their perspectives on the primary study area.

Federally recognized tribes are recognized as possessing certain inherent rights of self-government (i.e., tribal sovereignty) and are entitled to receive certain federal benefits, services, and protections because of their special relationship with the United States. At present, there are five federally recognized tribes in the vicinity of the primary study area: Big

Sandy Rancheria, Picayune Rancheria, Table Mountain Rancheria, Cold Springs Rancheria, and North Fork Rancheria.

Formal consultation with the federally recognized tribes has not yet been initiated. As the Investigation proceeds, coordination and consultation will continue with the tribes in accordance with Federal guidance.

Major Topics of Public and Stakeholder Interest

Scoping meetings, agency workshops, agency coordination meetings, and public meetings have included discussion of the potential impacts of construction and operation of potential alternatives. The public, stakeholders, other Federal agencies, and State and local agencies identified several areas of interest and concern at Investigation meetings and workshops. Key topics included impacts on air quality associated with construction activities; impacts to habitat and aquatic and terrestrial wildlife populations; impacts to sites of cultural and religious significance; impacts to PG&E hydropower facilities; inundation of the Millerton Lake Cave system; recreational impacts in the San Joaquin River Gorge; and the potential to induce growth by improving water supply reliability. These topics are discussed in more detail in Chapter 1, “Introduction.”

Next Steps in the Environmental Review Process

This Draft EIS will be circulated for public and agency review and comment for 45 days following the date when the EPA publishes the notice of availability of weekly receipt of environmental impact statements in the Federal Register. During the public comment period, Reclamation intends to hold public hearings. Comments provided during the public review period will be addressed in the Final EIS.

A Final EIS will be prepared and circulated in accordance with NEPA requirements and will include responses to all substantial comments. When the Final EIS is complete, Reclamation will publish the document, and the notice of availability will be printed in the Federal Register, which will mark the start of a minimum 30-day waiting period before

Reclamation could issue a ROD to implement a recommended plan/preferred alternative, if authorized by Congress.

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Chapter 30
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Chapter 31
Distribution of the Draft EIS

This chapter includes locations where the Draft EIS is available for review and provides a list of those Federal, State, and local agencies, as well as Indian Tribes and organizations, that have been identified to receive a copy of this Draft EIS based on proximity to the study area, involvement in the Investigation, and expressed interest during public engagement. A Notice of Availability was published in the Federal Register, indicating where the Draft EIS is available at government buildings, libraries, and online.

Document Availability

The public distribution of this Draft EIS emphasizes the use of electronic media to ensure cost-effective, broad availability to the public and interested parties. The Draft EIS is available for viewing on the Investigation public website at http://www.usbr.gov/mp/sccao/storage/.

The Draft EIS is also available for review at:

U.S. Department of the Interior, Bureau of Reclamation Library
2800 Cottage Way
Sacramento, California 95825

U.S. Department of the Interior, Bureau of Reclamation, South-Central California Area Office
1243 N Street
Fresno, California 93721-1813

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- State Senators
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Federal Agencies

- Federal Energy Regulatory Commission
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Natural Resources Conservation Service

- U.S. Department of Energy, Western Area Power Administration
- U.S. Department of Commerce, National Marine Fisheries Service
- U.S. Department of the Interior, Bureau of Indian Affairs
- U.S. Department of the Interior, Bureau of Land Management
- U.S. Department of the Interior, Fish and Wildlife Service
- U.S. Environmental Protection Agency
- U.S. Geological Survey

State Agencies

- California Department of Conservation
- California Department of Fish and Wildlife
- California Department of Food and Agriculture
- California Department of Parks and Recreation
- California Department of Public Health
- California Department of Water Resources
- California Natural Resources Agency
- Central Valley Regional Water Quality Control Board
- Delta Protection Commission
- Delta Stewardship Council
- State Water Resources Control Board

Regional and Local Entities

- Arvin-Edison Water Storage District
- Central California Irrigation District
- Chowchilla Red Top Resource Conservation District

- Chowchilla Water District
- City of Clovis
- Columbia Canal Company
- Contra Costa Water District
- East Bay Municipal Utility District
- East Stanislaus Resource Conservation District
- Eastern Madera County Water Oversight Advisory Committee
- Excelsior/Kings River Resource Conservation District
- Exeter Irrigation District/Ivanhoe Irrigation District
- City of Firebaugh
- Firebaugh Canal Water District
- City of Fresno
- Fresno County
- Fresno Irrigation District
- Friant Water Authority
- City of Fowler
- City of Huron
- Kaweah Delta Water Conservation District
- Kern County Water Agency
- Kings County
- Kings River Conservation District
- Lower San Joaquin Levee District
- Madera County
- Madera Irrigation District

- Madera-Chowchilla Water and Power Authority
- City of Mendota
- Metropolitan Water District of Southern California
- Orange Cove Irrigation District
- Porterville Irrigation District
- City of Reedley
- Root Creek Water District
- San Joaquin River Exchange Contractors Water Authority
- San Joaquin River Group Authority
- San Joaquin Valley Air Pollution Control District
- San Luis & Delta-Mendota Water Authority
- San Luis Canal Company
- Saucelito Irrigation District
- Sierra Resources Conservation District
- South Delta Water Agency
- Stone Corral Irrigation District
- Terra Bella Irrigation District
- Tulare County
- Tulare Irrigation District
- West Stanislaus Resource Conservation District
- Westlands Water District
- Westside Resource Conservation District

Tribal Interests

- Big Sandy Rancheria

- North Fork Rancheria
- Cold Springs Rancheria
- Picayune Rancheria of Chukchansi Indians
- Table Mountain Rancheria

Nongovernmental Organizations

- American Bass
- Association of California Water Agencies
- Bakersfield Bass Club
- The Bay Institute
- Butte Environmental Council
- California Bass Federation
- California Farm Bureau Federation
- California Grape & Tree Fruit League
- California Save Our Streams Council
- California Sportfishing Protection Alliance
- California Water Institute
- California Trout
- CVP Water Association
- Environmental Water Caucus
- Finegold Valley Landowners Association
- Fly Fishers for Conservation
- Fresno Bass Club
- Friends of the River
- Kerman Bass Club
- Kings River Bass Club

- Kings River Water Association
- Millerton Area Watershed Coalition
- Mother Lode Bass Anglers
- Natural Heritage Institute
- Natural Resources Defense Council
- Natural Resources Institute
- The Nature Conservancy
- Outdoor Sportsmen's Coalition of California
- Pacific Institute
- Protect Our Water
- Revive the San Joaquin
- San Joaquin Audubon Society
- San Joaquin Paddlers
- San Joaquin Raptor Rescue Center
- San Joaquin River Association
- San Joaquin River Parkway and Conservation Trust
- San Joaquin River Resource Management Coalition
- San Joaquin River Trail Council
- Santura Duck Club
- Sierra Bass Club
- Sierra Club
- Sierra Nevada Alliance
- South Yuba River Citizens League
- Taxpayers for Common Sense

- Trout Unlimited
- Trust for Public Land
- Tulare County Farm Bureau
- Valley Citizens for Water

Chapter 32
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Following is a list of persons who contributed to preparation of this Draft EIS.

This list is consistent with the requirements set forth in NEPA and CEQA (40 CFR 1502.17 and Section 15129 of the State CEQA Guidelines).

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Chapter 33
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This index has been prepared consistent with CEQ guidance. The index is a listing of names, places, and topics in alphabetical order, with chapters or page numbers indicating where they are discussed in this Draft EIS. Page numbers are hyphenated to include the relevant chapter number. For example, Chapter 3, page 5, is presented as page 3-5. Multiple pages in a single chapter, for example pages 5 and 7 of Chapter 3, are presented as pages 3-(5, 7). Occasionally, and index term is the subject of an entire chapter; in these cases, the chapter itself is referenced, rather than individual page numbers.

The page numbers presented below were compiled during preparation of the Draft EIS. While every effort has been made to ensure accuracy of the page numbers presented below, these references will not be finalized until the release of the Final EIS.

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USDA: *see* U.S. Department of Agriculture

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Y – Not Used

Z – Not Used