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Upper San Joaquin River Basin Storage Investigation

Feasibility Report

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

January 2014

Draft Feasibility Report

Upper San Joaquin River Basin Storage Investigation

Prepared by:

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

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January 2014

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.

Executive Summary

This Draft Feasibility Report documents the feasibility of alternative plans, including a range of operations and physical features, for the potential **Temperance Flat River Mile 274 Reservoir**.

Key Findings to Date:

- All alternative plans would provide benefits for water supply reliability, enhancement of the San Joaquin River ecosystem, and other resources.
- All alternative plans are technically feasible, constructible, and can be operated and maintained.
- Environmental analyses to date suggest that all alternative plans would be environmentally feasible. Environmental impacts of the alternative plans will be evaluated further in a Draft EIS/EIR.
- All alternative plans are economically feasible, and provide a wide range of benefit values that exceed costs.
- All alternative plans are projected to be financially feasible, depending upon the approach to recover costs.
- A recommended plan is not identified in this report; the alternative plan with the greatest net benefits is used as a representative plan for financial feasibility and other analyses.
- All alternative plans were formulated to be largely independent of Delta export operations and provide a balanced array of benefits.
- The potential for additional water supply would vary with changed conditions, including Delta export operations, integration with the CVP and SWP, conveyance improvements, and climate change.
- All alternative plans are consistent with the SJRRP and would provide beneficial effects in support of the Restoration and Water Management Goals, including enhancing conditions for anadromous fish and increasing the volume of Restoration Flows eligible for downstream recapture.

The Upper San Joaquin River Basin Storage Investigation (Investigation) is a joint feasibility study 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 potential 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 for improving water supply reliability and flexibility of the water management system for agricultural, urban, and environmental uses; and enhancing San Joaquin River water temperature and flow conditions to support anadromous fish restoration efforts.

The Investigation is one of five surface water storage studies recommended in the CALFED Bay-Delta Program (CALFED) Programmatic Environmental Impact Statement/Report (PEIS/R) Record of Decision (ROD) of August 2000. Progress and results of the Investigation have been documented in a series of interim reports that will culminate in a Feasibility Report and Environmental Impact Statement (EIS)/Environmental Impact Report (EIR).

The primary purpose of this Draft Feasibility Report is to (1) present the results to date of the ongoing Investigation; (2) determine the potential type and extent of Federal and non-Federal interest in alternative plans to address the planning objectives and related water resources needs and opportunities; (3) evaluate potential benefits and effects of alternative plans; and (4) determine technical, environmental, economic, and financial feasibility of alternative plans.

Consideration of comments received on the Draft Feasibility Report and pending Draft EIS/EIR will be reflected in the Final Feasibility Report.

Authorization

Federal authorization for the Investigation was initially provided in Public Law 108-7, Division D, Title II, Section 215, the omnibus appropriations legislation for Fiscal Year 2003, enacted in February 2003. Subsequent authorization and funding for the Investigation was provided in Public Law 108-361, Title I, Section 103, Subsection (d)(1)(A)(ii), the Water Supply, Reliability, and Environmental Improvement Act, signed October 25, 2004. Section 227 of the California Water Code (CWC) authorizes DWR to participate in water resources investigations.

Study Area

Aerial view of Millerton Lake and upper San Joaquin River Basin

The San Joaquin River is California's second longest river and discharges to the Sacramento-San Joaquin Delta (Delta) and, ultimately, to the Pacific Ocean through San Francisco Bay. 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. The Investigation includes both a primary and extended study area to reflect the localized effects of a potential new major dam and reservoir at Temperance Flat River Mile (RM) 274, and the effects of subsequent water deliveries over a rather large geographic area. The primary study area presented in this Draft Feasibility Report includes the following (Figure ES-1):

- San Joaquin River upstream from Friant Dam (about 20 miles northeast of Fresno) 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 includes locations of potential project features and areas potentially affected by alternative plan implementation and/or operation (Figure ES-2).

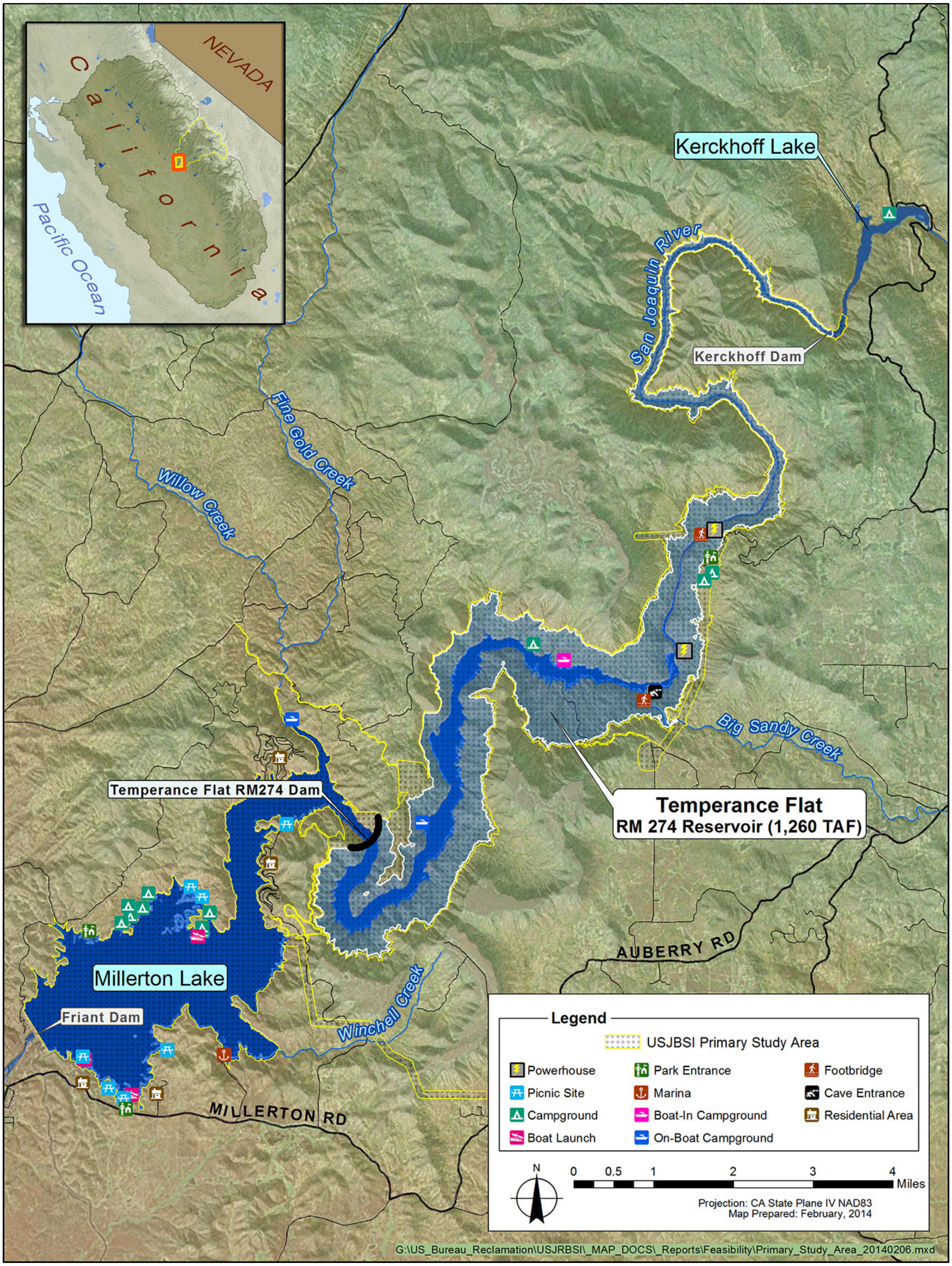


Figure ES-1. Primary Study Area and Temperance Flat RM 274 Reservoir

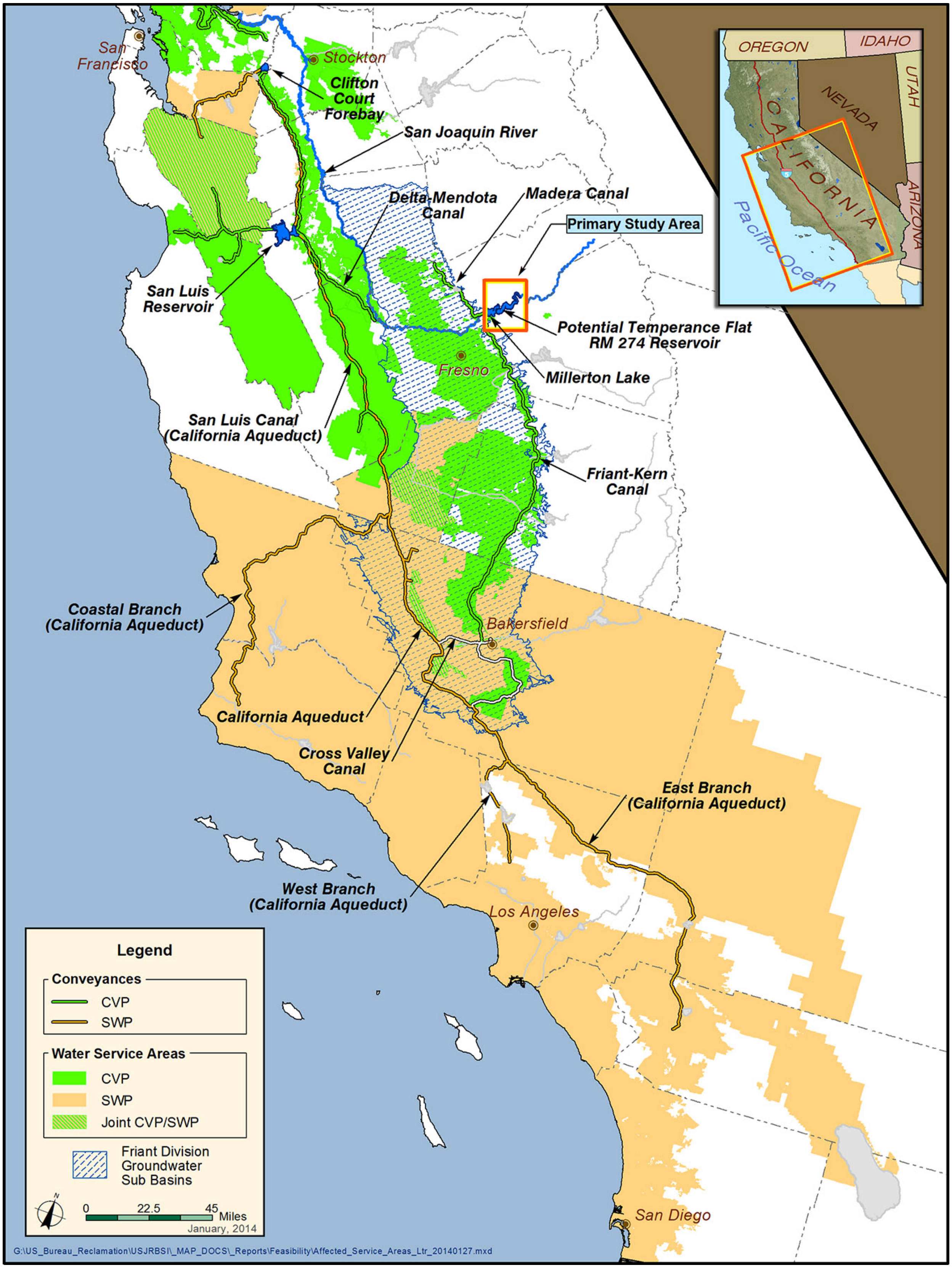


Figure ES-2. Extended Study Area

The extended study area encompasses the following:

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

Delta-Mendota Canal and California Aqueduct

Problems, Needs, and Opportunities

Water and related resources problems, needs, and opportunities include water supply reliability and operational flexibility, San Joaquin River ecosystem, and other resources.

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, future 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 environmental and agricultural water becomes less available, and a greater reliance on limited groundwater results in overdraft (DWR 2009a).

Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. CVP and SWP operational constraints related to ecosystem protection requirements have also led to growing competition for limited system resources. Climate change could broadly impact precipitation and runoff, snowpack, flood risk management, water demand, and sea levels. In addition to concerns about declining water supply and increasing water demand, the CVP and SWP lack flexibility in timing, location, and storage capacity to adapt to changing water priorities for multiple purposes. The water systems do not have the capacity to store enough water in wet years to provide sufficient supplies over multiple dry years.

Improved water management flexibility is needed to meet current and future challenges associated with increasing population, environmental needs, and climate change. An integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs.

In the Friant Division of the CVP, the 520 thousand acre-foot (TAF) storage capacity of Millerton Lake is small compared to the average annual inflow of approximately 1.8 MAF and limits Reclamation's ability to capture additional water in wet years. Reclamation employs a two-class system of water allocation in the Friant Division due to the storage limitations. Class 1 contracts include the first 800 TAF of water supply available and annual allocations to Class 1 contractors have historically been at or above 75 percent except in extremely dry years. Class 2 contracts include up to 1.4 MAF of water supply, and annual allocations vary widely in response to hydrologic conditions. The Class 2 contractors rely heavily on groundwater during dry years when allocations are very small. The limited storage capacity has even resulted in less than full Class 2 allocations in years when significant flood releases are made.

Figure ES-3 shows historical Friant Division allocations and flood releases between 1977 and 2011. Passage of the San Joaquin River Restoration Settlement Act in 2009 required Reclamation to release additional flows from Friant Dam to the San Joaquin River, adding operational requirements for which the dam was not originally designed, and reducing water supply allocations to the Friant Division.

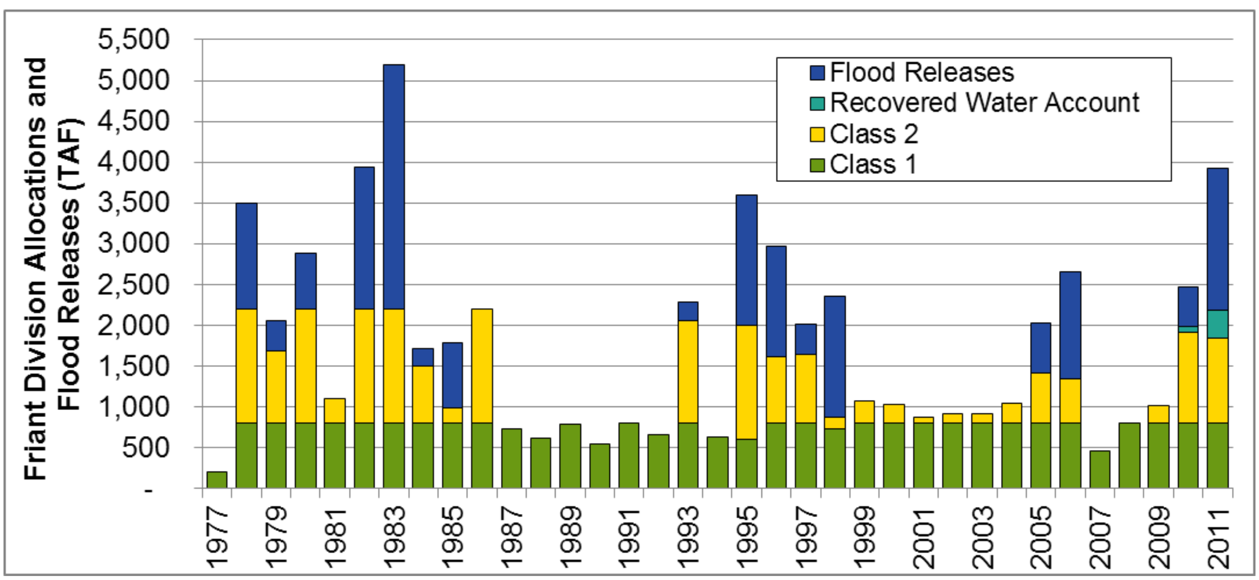


Figure ES-3. Friant Division Allocations and Flood Releases, 1977 – 2011

San Joaquin River Ecosystem

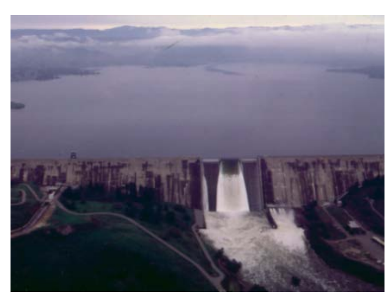
After construction of Friant Dam and before implementation of the San Joaquin River Restoration Program (SJRRP), the San Joaquin River between Friant Dam and the Merced River confluence did not support a continuous riparian and aquatic ecosystem. Generally unhealthy ecosystem conditions for the native cold-water fishery resulted from lack of reliable flows and poor water quality in the San Joaquin River. Implementing the SJRRP is expected and intended to alter the ecosystem conditions of the San Joaquin River, with a Restoration Goal 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. Actions to achieve the Restoration Goal include the release and conveyance of Restoration Flows from Friant Dam to the confluence of the Merced River, several channel capacity and fish passage improvements, and reintroduction of Chinook salmon (*Oncorhynchus tshawytscha*).

Chinook salmon

In addition to flow, success of Chinook salmon populations is known to be affected by water temperature. Water temperatures that are too high can be detrimental to the various life stages of salmon. Elevated water temperatures can negatively impact spawning adults, egg maturation and viability, and pre-emergent fry, substantially diminishing the resulting ocean population and next generation of returning spawners. Stress caused by high water temperatures also may reduce the resistance of fish to parasites, disease, and pollutants. The ability to manage the necessary volumes of cold water and to release water from Friant Dam at suitable temperatures, especially in drier water years, may present challenges to restoring and maintaining naturally reproducing and self-sustaining anadromous fish in the upper San Joaquin River.

Other Resources

Several other problems, needs, and opportunities associated with the San Joaquin River have been identified. Major storms during the past 3 decades have demonstrated that Friant Dam has little capacity to store water from large runoff events. Hydropower generation and ancillary service demands are expected to increase in the future, and water-oriented recreation demands continue to grow in the Central Valley. River water quality is degraded due to low flow and poor quality discharges. Urban drinking water treatment costs are also rising.



Friant Dam flood releases, January 1997

Public Involvement and Outreach

Public outreach, involvement, and support for development of the Draft Feasibility Report and pending Draft EIS/EIR include a wide range of activities. These activities were designed, in part, to meet requirements of National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), and President Clinton's April 29, 1994, memorandum regarding the engagement of federally recognized tribal governments. Reclamation and the cooperating agencies achieve these objectives by implementing a public involvement plan, and providing opportunities for the public and stakeholders to participate in developing the Investigation. Release of this Draft Feasibility Report, the pending Draft EIS/EIR, and their appendices provides a milestone opportunity for public and stakeholder input.

As part of the public involvement plan, briefings and workshops have been provided to various agencies and organizations to discuss the study. A Draft EIS/EIR will be prepared considering input from stakeholders and the public and cooperating agencies. In accordance with NEPA, a Notice of Availability will be published by the U.S. Environmental Protection Agency, and formal public hearings will be held at that time to receive public and agency comments. The Feasibility Report and EIS/EIR will be finalized after considering responses to public and agency comments.

Plan Formulation Process

The federal planning process begins by developing planning objectives, constraints, and considerations to guide alternatives formulation.

Federal and State Objectives

The Federal objectives are guided by both the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC 1983), which focuses on national economic development, and the *Principles and Requirements for Federal Investments in Water Resources* (P&R) (CEQ 2013), and encourages projects that maximize public benefits, both monetary and non-monetary.

As a partner with the Federal government, DWR requires that economic analyses 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. For example, the California Water Commission has new responsibilities under Senate Bill (SB) 1 regarding the distribution of State funds for public benefits of water storage projects, and is developing regulations and guidelines to quantify and manage those benefits.

Planning Objectives

Two primary and five secondary planning objectives were developed on the basis of the identified water resources problems, needs, and opportunities, study authorities, and other pertinent direction, including information contained in the August 2000 CALFED ROD and supporting documents. Primary planning objectives are those 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 planning objectives.

Primary Planning Objectives

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

- Enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River in support of restoring and maintaining naturally reproducing and self-sustaining anadromous fish (i.e., spring-run and fall-run Chinook salmon) and other fish populations.

Secondary Planning Objectives

- Reduce frequency and magnitude of flood releases from Friant Dam.

- Maintain value of hydropower attributes.

- Maintain and increase recreational opportunities in the primary study area.

San Joaquin River and Friant Dam

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

- Improve quality of water supplies delivered to urban areas.

Planning Constraints

Planning constraints help guide the feasibility study. Several key constraints identified for the Investigation are as follows:

- **Study Authorization –** Federal authorization was provided in 2003 (Public Law 108-7), and additional authorization was given in Public Law 108-361 in 2004. State authorization is in place to study reservoirs or reservoir systems based on Section 227 of the CWC.

- **CALFED ROD –** The objectives of the Investigation are consistent with the CALFED ROD (2000a), and alternative plans should address its goals, objectives, and programs.

- **Laws, Regulations, and Policies –** Numerous laws, regulations, executive orders, and policies need to be considered.

Planning Considerations

Planning considerations were specifically identified to help formulate, evaluate, and compare alternatives, including assumptions for operations of the CVP and SWP coordination with other Federal and State agencies, consistency with planning objectives, avoiding adverse effects to environmental and cultural resources, considering existing projects and programs, a 100-year period of analysis, and a 40-year repayment period for reimbursable costs according to Reclamation law and policy.

Formulation of Alternative Plans

The plan formulation process for the Investigation was divided into five phases, as shown in Figure ES-4. Alternative plans were developed based on these steps. In Phase 1, problems, needs, opportunities, and planning objectives and constraints were specified. In the Initial Alternatives Phase, a variety of management measures were identified that could be combined into alternative plans.

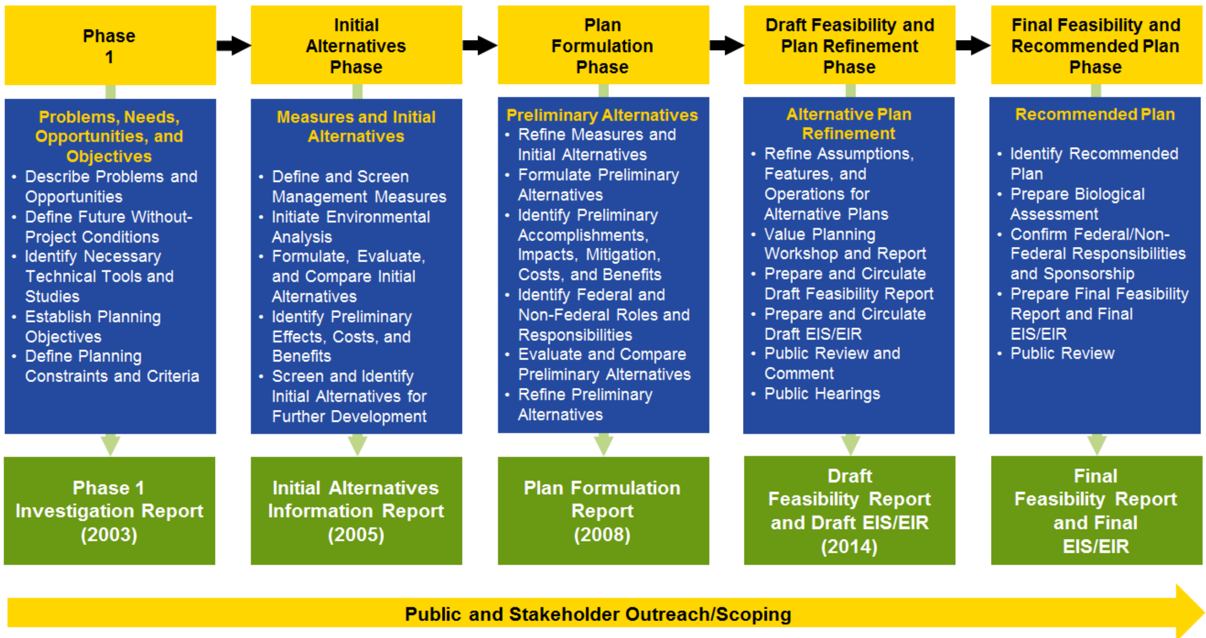


Figure ES-4. Plan Formulation Process

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. As shown in Figure ES-5, the Temperance Flat RM 274 site was chosen for feasibility-level evaluation after a detailed plan formulation and site selection process during the Investigation considering 22 separate storage sites, in addition to the 52 sites considered in the CALFED Initial Surface Water Storage Screening (2000b).

This Draft Feasibility Report is the outcome of the Draft Feasibility and Plan Refinement Phase and documents the evaluation of a No-Action Alternative and four alternative plans. Each alternative plan includes a variety of features and operations to address the planning objectives, in varying degrees. All alternative plans include constructing Temperance Flat RM 274 Dam and Reservoir in the upstream portion of Millerton Lake. The potential Temperance Flat RM 274 Reservoir would provide about 1,260 TAF of additional storage capacity. The alternative plans 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).

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).

The RM 274 site was considered superior to the two other sites, but the Friant location was selected to reduce construction and conveyance costs (Reclamation 2003).

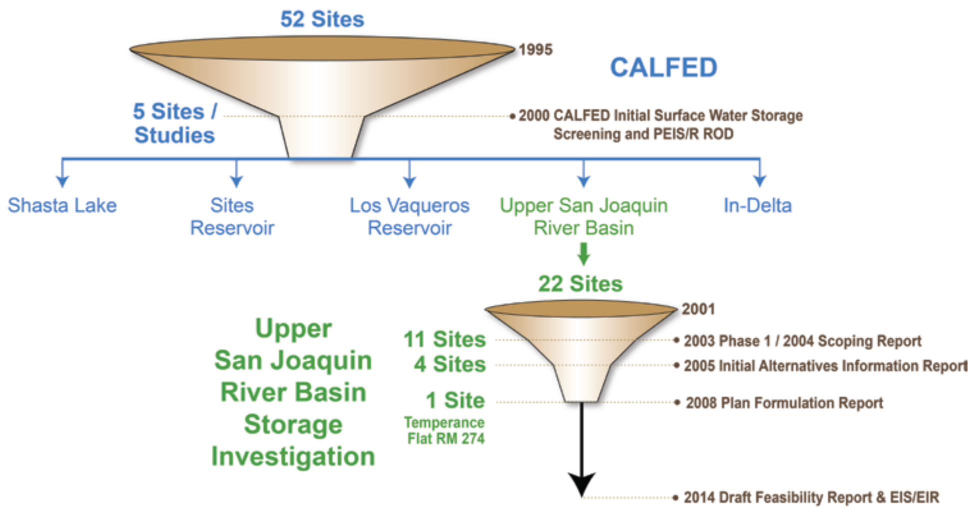


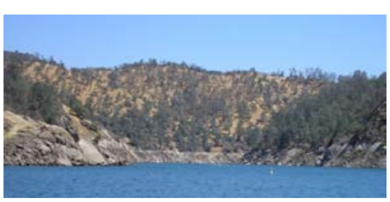
Figure ES-5. Site Selection Process for Temperance Flat RM 274 Reservoir

No-Action Alternative (No Additional Federal Action)

Under the No-Action Alternative, the Federal Government would continue to implement reasonably foreseeable actions, including implementation of the SJRRP, but would not take additional actions toward implementing a plan to increase upper San Joaquin River Basin water storage to help address water supply reliability, San Joaquin River ecosystem issues, or other related resource conditions. Reasonably foreseeable actions include actions with current authorization, secured funding for design and construction, and environmental permitting and compliance activities that are substantially complete. The No-Action Alternative provides a basis for comparing potential benefits and effects of alternative plans.

Alternative Plan 1

Alternative Plan 1 would include constructing a new dam and reservoir at RM 274 in the upstream portion of Millerton Lake, as well as diversion works, a powerhouse, valve house, transmission facilities, development of other construction areas, and relocation of affected existing facilities. In addition to the features common to all of the alternative plans, Alternative Plan 1 includes a fixed low-level intake structure (LLIS) on Temperance Flat RM 274 Reservoir, which would function to release higher flood flows and make normal releases. Temperance Flat RM 274 Reservoir would provide about 1,260 TAF of additional storage. The reservoir would provide new water supply to the Friant Division and SWP M&I contractors. New supply to SWP 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



Potential Temperance Flat RM 274 Dam Site water supply would be delivered to SWP 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.

In this report, the term **carryover** refers to the minimum storage target maintained in Millerton Lake and/or Temperance Flat RM 274 Reservoir for multiple purposes.

Minimum carryover storage is assumed not to be delivered for water supply; it would be maintained for public benefits such as cold-water pool, recreation, and emergency water supply, as well as providing a minimum pool for hydropower.

Alternative Plan 2

Alternative Plan 2 would include constructing the same features described in Alternative Plan 1, would have the same minimum carryover storage targets as in Alternative Plan 1, and would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. The new supply to SWP 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 supply would be delivered to SWP M&I contractors via the California Aqueduct. The new water supply to CVP SOD contractors would be developed by delivering water supplies to serve CVPIA Level 2 refuge water demands from Temperance Flat RM 274 Reservoir. The water would be released to the San Joaquin River and delivered to refuges from Mendota Pool, allowing direct access or exchange with Delta supplies for delivery to CVP SOD contractors.

Alternative Plan 3

Alternative Plan 3 would include constructing the same features described in Alternative Plan 1, would have the same minimum carryover storage targets as in Alternative Plan 1, and would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. New supply to SWP M&I contractors would be delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. New water supply 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

Alternative Plan 4 would include constructing the same features common to all of the alternative plans, and would also include a selective-level intake structure (SLIS) on Temperance Flat RM 274 Reservoir. The SLIS would consist of a low-level gate and three upper-level inlet gates to selectively withdraw water at different depths for temperature management. The reservoir would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors.

New supply to SWP M&I 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 supply would be delivered to SWP M&I contractors via the California Aqueduct. New water supply 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 include minimum carryover storage targets of 340 TAF of in Millerton Lake and 325 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 665 TAF.

<table>
<tr><th>Alternative Plan</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Millerton Lake Minimum Carryover Storage Target</td><td colspan="4">340 TAF</td></tr>
<tr><td>Temperance Flat Minimum Carryover Storage Target</td><td colspan="3">200 TAF</td><td>325 TAF</td></tr>
<tr><td>Beneficiaries</td><td>Friant Division, SWP M&I</td><td colspan="3">Friant Division, SWP M&I, CVP SOD</td></tr>
<tr><td>Conveyance Routing:
Friant Division</td><td colspan="4">Friant-Kern and Madera canals</td></tr>
<tr><td>CVP SOD</td><td>N/A</td><td colspan="3">San Joaquin River Exchanges at Mendota Pool</td></tr>
<tr><td>SWP M&I</td><td colspan="2">San Joaquin River Exchanges at Mendota Pool</td><td>Friant-Kern, cross-valley conveyance, CA Aqueduct</td><td>San Joaquin River Exchanges at Mendota Pool</td></tr>
<tr><td>Intake Structure Type</td><td colspan="3">Low-level intake structure</td><td>Selective-level intake structure</td></tr>
</table>

Alternative plans vary in four ways: minimum carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and intake structure type.

Summary of Alternative Plans Features, Benefits, and Costs

Alternative plan physical features are summarized in Table ES-1. Table ES-2 summarizes the physical accomplishments of the alternative plans. Figure ES-6 is a schematic of SOD systemwide operations of the alternative plans. Table ES-3 summarizes estimated annual costs, annual benefits, and net benefits for the alternative plans.

Based on the conditions evaluated in this Draft Feasibility Report and summarized in Tables ES-2 and ES-3:

- Alternative Plan 3 would provide the greatest water supply improvement in dry and critical years, and on a long-term average basis.

- Alternative Plan 4 has the greatest potential to improve long-term average abundance of spring-run Chinook salmon and Alternative Plan 1 has the greatest potential to improve abundance in dry and critical years.

- All alternative plans would provide similar levels of emergency water supply and Friant Dam hydropower generation. Only Alternative Plan 3 would improve M&I water quality. Alternative Plan 4 with the highest carryover would have the highest potential for replacing Kerckhoff Project value and increasing recreation, while Alternative Plans 1, 2, and 3 with lower carryover would provide more incidental flood space.

- Estimated investment costs for the alternative plans range from $2.5 to $2.6 billion and annualized costs range from $115.9 to $120.8 million.

- Estimated annual monetary benefits for the alternative plans range from $94.8 to $578.2 million, considering various ecosystem benefit assumptions.

- All alternative plans evaluated result in a benefit-cost ratio greater than one, with the exception of one condition. Benefit-cost ratios range from 0.81 to 4.99, depending on the assumptions regarding fish behavior and the geographic extent of public beneficiaries for ecosystem enhancement.

Table ES-1. Summary of Physical Features of Alternative Plans

Project Feature	Description
Temperance Flat RM 274 Dam	665-foot high RCC gravity arch dam with uncontrolled ogee crest spillway. Total storage capacity of 1,331 TAF (net additional capacity 1,260 TAF).
Diversion and Outlet Works	30-foot-diameter, concrete-lined tunnel through left abutment for diversion during construction and 240-foot high embankment cofferdams to divert stream flows around dam construction site. Diversion tunnel converted to outlet works after construction.
Low-Level Intake Structure	Inclined reinforced-concrete structure with two low-level fixed-wheel gates connected to outlet works tunnel (*included in Alternative Plans 1, 2, and 3*).
Selective-Level Intake Structure	Inclined reinforced-concrete structure with two low-level and three upper-level fixed-wheel gates for temperature management (*included in Alternative Plan 4*).
Valve House, Powerhouse, and Transmission Facilities	At-grade reinforced-concrete valve house structure connected to diversion tunnel and powerhouse; 160 MW powerhouse and tailrace; transmission line approximately 5 miles southeast to the existing Kerckhoff–Sanger line.
Other Construction Areas	Permanent access roads and temporary haul roads; aggregate quarry; batch plant; staging area; waste area for tunneling and excavation.
Affected Existing Facilities	Decommission Kerckhoff Hydroelectric Project powerhouses; replace Kerckhoff Dam mechanical equipment; relocate portions of existing transmission lines, relocate affected BLM and State Parks facilities and utilities; provide recreation access to new reservoir.

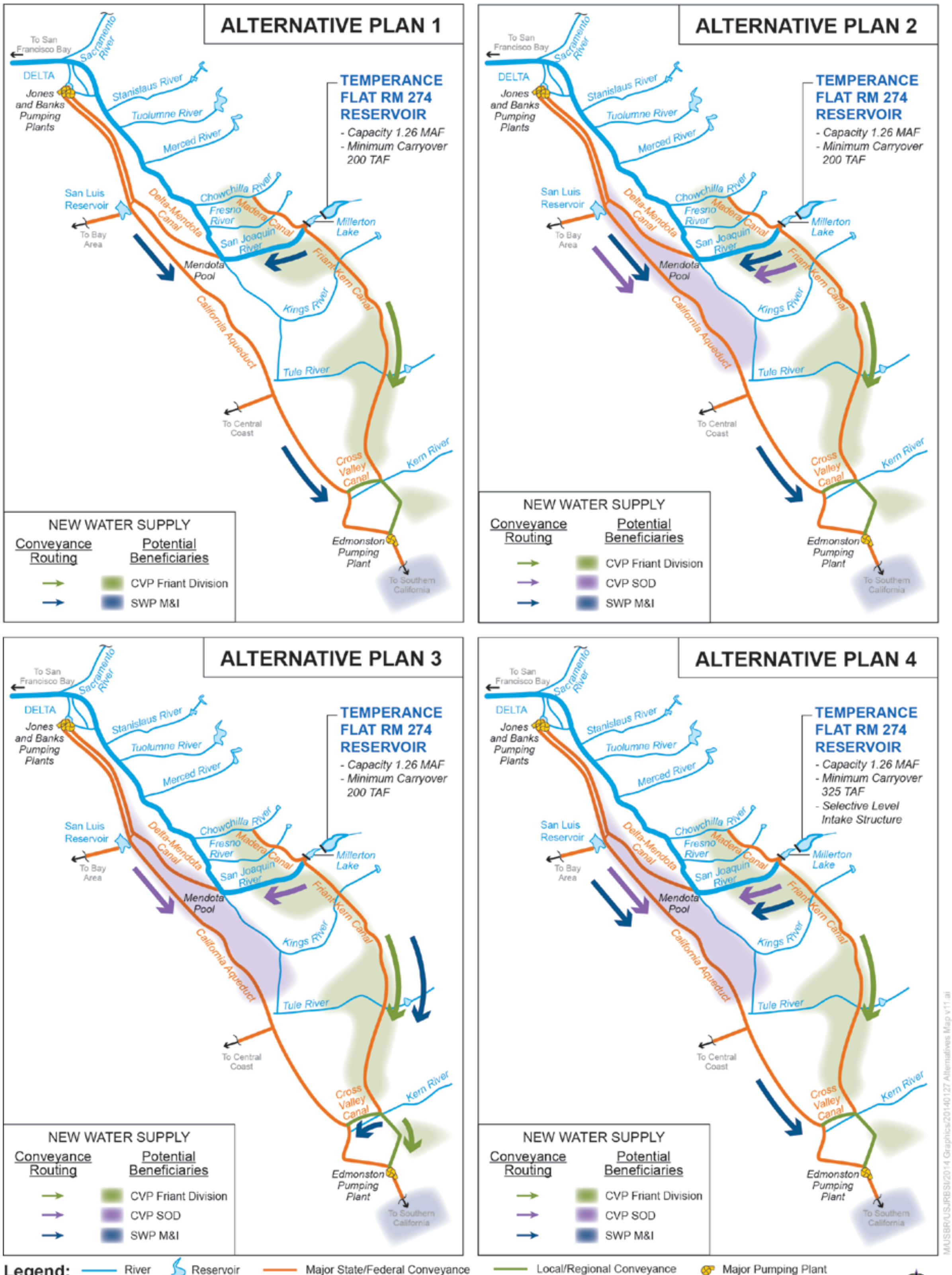
Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
MW = megawatt
RCC = roller-compacted concrete
RM = river mile
State Parks = California Department of Parks and Recreation
TAF = thousand acre-feet

Table ES-2. Summary of Physical Accomplishments of Alternative Plans[1]

Alternative Plan	1	2	3	4
Potential Physical Accomplishments [2]				
Long-Term Average Annual Increase in Agricultural Delivery (TAF) [3]	30	49	52	41
Long-Term Average Annual Increase in M&I Delivery (TAF)	40	22	25	21
Long-Term Average Annual Increase in Total Delivery (TAF)	70	71	76	61
Dry and Critical Year Increase in Total Delivery (TAF)	19	24	30	21
Long-Term Average Spring-Run Chinook Abundance Increase–High SAR[4]	2.8%	2.8%	0.6%	4.9%
Dry and Critical Year Spring-Run Chinook Abundance Increase–High SAR[4]	15.9%	13.2%	14.6%	13.1%
Long-Term Average Spring-Run Chinook Abundance Increase–Low SAR [4]	0.6%	-0.7%	-0.1%	2.8%
Dry and Critical Year Spring-Run Chinook Abundance Increase–Low SAR [4]	14.0%	9.2%	13.3%	11.1%
Emergency Water Supply Available during Delta Export Disruption (TAF) [5]	194	195	195	203
Change in M&I Water Quality at Edmonston Pumping Plant (mg/L TDS)	NE	NE	-1.7	NE
Increase in Annual Friant Dam Hydropower Energy Generation (GWh)	15.8	15.7	15.7	15.8
Replacement of Kerckhoff Hydroelectric Project Value [6]	81.1%	81.1%	81.1%	91.4%
Increase in Annual Recreation (thousands of visitor-days) [7]	116.2	117.0	113.6	130.4
Increase in Incidental Flood Space (TAF) [8]	361	360	343	236

Notes: [1] Operations based on Reclamation March 2012 CalSim II Benchmark with 2008/2009 BOs.
[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] Alternative plans 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 mitigation 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 exceedence.

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



Notes:
1. Millerton Lake would be operated at a minimim carryover storage target of 340 TAF in all alternatives.
2. In Alternative Plan 2, San Joaquin Valley CVP wildlife refuges would receive higher quality San Joaquin River water supplies from Temperance Flat Reservoir (Level 2 refuge diversification).

Figure ES-6. South-of-Delta Systemwide Operations of Alternative Plans

Table ES-3. Annual Costs, Annual Benefits, Net Benefits, and Benefit-Cost Ratio for Alternative Plans[1] ($ million)

Alternative Plan	***1***		***2***		***3***		***4***	
Total Estimated Investment Cost	$2,488		$2,488		$2,488		$2,578	
Interest and Amortization[2]	$95.7		$95.7		$95.7		$99.2	
Other Annual Costs[3]	$25.1		$21.6		$21.8		$16.7	
Total Annual Cost	**$120.8**		**$117.3**		**$117.5**		**$115.9**	
Agricultural Water Supply Reliability Benefits	$18.6		$20.8		$20.8		$18.9	
M&I Water Supply Reliability Benefits	$43.2		$24.0		$25.7		$22.3	
Emergency Water Supply Benefits	$25.9		$26.0		$25.8		$27.1	
M&I Water Quality Benefits	$0.0		$0.0		$2.0		$0.0	
Hydropower Benefits at Friant Dam	$1.6		$1.6		$1.6		$1.6	
Recreation Benefits	$6.6		$6.6		$6.4		$7.4	
Flood Damage Reduction Benefits	$5.0		$5.0		$4.9		$4.0	
Potential Annual Monetary Benefits *(without ecosystem benefits)*	**$100.9**		**$84.0**		**$87.2**		**$81.3**	
With Ecosystem Benefits[4]	***Low SAR***	***High SAR***	***Low SAR***	***High SAR***	***Low SAR***	***High SAR***	***Low SAR***	***High SAR***
Ecosystem Enhancement Benefits (6-County Level)	$3.9	$2.2	$2.5	$2.2	$2.7	$0.5	$4.9	$3.9
Ecosystem Enhancement Benefits (CA Level)	$59.6	$34.1	$38.8	$33.9	$40.9	$7.6	$75.6	$59.5
Ecosystem Enhancement Benefits (U.S. Level)	$391.7	$224.2	$255.2	$222.9	$269.2	$49.7	$496.9	$391.3
Total Potential Annual Monetary Benefits *(with CA level ecosystem benefits)*	**$160.5**	**$135.0**	**$122.8**	**$117.9**	**$128.1**	**$94.8**	**$156.9**	**$140.8**
Total Potential Annual Monetary Benefits *(with U.S. level ecosystem benefits)*	**$492.6**	**$325.1**	**$339.2**	**$306.9**	**$356.4**	**$136.9**	**$578.2**	**$472.6**
Potential Net Benefits (CA level)	$39.7	$14.2	$5.5	$0.6	$10.6	-$22.7	$41.0	$24.9
Potential Net Benefits (U.S. level)	$371.8	$204.3	$221.9	$189.6	$238.9	$19.4	$462.3	$356.7
Preliminary Benefit-Cost Ratio (CA level)	**1.33**	**1.12**	**1.05**	**1.01**	**1.09**	**0.81**	**1.35**	**1.21**
Preliminary Benefit-Cost Ratio (U.S. level)	**4.08**	**2.69**	**2.89**	**2.62**	**3.03**	**1.17**	**4.99**	**4.08**

Notes: General: All benefits and costs are reported in January 2013 dollars. All numbers are rounded for display purposes; therefore, line items may not sum to totals.

[1] All benefits are reported as changes compared to the respective future No-Action Alternative conditions.

[2] 100-year period of analysis, and 3.75 percent interest rate (Federal discount rate).

[3] Other annual costs include O&M for reservoir facilities, additional hydropower mitigation, and net additional CVP/SWP power costs. Does not include water conveyance costs beyond the net power requirement for delivering the new water supply, and additional costs may be incurred to achieve the intended benefits.

[4] The monetary valuation of ecosystem benefits is uncertain, so ranges are presented to capture varying anadromous fish return rates and geographic extent of the ecosystem benefits.

Key:$ million = million dollars
CA = California
CVP = Central Valley Project
M&I = municipal and industrial
NED = National Economic Development
O&M = operations and maintenance
SAR = smolt-to-adult-return rate
SWP = State Water Project
US = United States

Sensitivity of Results to Operations Assumptions

Friant Dam and Millerton Lake

The accomplishments reported for the alternative plans are strongly influenced by assumptions regarding the management of water supplies developed by Temperance Flat RM 274 Reservoir, CVP and SWP operations conditions in the Delta, and the availability of other infrastructure for water conveyance. To illustrate the variability of accomplishments in relation to these factors, operational sensitivity evaluations were performed on (1) the relative balancing of active and carryover storage in Millerton lake and Temperance Flat Reservoir, (2) regulatory conditions for CVP and SWP operations in the Delta, and (3) potential new conveyance in the Delta, and between the east side and west side of the San Joaquin Valley.

Table ES-4 presents results from sensitivity analyses performed to illustrate how new water supply developed by Temperance Flat RM 274 Reservoir would be affected by changes in assumed minimum carryover storage. Table ES-5 summarizes water supply that could be developed by Temperance Flat RM 274 Reservoir under various Delta operational conditions for the CVP and SWP operating conditions and availability of additional conveyance, as presented in documents completed prior before this Draft Feasibility Report. Ecosystem and other accomplishments are also sensitive to these variables.

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

Notes:
[1] Combined total storage capacity = 520 TAF Millerton + 1,260 TAF Temperance Flat = 1,780 TAF.
[2] Active storage capacity = total storage capacity minus minimum carryover storage.
[3] Alternative Plans compared to No-Action Alternative.
[4] All estimates of new water supply/change in deliveries based on CVP and SWP operating conditions with the 2008/2009 BOs.
[5] The values represent the net change in CVP/SWP system-wide deliveries, accounting for new deliveries from Temperance Flat 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.
[6] Values represent the range of new water supply for Alternative Plans 1, 2, and 3, which include the same minimum carryover.
[7] Value for new water supply represents Alternative Plan 4.

Key:
BO = Biological Opinion
CVP = Central Valley Project
RM = River Mile
SWP = State Water Project
TAF = thousand acre-feet

Table ES-5. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir with Varying CVP/SWP Operations and Conveyance

Row ID	CVP and SWP Operations (BOs)	Total Minimum Storage in Millerton and Temperance Flat (TAF)[1]	Integration with CVP and SWP	New Delta Conveyance[2]	New Transvalley Conveyance[3]	Average Annual Change in Deliveries (TAF)[4]
A	2008/2009	230	--	--	--	98[5]
B[6]	2004/2005	230	--	--	--	113[5]
C[6]	2004/2005	230	☑	--	--	158 – 180[7]
D[6]	2004/2005	230	☑	--	☑	240
E[8]	2008/2009	230	☑	--	--	140
F[8]	2008/2009	230	☑	☑		230

Notes: General: Draft Feasibility Report alternative plans assume 2008/2009 BOs with No Integration, No New Delta Conveyance, and No New Transvalley Conveyance, with a total minimum carryover in Temperance Flat and Millerton of 540 to 665 TAF.

[1] Minimum storage in Millerton Lake is 130 TAF; minimum storage in Temperance Flat is 100 TAF.

[2] Assumed capacity and configuration of new Delta conveyance representation not specified in DWR 2010b.

[3] Assumed new bi-directional Transvalley canal (1,000 cfs capacity) connecting Friant-Kern Canal and California Aqueduct. Water supply delivery estimate would be smaller with 2008/2009 BOs.

[4] Alternative Plans compared to No-Action Alternative. Values represent net change in CVP/SWP system-wide deliveries, accounting for new deliveries from Temperance Flat and decreases in Delta exports due to the decrease in San Joaquin River flood flows. All scenarios presented assume implementation of the SJRRP.

[5] The 2 scenarios without integration would result in the same water supply developed from Temperance Flat and the same reduction in San Joaquin River flood flows; values with 2008/2009 BOs are smaller than with 2005/2005 BOs due to additional reductions in Delta exports.

[6] Source: Reclamation 2008a

[7] A range of values is presented since multiple scenarios were evaluated

[8] Source: DWR 2010b

Key:
BO = Biological Opinion
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DWR = California Department of Water Resources
RM = River Mile
SWP = State Water Project
TAF = thousand acre-feet
Reclamation = Bureau of Reclamation

The outputs of the No Action Alternative and all alternative plans for water supply reliability and other resources are also projected to be sensitive to climate change. The alternative plans would not interfere with the implementation of the SJRRP, and would provide beneficial effects in support of the Restoration Goal and Water Management Goal of the Settlement.

Summary of Potential Environmental Effects

Many detailed environmental resources studies were conducted for the Investigation in support of feasibility analyses and environmental impact assessments. Some of the results of these analyses are documented in this report. The assessment of potential impacts of alternative plans on environmental resources, along with proposed mitigation measures, will be further documented in the pending Draft EIS/EIR. All alternative plans are anticipated to have similar potential environmental impacts within the primary study area. The level of some potential environmental impacts across the extended study area would vary, depending on water operations for alternative plans. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures (PRC Section 21002). Some adverse effects for action alternative plans would remain unavoidable despite practicable measures identified to mitigate effects. All of the alternative plans have been formulated to provide ecosystem benefits associated with improvements in spring-run Chinook salmon abundance due to temperature and flow enhancement in the San Joaquin River between Friant Dam and the Merced River.

Plan Evaluation and Comparison

Four accounts are established to display, and facilitate evaluation of, the effects of alternative plans as required by the P&G (WRC 1983): national economic development (NED), environmental quality (EQ), regional economic development (RED), and other social effects (OSE). Effects of alternative plans are displayed as the difference in conditions, or differences in metrics under each account, compared to the No-Action Alternative. As shown in Table ES-6, all alternative plans are cost-effective, providing positive net NED benefits with inclusion of California- and U.S.-level ecosystem benefits. California-level ecosystem benefits are used in the NED benefit-cost ratio presented below because they represent the middle of the range of estimated ecosystem benefits and uncertainty in the magnitude of the estimates.

Table ES-6. Summary of Estimated Benefit-Cost Ratios and Net NED Benefits

Ranking	Alternative Plan	Benefit-Cost Ratio[1]	Net NED Benefits ($ million)[1]
Highest	4	1.35	$41.0
Moderate-High	1	1.33	$39.7
Moderate	3	1.09	$10.6
Moderate-Low	2	1.05	$5.5
Lowest	NAA	Not Applicable	$0.0

Notes:
[1] Based on California-level and low smolt-to-adult return rate ecosystem benefits valuation.

Key:
$ million = million dollars
NAA = No-Action Alternative
NED = National Economic Development

The alternative plans were also compared based on the planning objectives and the four P&G criteria of completeness, effectiveness, efficiency, and acceptability (Table ES-7). Based on analyses and evaluations to date, in comparison to the other alternative plans, Alternative Plan 4 best addresses the Investigation planning objectives (highest rank for effectiveness), has a high certainty of achieving the intended benefits (completeness), has a relatively high economic efficiency, and provides the greatest net benefits.

Table ES-7. Summary of Alternative Plan Comparison Related to Planning Criteria

Criterion	No-Action Alternative	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4
Effectiveness	Lowest	Moderate	Moderate-High	Moderate-Low	Highest
Efficiency	Lowest	Moderate-High	Moderate-Low	Moderate	Highest
Acceptability	Moderate-Low	Moderate-Low	Highest	Highest	Highest
Completeness	Lowest	Highest	Highest	Highest	Highest
COMBINED RANKING	**Lowest**	**Moderate-Low**	**Moderate-High**	**Moderate**	**Highest**

No specific alternative plan has been chosen or recommended for implementation at this stage of the Investigation, but Alternative Plan 4 was selected as the “representative” plan to illustrate the topics that will be evaluated for a recommended plan that will be identified in the Final Feasibility Report.

Determination of Feasibility

View of Temperance Flat RM 274 dam site from top of left abutment

A project feasibility determination includes the following four elements:

- Technical feasibility consists of engineering, operations, and constructability analyses verifying that it is physically and technically possible to construct, operate, and maintain the project.
- Environmental feasibility consists of analyses verifying that constructing or operating the project will not result in unacceptable environmental consequences to endangered species or cultural, Indian trust, or other resources.
- Economic feasibility consists of analyses verifying that constructing the project is an economically sound investment of capital (i.e., that the project would result in positive net benefits or that the project's benefits would exceed the costs).
- Financial feasibility entails examining and evaluating project beneficiaries' ability to pay for their share of project costs and/or repay their appropriate portion of the Federal investment in the project over a period of time, consistent with applicable law.

Further refinements to the alternative plans are expected after additional water operations and related analyses.

Technical Feasibility

All of the alternative plans, including the representative plan, are projected to be technically feasible, constructible, and can be operated and maintained. Designs and cost estimates of project features in this Draft Feasibility Report have been developed primarily to a feasibility-level, but will not be suitable for use for congressional authorization and appropriation until the Final Feasibility Report. Additional review, including a feasibility-level design, estimating, and construction (DEC) review, will be completed once Draft Feasibility Report comments on engineering features from public agencies and stakeholders have been addressed. The feasibility-level DEC review could identify (1) remaining significant items not listed in the cost estimate, and (2) needed refinements to construction methods and scheduling. Additionally, operations of alternative plans are technically feasible.

Environmental Feasibility

Environmental analyses conducted to date suggest that all of the alternative plans, including the representative plan, would be environmentally feasible. The alternative plans will be evaluated further in the Draft EIS/EIR, and are anticipated to further demonstrate environmental feasibility. Implementation of the alternative plans would affect environmental resources in the primary and extended study areas, with beneficial effects on some resources, and adverse effects on other resources. Potential environmental effects will be evaluated and mitigation measures for each alternative plan will be identified in the Draft EIS/EIR. An environmentally preferable alternative, consistent with NEPA, will be identified in the ROD.

It is recognized that further refinement and changes may occur to the alternative plans based on additional analyses and responses to comments by concerned agencies, stakeholders, and the public.

Reclamation and the CEQA lead agency will incorporate certain environmental commitments and best management practices into the alternative plans to avoid or minimize potential adverse effects. Reclamation has also committed, contingent on congressional authorization, to coordinate the planning, engineering, design, construction, and O&M phases of the project with applicable resource agencies. Specific actions to avoid, mitigate, and/or compensate for potential adverse environmental effects will be identified and addressed in the Draft and Final EIS/EIR to the greatest extent practicable.

Economic Feasibility

All of the alternative plans, including the representative plan, are currently projected to be economically feasible, because the estimated benefits exceed the estimated costs for each alternative plan. Alternative Plan 4 has the highest net benefits of the alternative plans evaluated in this Draft Feasibility Report, and would result in positive net benefits of an estimated $24.9 million to $41.0 million annually. Additional monetary benefit categories could be analyzed for the Final Feasibility Report, if any are identified, and an appropriate valuation methodology is available. Potential supplemental refinements to alternative plan features, hydropower mitigation strategies, and their associated cost estimates for the Final Feasibility Report may also affect economic feasibility of the alternative plans.

Financial Feasibility

Financial feasibility determination during the planning stage consists of (1) a preliminary allocation and assignment of estimated construction, interest during construction, and O&M costs to project purposes, both reimbursable and nonreimbursable, (2) identification of potential project beneficiaries, and (3) determination of project beneficiaries' potential ability to pay the allocated and assigned costs. This process informs the Federal government and other non-Federal partners of the appropriateness of investment in the overall project. Alternative Plan 4 is used as an example to characterize the financial feasibility of a representative alternative plan for this Draft Feasibility Report because it provides the highest net NED benefits.

Reimbursable costs are borne by beneficiaries via construction cost sharing, or repaid via rates or repayment contracts.

Nonreimbursable costs are borne by the Federal, state, or local government via tax or bond revenues because the benefits generally accrue to taxpayers.

Preliminary Cost Allocation

Cost allocations are required for Federal multipurpose water resources projects to derive an equitable distribution of project costs among authorized or proposed project purposes. A preliminary cost allocation was developed for the representative plan using the alternative justifiable expenditure (AJE) approach. Table ES-8 summarizes the allocation of costs using the AJE method. A preliminary cost allocation using the separable costs-remaining benefits (SCRB) method for the recommended plan will be included in the Final Feasibility Report. A final cost allocation would be performed when project construction is substantially complete.

Cost Assignment

Once costs are allocated to project purposes, repayment of the costs is assigned to the project beneficiaries. Costs allocated to project purposes are assigned as reimbursable or nonreimbursable. Table ES-8 illustrates assignment of costs of the representative plan to examine the potential amount of reimbursable costs to be repaid by project beneficiaries.

The assignment percentages are based on pertinent Federal and State authority and assumptions about implementation. Costs to be assigned include costs to accomplish eight potential project purposes consistent with the planning objectives. Approximately 27 percent of the allocated costs for the representative plan are estimated to be reimbursable, 28 percent Federal nonreimbursable, and 45 percent State/local nonreimbursable. Assignment percentages may be updated for the preliminary cost allocation for the recommended plan in the Final Feasibility Report.

Table ES-8. Preliminary Annual Cost Allocation and Cost Assignment for Representative Plan ($ million)

Purpose	Cost Allocation Summary						Cost Assignment Summary					
							Reimbursable		Nonreimbursable			
									Federal		State/Local	
	Benefits[1,2]	Specific Costs[3]	Remaining Benefits[4]	Allocated Joint Costs[5]	Overall Cost Allocation	Total Allocated Costs[6]	Assigned	Cost	Assigned	Cost	Assigned	Cost
Water Supply	**$68.3**	**–**	**$68.3**	**$49.8**	**43.0%**	**$49.8**	**60.3%**	**$30.1**	–	–	**39.7%**	**$19.8**
Agricultural	*$18.9*	–	*$18.9*	*$13.8*	*11.9%*	*$13.8*	*100%*	*$13.8*	–	–	–	–
M&I	*$22.3*	–	*$22.3*	*$16.3*	*14.0%*	*$16.3*	*100%*	*$16.3*	–	–	–	–
Emergency	*$27.1*	–	*$27.1*	*$19.8*	*17.1%*	*$19.8*	–	–	–	–	*100%*	*$19.8*
M&I Water Quality	–	–	–	–	–	–	*100%*	–	–	–	–	–
Ecosystem / Fish & Wildlife Enhancement	**$75.6**	**$4.8**	**$70.8**	**$51.6**	**48.7%**	**$56.4**	**–**	–	**50%**	**$28.2**	**50%**	**$28.2**
Hydropower[5]	**$1.6**	–	**$1.6**	**$1.2**	**1.0%**	**$1.2**	**100%**	**$1.2**	–	–	–	–
Recreation	**$7.4**	**$0.4**	**$7.0**	**$5.1**	**4.8%**	**$5.5**	**–[8]**	**$0.6[8]**	**50%[8]**	**$2.5**	**50%[8]**	**$2.5**
Flood Damage Reduction	**$4.0**	–	**$4.0**	**$2.9**	**2.5%**	**$2.9**	**–**	–	**50%**	**$1.5**	**50%**	**$1.5**
TOTAL[9]	**$156.9**	**$5.2**	**$151.7**	**$110.6**	**100%**	**$115.9**	**27.4%**	**$31.8**	**27.8%**	**$32.1**	**44.8%**	**$51.9**

Notes:

General. This information is preliminary and for illustrative purposes only. Cost and benefit information based on annual values; line item values may not sum to total due to rounding.

[1] Annual benefits used for this preliminary cost allocation are displayed in Table 5-9 for Alternative Plan 4. California-level ecosystem benefits with low SAR are used for this preliminary cost allocation. See Table 5-3 for a more detailed summary of the range of ecosystem benefit estimates.

[2] Annual benefits are the justifiable expenditure for each purpose because single-purpose alternative costs have not been estimated at this stage in the Investigation. It is likely that any single-purpose alternative costs will exceed each purpose's benefits and not affect the justifiable expenditure calculation.

[3] Specific costs are used instead of separable costs with the AJE approach. Including separable costs may change allocated joint cost percentages.

[4] Remaining benefits = Benefits less separable costs, but must be greater than $0. Remaining benefits are the remaining justifiable expenditure after specific costs have been removed from each project purpose.

[5] Total project costs less sum of separable costs (specific costs for AJE approach), times percentage share of remaining benefits.

[6] Sum of specific costs and allocated joint costs.

[7] Hydropower values represent only hydropower at Friant Dam.

[8] For recreation, investment cost is split 50%/50%, but O&M cost would be 100% reimbursable.

[9] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:% = percent
$ million = million dollars
AJE = alternative justifiable expenditure
M&I = municipal and industrial
O&M = operations and maintenance
SAR = smolt-to-adult return rate

Payment Capacity/Ability to Pay

Financial feasibility is ultimately based on the ability of project beneficiaries to pay their allocated and assigned costs associated with a recommended plan. Payment capacity/ability to pay analysis is necessary to assess the financial capacity of non-Federal project beneficiaries to absorb additional costs associated with benefits they would receive under the recommended plan. These preliminary payment capacity/ability to pay analyses for agricultural and M&I water supply beneficiaries are presented for the representative plan for illustrative purposes only. Further payment capacity/ability to pay analysis will be performed for the Final Feasibility Report with the recommended plan.

An initial ability to pay analysis for potential agricultural water supply beneficiaries was developed in 2011 for four regions of the CVP using four representative contractors. Financial feasibility for agricultural water supply was evaluated by comparing the representative beneficiaries' ability to pay with potential agricultural water costs developed with two approaches. For CVP agricultural water supply, the marginal increase in the cost of water for existing agricultural contractors would be approximately $3.95 per acre-foot ($3 for repayment and $0.95 for other annualized costs). If new contracts were required, agricultural water costs would be approximately $212 per acre-foot ($161 for repayment and $51 for other annualized costs). Based on current CVP and SWP operational assumptions and studies to date with the representative plan, agricultural water supply beneficiaries only have the ability to pay the marginal increase in the cost of water; however, it is recognized that further refinement and changes may occur to this and other alternative plans.

Payment capacity was estimated for M&I water supply beneficiaries based on household median income affordability thresholds. Financial feasibility for M&I water supply was evaluated by comparing representative beneficiaries' payment capacity with the allocated annualized costs. Studies to date indicate that M&I water supply beneficiaries' payment capacity significantly exceeds potential costs allocated to this purpose for the representative plan and beneficiaries have the ability to pay for potential water supply reliability benefits they would receive. For M&I water supply, if new contracts were required, M&I water costs for the project would be approximately $1,305 per acre-foot ($1,054 for repayment, and $251 for other annualized costs).

Key Findings

View of Temperance Flat RM 274 Dam Site

Key findings to date about the feasibility of Temperance Flat RM 274 Reservoir alternative plans and evaluations in this Draft Feasibility Report include:

- All alternative plans would provide benefits for water supply reliability, enhancement of the San Joaquin River ecosystem, emergency water supply, hydropower, recreation, and flood damage reduction.
- All alternative plans are projected to be technically feasible, constructible, and can be operated and maintained.
- Environmental analyses conducted to date suggest that all alternative plans would be environmentally feasible. Environmental impacts of the alternative plans will be evaluated further in the pending Draft EIS/EIR.
- All alternative plans are currently economically feasible, provide a wide range of benefits, and would provide estimated benefit values that exceed estimated costs.
- Based on preliminary analysis of an example alternative, all alternative plans are projected to be financially feasible, depending upon the approach to recover costs.
- A recommended plan is not identified in this report; the alternative plan with the greatest net benefits of those evaluated is used as a representative plan for financial feasibility and other analyses, but was not optimized for accomplishments, benefits, or repayment.
- All alternative plans evaluated in this report were formulated to be largely independent of Delta export operations and balance traditional economic benefits dependent on active storage capacity and public benefits influenced by minimum carryover storage target. This balancing was intended to increase net benefits and potential public benefits within the constraints, and incorporate the planning objectives.

- The amount of new water supply that could be developed by Temperance Flat RM 274 Reservoir is strongly influenced by a variety of factors, including minimum carryover storage, CVP and SWP operating conditions in the Delta, conveyance improvements, and climate change. Results from sensitivity evaluations were included to demonstrate the range of variability that could be expected under a wider range of operations.

- Integration of Temperance Flat RM 274 Reservoir operations with the CVP and SWP is not included in the alternative plans; however, previous evaluations show that doing so would significantly increase water supply, ecosystem, and other benefits under potential future conditions with increased flexibility for Delta export operations.

- Climate change could affect water supply reliability and other resources in the No Action Alternative and all alternative plans.

- All alternative plans would not interfere with implementation of the SJRRP, and would provide beneficial effects in support of the Restoration Goal and Water Management Goal of the Settlement being implemented through the SJRRP.

- All alternative plans could increase the volume of Restoration Flows eligible for downstream recapture and enhance San Joaquin River habitat for anadromous fish through providing a larger cold-water pool; improving the capability, reliability, and flexibility to release water at suitable temperatures downstream from Friant Dam; and providing additional flow from Friant Dam to Mendota Pool (for water supply exchanges).

- The monetary valuation of ecosystem benefits is challenging, but the range of benefits clearly illustrates that the ecosystem benefits are sufficient to demonstrate economic feasibility.

Reach 2A of the San Joaquin River

Millerton Lake

Risk and Uncertainty

Various risks and uncertainties associated with the Investigation include:

- **Hydrology and Climate Change –** Uncertainty exists regarding the potential for, and magnitude of, climate change causing changes in temperature, precipitation, and snow levels.

- **Water Supply Reliability and Demands –** There are numerous variables considered in projecting accurate and quantified water supply and shortages in California and, just as important, numerous opinions regarding these variables, depending on anticipated population growth scenarios, land-use patterns, and water-use efficiency actions.

- **Water System Operations Analysis –** Predictions of future water system operations depend on assumptions about future facilities, operational constraints, and other programs and planning policies that are subject to change, include implementation of and changes in Delta export infrastructure, regulations, or policies resulting from the biological opinions (BO) for the Coordinated Long-Term Operation of the CVP and SWP, new U.S. Endangered Species Act (ESA) listings, or recommendations from various planning processes for the Delta, including the Delta Vision, Delta Plan, and the Bay Delta Conservation Plan (BDCP).

- **San Joaquin River Ecosystem Enhancement –** Predicting anadromous fish survival is difficult because of many influencing factors, including limited data on the survival of San Joaquin River Chinook salmon. Models used to predict fish habitat for this Draft Feasibility Report contains assumptions with varying levels of uncertainty. The effects of the alternative plans on the i mplementation of the SJRRP will continue to be evaluated.

- **Cost Estimates –** Varying uncertainties are associated with the material and unit costs used to develop cost estimates, including the price of construction materials and labor costs. Trends from the past few years were used to estimate the cost of materials and labor, but other factors could further influence price changes.

Next Steps for the Feasibility Study

This Draft Feasibility Report is a significant milestone in the Investigation. Based on the findings of the Investigation to date, the next steps for the Investigation include:

Friant-Kern Canal

- Solicit public input on the Draft Feasibility Report.
- Prepare, release, and solicit public input on the Draft EIS/EIR.
- Continue to refine and evaluate alternative plans and identified measures to respond to public comments and reflect potential changes to existing and likely future conditions.
- Perform additional climate change analysis to describe potential effects that future climate change and related operations would have on water supply and other resource areas.
- Perform additional geologic investigations; refine feature designs and cost estimates, including river outlet works and diversion plan, additional low-level outlet, reservoir clearing, and affected facilities; and update cost estimates with current unit pricing and escalation.
- Refine estimates for non-contract costs, including project area lands requirements, and environmental and cultural resources mitigation costs consistent with mitigation requirements identified in the Draft and Final EIS/EIR.
- Update estimates of accomplishments and benefits of the alternative plans and identify the recommended plan (consistent with the P&G).
- Identify and confirm specific non-Federal partner(s) and beneficiaries.
- Update cost allocation using the SCRB method to allocate costs to project purposes and assess financial capability of non-Federal partner(s) and beneficiaries.
- Continue to coordinate with stakeholders and other agencies to address and work toward resolving issues that are unresolved at this stage of the Investigation.

Unresolved Issues

Subject areas that need to be addressed during upcoming phases of the Investigation are described below. All reasonable efforts will be made to resolve these issues in the Final Feasibility Report and EIS/EIR.

- **Non-Federal Partner(s) –** If authorized for construction, a recommended plan would likely require a portion of its costs to be shared and/or reimbursed by a non-Federal partner(s) or other beneficiaries.

- **Water Rights –** Potential changes to the terms and conditions of existing Reclamation water rights permits may be required for proposed operations.

- **Native American and Cultural Resources –** The Draft and Final EIS/EIR will include supporting information consistent with the National Historic Preservation Act, Section 106. Tribal groups will continue to have the opportunity to participate and provide input to the Investigation through the Section 106 and NEPA processes.

- **Environmental Impacts and Mitigation Requirements –** The assessment of potential impacts of alternative plans on environmental resources, along with proposed mitigation measures, will be documented in the Draft and Final EIS/EIR.

- **Special Designations –** Coordinate with U.S. Department of the Interior, Bureau of Land Management (BLM) on their preliminary determination that the San Joaquin River segment from Kerckhoff Dam to Kerckhoff Powerhouse is suitable for inclusion in the National Wild and Scenic Rivers System.

- **Hydropower Mitigation –** Additional hydropower refinements may be considered before completing the feasibility study, such as refinements in unit number, size, and operation, and additional mitigation components. Hydropower mitigation issues will continue to be coordinated with affected stakeholders during development of the Final Feasibility Report.

San Joaquin River near Kerckhoff Powerhouse

Implementation Requirements and Timeline

After the feasibility study is completed, the following requirements would need to be addressed before the project could be implemented.

- **Feasibility Report Approval –** The Final Feasibility Report would be submitted by the Commissioner of Reclamation to the Secretary of the Interior. After review by the Office of Management and Budget, the Secretary would transmit the Final Feasibility Report, EIS/EIR, and ROD to Congress. The Secretary may recommend any of the alternatives, including the No-Action Alternative.

- **Federal Project Authorization and Funding –** If Congress authorizes project construction, funding for the authorized project would be included in either an appropriations act or the president's budget.

- **Non-Federal Project Authorization and Funding –** Federal funding may be supplemented by State or local funding in various ways. If passed by voters, State or local bonds could provide funds to pay costs allocated to State or local taxpayers.

- **Regulatory Requirements for Environmental Compliance –** Construction and operations of a recommended alternative plan would be subject to Federal, State, and local laws, policies, and environmental regulations. Reclamation would need to obtain various permits and regulatory authorizations before project construction could begin.

- **Preconstruction and Construction Activities –** If Congress authorizes a project and appropriates funds, then detailed project designs would be initiated, a Definite Plan Report would be prepared, and real estate acquisitions could be initiated. Preconstruction activities may take approximately 3 years, and construction activities could take 8 or more years.

- **Federal Responsibilities** – If authorized, the Federal Government would likely construct the project and implement related mitigation requirements. Reclamation and other Federal agencies could be responsible for various O&M activities.

- **Non-Federal Responsibilities** – If authorized for Federal construction, the non-Federal partner(s) would need to agree to perform items of local and State cooperation specific to the authorized purposes of the project and share in the cost of the recommended plan.

Figure ES-7 is an estimated timeline of major actions to complete the feasibility study and future milestones leading to potential project implementation.

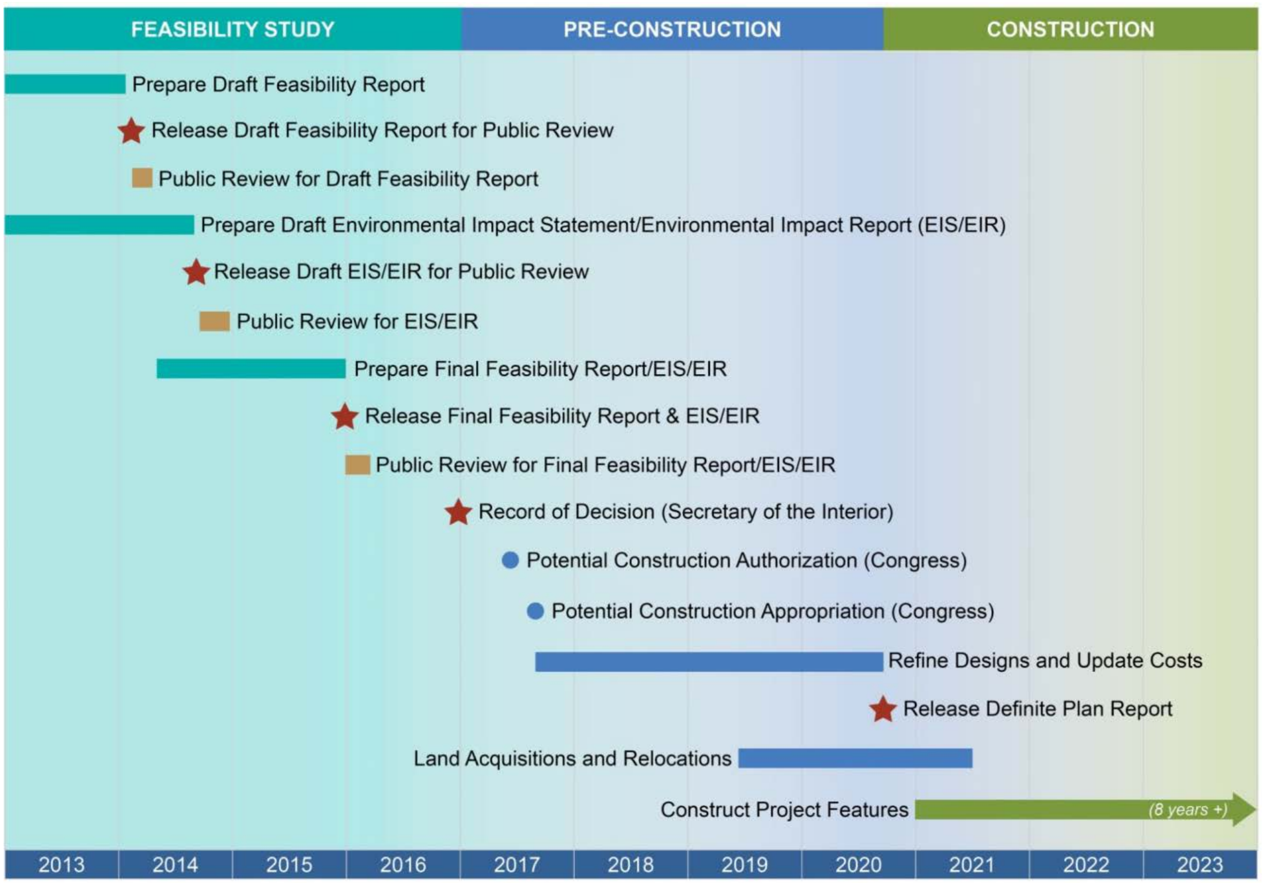


Figure ES-7. Upper San Joaquin River Basin Storage Investigation Project Timeline

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Abbreviations and Acronyms

°F	degrees Fahrenheit
2004 NMFS BO	Biological Opinion on the Long-Term CVP and SWP OCAP (NMFS 2004)
2005 USFWS BO	Reinitiation of Formal and Early Section 7 ESA Consultation on the Coordinated Operations of the CVP and SWP and the OCAP to Address Potential Critical Habitat Issues (USFWS 2005)
2008 USFWS BO	Revised Biological Opinion on the Coordinated Operations of the CVP and SWP in California (USFWS 2008a)
2009 NMFS BO	Final Biological and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009)
ACWD	Alameda County Water District
AJE	alternative justifiable expenditure
ALP	Alternative Licensing Process
ATP	ability to pay
BA	Biological Assessment
Bay Area	San Francisco Bay Area
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
Bay Delta Plan	Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
BDCP	Bay Delta Conservation Plan
BLM	U.S. Department of the Interior, Bureau of Land Management
BO	biological opinion
Cal/EPA	California Environmental Protection Agency
CALFED	CALFED Bay-Delta Program
CalSim II	California Statewide Simulation Model
CAS	Corrective Action Study
CCD	Fresno Census-County Division
CDFW	California Department of Fish and Wildlife (formerly the DFG)
Central Valley Water Board	Central Valley Regional Water Quality Control Board (formerly the CVRWQCB)
CEQA	California Environmental Quality Act

CESA	California Endangered Species Act
cfs	cubic feet per second
CMP	Common Model Package
CNDDB	California Natural Diversity Database
Commission	California Water Commission
Comprehensive Study	Sacramento and San Joaquin River Basins Comprehensive Study
CSAMP	collaborative science and adaptive management program
CVFMP	Central Valley Flood Management Program
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
CWC	California Water Code
D-1485	Water Right Decision 1485
D-1641	Water Rights Decision 1641
DDT	dichlorofiphenyl-trichloroethane
DEC	Design, estimating, and Construction
Delivery Impact Report	A CVP Yield Feasibility Investigation Report: The Delivery Impact of CVPIA
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
District Court	District Court for the Eastern District of California
DMC	Delta-Mendota Canal
DPR	California Department of Parks and Recreation
DRMS	Delta Risk Management Strategy
DSM2	Delta Simulation Model
DWR	California Department of Water Resources
E. coli	Escherichia coli
EA	Environmental Assessment
EAD	estimated annual damages
EC	electrical conductivity
EDT	ecosystem diagnosis and treatment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency

EQ	environmental quality
ESA	Endangered Species Act
Exchange Contractors	San Joaquin River Exchange Contractors Water Authority
FERC	Federal Energy Regulatory Commission
FloodSAFE	FloodSAFE California
FPA	Friant Power Authority
FWUA	Friant Water Users Authority
GAMA	Groundwater Ambient Monitoring and Assessment
GP	General Plan
GRCD	Grassland Resource Conservation District
GWh	gigawatt-hours
HCP	Habitat Conservation Plan
HEC-FDA	USACE Hydraulic Engineering Center Flood Damage Assessment model
I/O	input/output
IAIR	Initial Alternatives Information Report
IDC	interest during construction
IMPLAN	IMpact analysis for PLANning
Investigation	Upper San Joaquin River Basin Storage Investigation
IRWM	Integrated Regional Water Management
ITA	Indian Trust Assets
LCPSIM	Least Cost Planning Simulation Model
LLIS	low-level intake structure
LTGen	LongTermGen
M&I	municipal and industrial
MAA	Management Agency Agreement
MAF	million acre-feet
MW	megawatts
MWD	Metropolitan Water District of Southern California
NAHC	Native American Heritage Commission
NAWQA	National Water Quality Assessment
NCCP	Natural Community Conservation Plans
NCCPA	Natural Communities Conservation Planning Act
NED	national economic development

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOD	north-of-Delta
NODOS	North-of-the-Delta Offstream Storage
NOI	Notice of Intent
NOP	Notice of Preparation
NRDC	National Resources Defense Council
NRHP	National Register of Historical Places
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic Rivers System
O&M	operations and maintenance
OM&R	operation, maintenance, and replacement
O_3	ozone
OCAP	Operations Criteria and Plan
OSE	other social effect
P&G	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
P&R	Principles and Requirements for Federal Investments in Water Resources
PCA	Project Cooperation Agreement
PCB	polychlorinated biphenyl
PCT	Project Coordination Team
PEIS/R	Programmatic Environmental Impact Statement/Report
PFR	Plan Formulation Report
PG&E	Pacific Gas and Electric Company
PM	particulate matter
PM_{10}	particulate matter standards of 10 microns in aerometric diameter or less
$PM_{2.5}$	particulate matter standards of 2.5 microns or less
PRC	California Public Resources Code
RCC	roller-compacted concrete
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RED	regional economic development
RM	river mile
RMP	Resource Management Plan
ROD	Record of Decision

RPA	Reasonable and Prudent Alternative
RWA	Recovered Water Account
RWQCB	Central Valley Regional Water Quality Control Board
SALMOD	Salmonid Population Model
San Francisco Bay Water Board	San Francisco Bay Regional Water Quality Control Board (formerly the SFBRWQCB)
SAR	smolt-to-adult return rate
SB	Senate Bill
SBX7-2	Safe, Clean, and Reliable Drinking Water Act of 2012
SCE	Southern California Edison
SCRB	separable costs-remaining benefits
SCVWD	Santa Clara Valley Water District
SDIP	South Delta Improvements Program
Settlement	Stipulation of Settlement in NRDC et al. vs. Kirk Rodgers et al.
SJAFCA	San Joaquin Area Flood Control Agency
SJRA	San Joaquin River Agreement
SJRC	San Joaquin River Conservancy
SJRGMA	San Joaquin River Gorge Management Area
SJRRP	San Joaquin River Restoration Program
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SLIS	selective level intake structure
SLLPIP	San Luis Low Point Improvement Project
SMT	Study Management Team
SOD	south-of-Delta
SPFC	State Plan of Flood Control
SRA	State Recreation Area
SRWQM	Sacramento River Water Quality Model
State	State of California
State Parks	State of California Department of Parks and Recreation
State Water Board	State Water Resources Control Board (formerly the SWRCB)
SWAMP	Surface Water Ambient Monitoring Program
SWAP	Statewide Agricultural Production Model
SWP	State Water Project

SWP Power	SWP Power California
TAF	thousand acre-feet
TCD	temperature control device
TDS	total dissolved solids
TMDL	total maximum daily load
TWG	Technical Working Group
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Program
WA	Wildlife Area
WAM	Water Analysis Module
WDR	Waste Discharge Requirement
WIM	Watershed Improvement Measure, Measure "W"
WMA	Wildlife Management Area
WQCP	Water Quality Control Plan
WSD	Water Storage District
WY	water year

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Chapter 1
Introduction

Aerial View of Millerton Lake and Upper San Joaquin River Basin

The Upper San Joaquin River Basin Storage Investigation (Investigation) is a joint feasibility study 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 potential 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 for improving water supply reliability and flexibility of the water management system for agricultural, urban, and environmental uses; and enhancing San Joaquin River water temperature and flow conditions to support anadromous fish restoration efforts.

The Investigation is one of five surface water storage studies recommended in the CALFED Bay-Delta Program (CALFED) Programmatic Environmental Impact Statement/Report (PEIS/R) Record of Decision (ROD) of August 2000. 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 ROD (CALFED 2000a, 2000b, 2000c).

Progress and results of the Investigation have been documented in a series of interim reports that will culminate in a Feasibility Report and Environmental Impact Statement (EIS)/ Environmental Impact Report (EIR), 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; DWR guidance; and applicable environmental laws and policies. The Feasibility Report and EIS/EIR address and build on the results of the feasibility study process and findings of previous planning documents, including the *Phase 1 Investigation Report* (Reclamation 2003), *Initial Alternatives Information Report* (Reclamation 2005b) and *Plan Formulation Report* (Reclamation 2008a). After a detailed plan formulation and site selection process, Temperance Flat River Mile (RM) 274 Reservoir was identified as the site to be carried forward for more detailed analysis in the feasibility phases of the Investigation (Reclamation 2008a).

Draft Feasibility Report Purpose and Organization

The primary purpose of this Draft Feasibility Report is to (1) present the results to date of the ongoing Investigation; (2) determine the potential type and extent of Federal and non-Federal interest in alternative plans to improve water supply reliability and flexibility of the water management system for agricultural, urban, and environmental uses; enhance San Joaquin River water temperature and flow conditions to support anadromous fish restoration efforts; and address related water resources needs and opportunities; (3) evaluate potential benefits and effects of alternative plans; and (4) determine technical, environmental, economic, and financial feasibility of alternative plans. Consideration of comments received on the Draft Feasibility Report and pending Draft EIS/EIR will be reflected in the Final Feasibility Report.

This Draft Feasibility Report includes the following topics:

- **Chapter 1** describes the study authorization; project background; and a summary of problems, needs and opportunities, and Investigation planning objectives. The chapter also describes the Investigation study area; and prior studies, projects, and programs pertinent to the Investigation.

- **Chapter 2** describes the identified problems, needs, and opportunities; and existing and likely future water resources and related conditions in the study area.

- **Chapter 3** describes the plan formulation process, including planning objectives and opportunities; planning constraints, principles, and criteria used to help guide the Investigation; and management measures, storage site selection, and refinement of features and operations for alternative plans.

- **Chapter 4** presents the No-Action Alternative and alternative plans, including features, operations, and physical accomplishments.

- **Chapter 5** provides the evaluation and comparison of alternative plans by P&G criteria and presents the rationale for selection of a recommended plan.

- **Chapter 6** describes the representative plan, including its features and accomplishments, allocation and assignment of costs, Federal and non-Federal responsibilities, and potential implementation schedule.
- **Chapter 7** provides an overview of coordination and public involvement for the Investigation, including stakeholder outreach, public involvement plan, and agency coordination and consultation.
- **Chapter 8** summarizes major findings of this Draft Feasibility Report
- **Chapter 9** contains the sources used to prepare this Draft Feasibility Report.

Study Authorization and Guidance

Federal and State authorizations for the Investigation and related guidance are described below.

Federal Authorization

Reclamation is the Federal lead agency for the Investigation. Federal authorization for the Investigation was initially provided in Public Law 108-7, Division D, Title II, Section 215, the omnibus appropriations legislation for Fiscal Year 2003, 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 (2000a), including the Investigation:

> *The Secretary of the Interior, in carrying out CALFED-related activities, may undertake feasibility studies for Sites Reservoir, Los Vaqueros Reservoir Enlargement, and Upper San Joaquin Storage projects. These storage studies should be pursued along with ongoing environmental and other projects in a balanced manner.*

Subsequent authorization and funding for the Investigation was provided in Public Law 108-361, Title I, Section 103, Subsection (d)(1)(A)(ii), the Water Supply, Reliability, and Environmental Improvement Act, signed October 25, 2004:

> *Planning and feasibility studies for the following projects requiring further consideration –…(II) the Upper San Joaquin River storage in Fresno and Madera Counties.*

At the conclusion of the Investigation, the Secretary may submit the Feasibility Report to Congress with a recommendation to construct with Federal funding, according to Public Law 108-361, Title I, Section 103, Subsection (d)(1)(B)(i):

> *If on completion of the feasibility study for a project described in clause (i) or (ii) of subparagraph (A), the Secretary, in consultation with the Governor, determines that the project should be constructed in whole or in part with Federal funds, the Secretary shall submit the feasibility study to Congress.*

State of California Authorization

DWR is the State lead agency for the Investigation. Section 227 of the California Water Code (CWC) authorizes DWR to participate in water resources investigations:

> *The department may investigate any natural situation available for 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. The department may ascertain the feasibility of projects for such reservoirs or reservoir systems, the supply of water that may thereby be made available, and the extent and character of the areas that may be thereby irrigated. The department may estimate the cost of such projects.*

Guidance in the CALFED Record of Decision

The principal objective of CALFED was to develop a comprehensive, long-term strategy to provide reliable water supplies to cities, agriculture, and the environment while restoring the overall health of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta). The National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) lead agencies for the CALFED PEIS/R were Reclamation and DWR, respectively.

Several program elements were defined that, in combination, would help attain the overall goals of CALFED. The CALFED ROD recommended numerous projects and actions to increase water supply reliability, improve ecosystem health, increase water quality, and improve Sacramento-San Joaquin Delta (Delta) levee stability (CALFED 2000a).The Storage Program element included five investigations of potential increased surface storage capabilities at various locations in the Central Valley, including the upper San Joaquin River Basin, as well as efforts to increase groundwater storage through conjunctive management. 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.*

Summary of Problems, Needs, Opportunities, and Planning Objectives

Several water and related resources problems, needs, and opportunities were identified for the Investigation based on the study authorization, information from prior studies, projects, programs, existing and likely future water resources conditions, and input to the study process through public outreach. Planning objectives were then developed on the basis of identified problems, needs, and opportunities, study authorities, and other pertinent direction, including information contained in the 2000 CALFED ROD.

Problems, Needs, and Opportunities

Water and related resources problems, needs, and opportunities include water supply reliability and operational flexibility, San Joaquin River ecosystem, and other resources, as summarized below and discussed in detail in Chapter 2.

Water Supply Reliability and Operational Flexibility

> Without further investment in water management and infrastructure, future statewide shortages are expected to increase to approximately 4.9 million acre-feet per year by 2030 (DWR 2009a).

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, future 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 environmental and agricultural water becomes less available, and a greater reliance on limited groundwater results in overdraft (DWR 2009a).

Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. Increasing Central Valley Project (CVP) and State Water Project (SWP) operational constraints have also led to growing competition for limited system resources. Another potentially significant factor affecting water supply reliability is climate change, which could broadly impact precipitation and runoff, snowpack, flood risk management, water demand, and sea levels. In addition to concerns about future water supply and demand, the CVP and SWP lack flexibility in timing, location, and storage capacity to meet multiple purposes. The water and flood systems face the threat of too little water to meet needs during droughts and too much water during floods, respectively. In the Friant Division of the CVP, the 520 thousand acre-foot (TAF) storage capacity of Millerton Lake, located on the upper San Joaquin River, is small compared to the average annual inflow to the lake of approximately 1.8 MAF and limits the Reclamation's ability to capture additional water in wet years. Passage of the San Joaquin River Restoration Settlement Act in 2009 required Reclamation to release additional flows from Friant Dam to the San Joaquin River, adding operational requirements for which the dam was not originally designed, and reducing water supply allocations to the Friant Division.

Improved water management flexibility and adaptability capabilities are needed to meet current and future challenges associated with increasing population, environmental needs, and climate change. An integrated portfolio of solutions, regional and statewide, to meet future water supply needs would include increased urban water use efficiency, recycling of municipal supplies, and improving Delta conveyance. In addition, development of additional water sources will be critically important in any future water resources plan.

San Joaquin River Ecosystem

After construction of Friant Dam and before implementation of the San Joaquin River Restoration Program (SJRRP), the San Joaquin River between Friant Dam and the Merced River confluence did not support a continuous riparian and aquatic ecosystem. Generally unhealthy ecosystem conditions for the native cold water fishery resulted from lack of reliable flows and poor water temperatures in the San Joaquin River.

Implementing the SJRRP is expected and intended to alter the ecosystem conditions of the San Joaquin River, with a goal to restore and maintain fish populations in "good condition" in the main stem 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. Actions to achieve the Restoration Goal include the release and conveyance of Restoration Flows from Friant Dam to the confluence of the Merced River, several channel capacity and fish passage improvements, and introduction of Chinook salmon.

In addition to flow, success of Chinook salmon populations is known to be affected by water temperature. Water temperatures that are too high, or in some cases too low, could be detrimental to the various life stages of salmon.

Other Resources

Several other problems, needs, and opportunities associated with the San Joaquin River have been identified. Major storms during the past 3 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. River water quality is degraded due to low flow and poor quality discharges. Urban drinking water treatment costs are rising.

Planning Objectives

A set of primary and secondary planning objectives were developed for the Investigation to address identified problems, needs, and opportunities described above. Primary planning 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 planning objectives.

- Primary planning objectives are:
  - Increase water supply reliability and system operational flexibility for agricultural, municipal and industrial (M&I), and environmental purposes in the Friant Division, other San Joaquin Valley areas, and other regions.
  - Enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River in support of restoring and maintaining naturally reproducing and self-sustaining anadromous fish (i.e., spring-run and fall-run Chinook salmon [*Oncorhynchus tshawytscha*]) and other fish populations.
- Secondary planning objectives are:
  - Reduce frequency and magnitude of flood releases from Friant Dam.
  - Maintain the value of hydropower attributes.
  - Maintain and increase recreational opportunities in the primary study area.
  - Improve San Joaquin River water quality downstream from Friant Dam.
  - Improve quality of water supplies delivered to urban areas.

Additional details regarding the objectives are provided in Chapter 3.

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, the San Joaquin River carries snowmelt and rainfall runoff from mountain meadows south of Yosemite National Park to the valley floor near Fresno. Tributaries to the San Joaquin River from the east include the Merced, Tuolumne and the Stanislaus rivers; small streams, sloughs, wetlands, and agricultural drainage provide 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 Investigation includes both a primary and extended study area to reflect the localized effects of a potential new major dam and reservoir at Temperance Flat RM 274, and the effects of subsequent water deliveries over a rather large geographic area. The primary study area was refined as the Investigation has progressed and the number and location of storage sites have been narrowed. The primary study area presented in this Draft Feasibility Report 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.

- 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 includes locations of potential project features and areas potentially affected by alternative implementation and/or operation. 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 for physical, biological, cultural, and socioeconomic resources within the Investigation study area will be included in the Draft EIS/EIR.

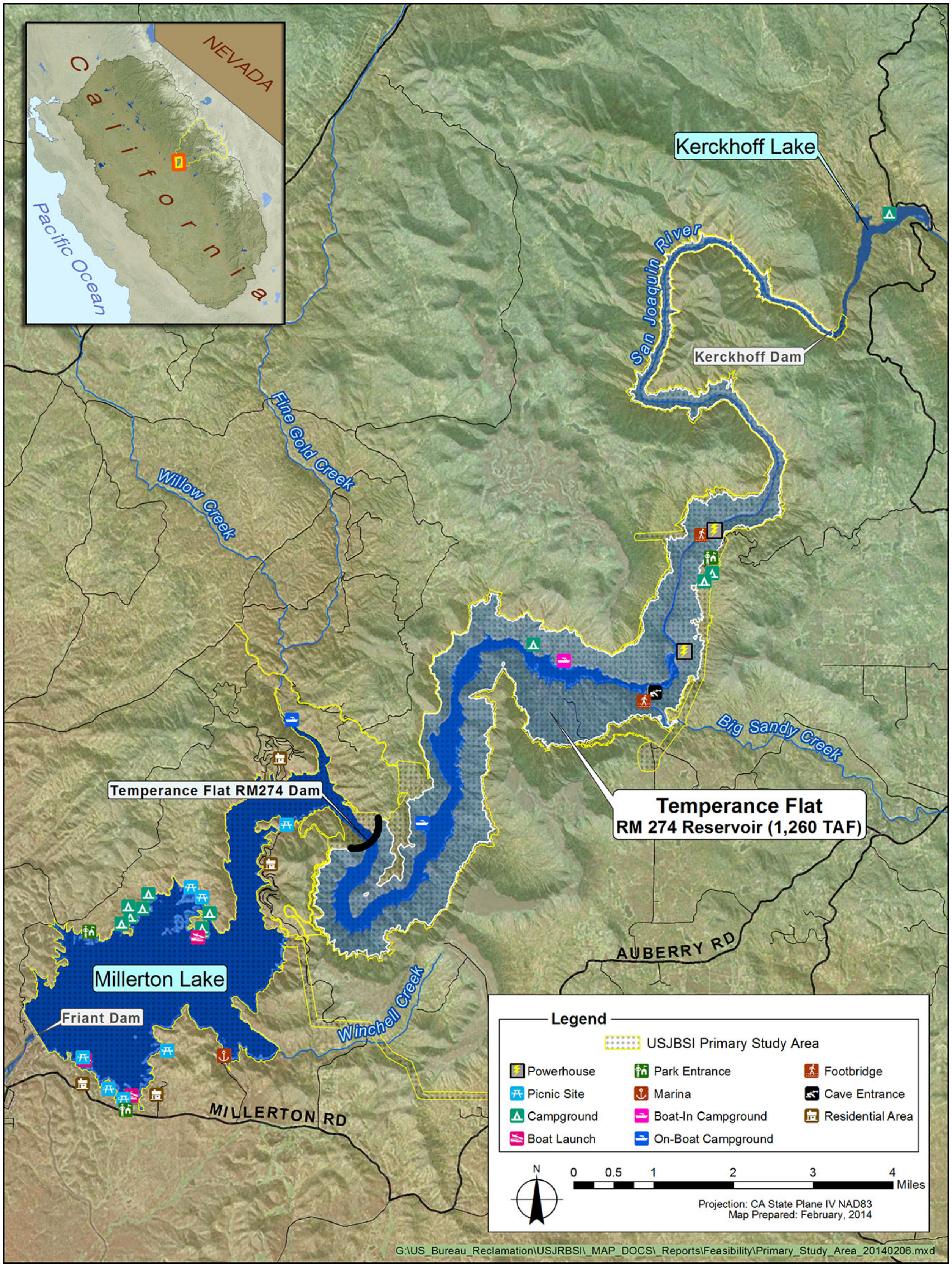


Figure 1-1. Primary Study Area and Temperance Flat RM 274 Reservoir

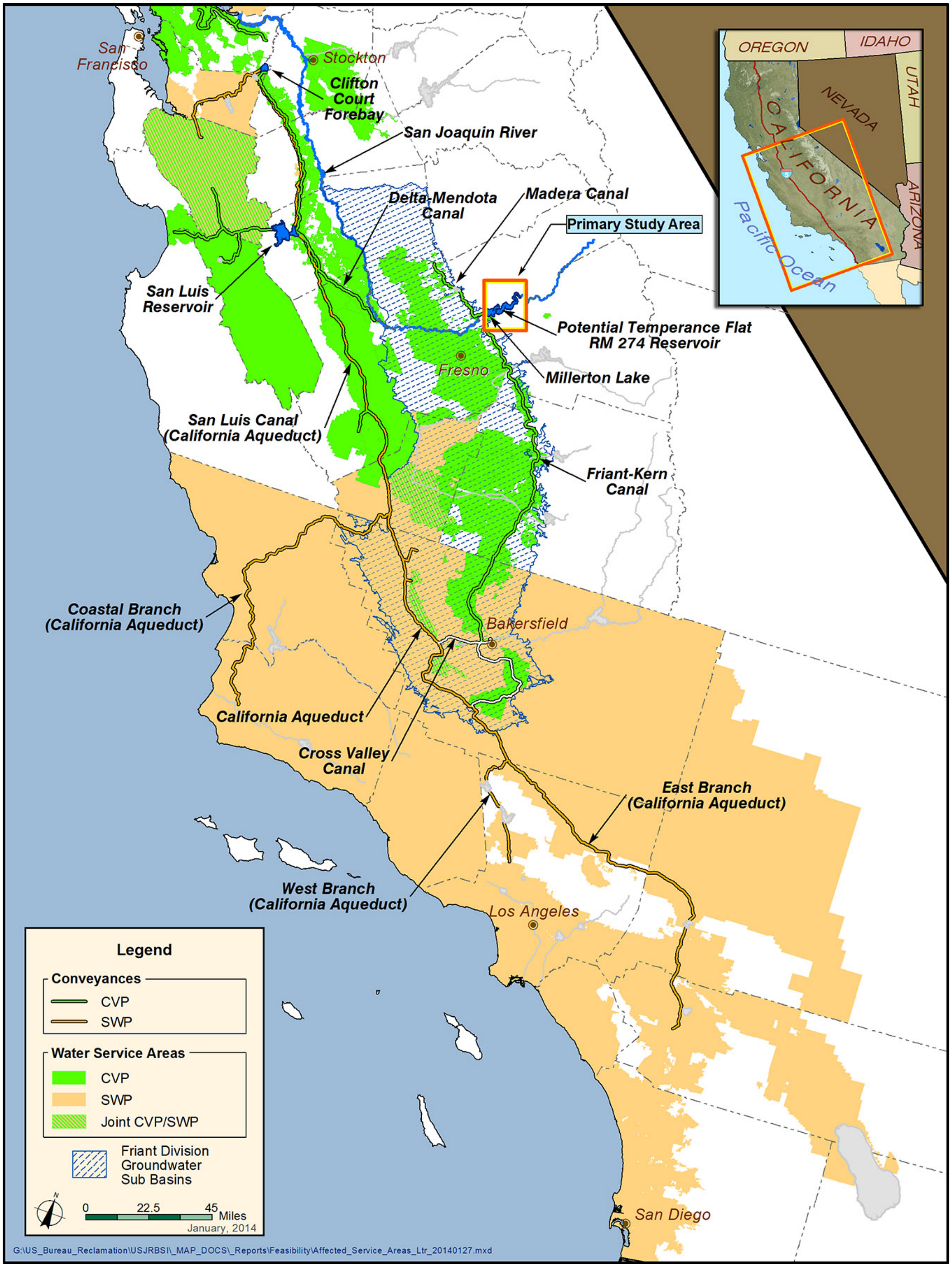


Figure 1-2. Extended Study Area

Related Studies, Projects, Programs, and Plans

Various Federal and State agencies, including Reclamation, U.S. Army Corps of Engineers (USACE), and DWR, and numerous local working groups and private organizations are conducting activities pertinent to the Investigation. A summary of these pertinent studies, projects, programs, and plans in the study area follows.

Federal

Federal studies, projects, programs, and plans relevant to the Investigation are described below.

U.S. Department of the Interior, Bureau of Reclamation

As the owner and operator of the CVP, including Friant Dam and Millerton Lake, Reclamation has many ongoing projects or continuing programs and plans relevant to the Investigation.

Central Valley Project

The CVP, the largest surface water storage and delivery system in California (see Figure 1-2), supplies water to more than 250 long-term water contractors in the Central Valley, Tulare Lake Basin, and San Francisco Bay Area (Bay Area) (Reclamation 2013a). CVP service areas, shown in Figure 1-2, cover 29 of the State’s 58 counties. Operated by Reclamation, the CVP consists of 20 reservoirs capable of storing over 11 MAF of water, 11 power plants; 500 miles of major canals and aqueducts; and many tunnels, conduits, and power transmission lines (Reclamation 2013a). Annually, the CVP has the potential to supply about 7.0 MAF for agricultural, urban and industrial, and wildlife uses (Reclamation 2013a). The CVP also provides flood protection, navigation, power, recreation, and water quality benefits.

Prior Studies of Enlarging Friant Dam

Several previous studies examined the potential to provide new water storage at Millerton Lake. In 1952, 10 years after completion of Friant Dam, Reclamation conducted a study to determine the feasibility of raising Friant Dam (Reclamation 1952). The study included designs and costs for raising Friant Dam by 60 feet and constructing four earth saddle dams. Based on a comparison of costs to potential revenue from the sale of increased yield, the study concluded that the raise would be infeasible.

Reclamation revisited the potential cost for a 60-foot raise at a reconnaissance level in 1975, and developed a cost estimate for an approximate 140-foot raise in 1982 (Reclamation 1982). In 1997, Reclamation again reconsidered the feasibility of raising Friant Dam to provide additional storage capacity in Millerton Lake. Raises of 60 feet and 140 feet were considered (Reclamation 1997). Also, in 2000, a study conducted for the Friant Water Users Authority (FWUA) and Natural Resources Defense Council (NRDC) coalition considered a 20-foot raise of Friant Dam as one of many alternatives for increasing potential water supply to the San Joaquin River (FWUA and NRDC 2002).

Central Valley Project Improvement Act

Enacted in 1992, the Central Valley Project Improvement Act (CVPIA) addresses conflicts over water rates, irrigation land limitations, and environmental impacts of the CVP. 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 2008b).

CVP Yield Feasibility Investigation: Delivery Impact of CVPIA

In May 2005, Reclamation quantified the delivery impacts of the CVPIA on the CVP and analyzed a wide range of storage and conveyance projects to offset these impacts in *A CVP Yield Feasibility Investigation Report: The Delivery Impact of CVPIA* (Delivery Impact Report) (Reclamation 2005a). Total delivery impacts of the CVPIA to agricultural and M&I contractors were determined to be 516 TAF in average water years and 586 TAF in dry years, with impacts to SOD contractors being much greater than impacts to north-of-Delta (NOD) contractors, and impacts to agricultural contractors being much greater than impacts to M&I contractors. In the

Delivery Impact Report, Reclamation analyzed 90 difference combinations of increased conveyance, increased NOD storage, and increased SOD storage. Reclamation recommended continued participation in CALFED programs, participation in regional and watershed integrated resource management planning activities, and continued CVP and SWP integrated operations to help offset delivery impact of the CVPIA.

Water Supply and Yield Study

In March 2008, Reclamation prepared the *Water Supply &Yield Study*, which describes existing California statewide water demand and available supplies, as well as projected future demand, available supplies, and willingness to pay for CALFED storage and conveyance projects (Reclamation 2008b). Using demands from DWR's *California Water Plan Update 2005* and assuming no inter-basin transfers, statewide supply-demand gaps were calculated to be 2.3 MAF in average water years and 4.2 MAF in dry water years. Without investment in storage and conveyance projects, statewide supply-demand gaps were projected to grow to 4.9 MAF in average water years and 6.1 MAF in dry water years by 2030. The *Water Supply & Yield Study* also determined that if CALFED storage and conveyance projects, including the Investigation, were constructed, the projected 2030 supply-demand gap would be reduced to 1.5 MAF in average water years and 2.2 MAF in dry water years.

Coordinated Long-Term Operation of the CVP and SWP

In June 2004, Reclamation prepared the *Long-Term CVP Operations Criteria and Plan* (OCAP) to provide a description of facilities and the operating environment of the CVP and SWP (Reclamation 2004a). Using operational information in the 2004 OCAP, Reclamation and DWR developed the 2004 *Long-Term CVP and SWP OCAP Biological Assessment* (BA) (Reclamation and DWR 2004), prepared as part of the consultation process required by Section 7 of the Endangered Species Act (ESA). Reclamation consulted with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) on the 2004 OCAP, and the two agencies issued biological opinions (BO). NMFS issued the 2004 *Biological Opinion on the Long-Term CVP and SWP OCAP* (2004 NMFS BO) (NMFS 2004), and USFWS issued the 2005 *Reinitiation of Formal and Early Section 7 ESA Consultation on the Coordinated Operations of the CVP and SWP and the OCAP to Address Potential Critical Habitat Issues* (2005 USFWS BO) (USFWS 2005). In 2007, the District Court for the Eastern District of California (District Court), in *Natural Resources Defense Council (NRDC), et al., v. Dirk Kempthorne*, found the 2005 USFWS BO to be unlawful and inadequate. In May 2008, in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, the District Court found the 2004 NMFS BO to be unlawful and inadequate. The 2004 NMFS BO and 2005 USFWS BOs were remanded by the District Court to NMFS and USFWS for revision, but were not vacated.

In December 2008, USFWS issued a Revised Biological Opinion on the Coordinated Operations of the CVP and SWP in California (2008 USFWS BO) (USFWS 2008a). In June 2009, NMFS issued the 2009 Final Biological and Conference Opinion on the Long-Term Operations of the CVP and SWP (2009 NMFS BO) (NMFS 2009). The 2008 USFWS BO made a finding that the long-term operations of the CVP and SWP, as described in the 2004 OCAP BA, would jeopardize the continued existence of the delta smelt (Hypomesus transpacificus) (USFWS 2008b). The 2009 NMFS BO made a finding that the same operations would jeopardize populations of listed salmonids, steelhead (Oncorhynchus mykiss), green sturgeon (Acipenser medirostris), and orcas (Orcinus orca). Because both agencies made jeopardy determinations, both agencies included a Reasonable and Prudent Alternative (RPA) in their BOs to allow the CVP and SWP to continue without causing jeopardy or adverse modification.

Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's provisional acceptance of the RPA included with each BO (*Consolidated Salmonid Cases*, *Delta Smelt Consolidated Cases*). On November 13, 2009, and March 5, 2010, the District Court concluded that Reclamation had violated NEPA by failing to perform a NEPA analysis before provisionally adopting the 2008 USFWS RPA (USFWS 2008b) and 2009 NMFS RPA (NMFS 2009). On December 14, 2010, the District Court found the 2008 USFWS BO (USFWS 2008a) to be unlawful and remanded the BO to USFWS. The District Court issued a similar ruling for the 2009 NMFS BO (NMFS 2009) on September 20, 2011. On May 4, 2011, in the *Delta Smelt Consolidated Cases*, the District Court ordered USFWS to prepare a draft BO by October 1, 2011, which was subsequently extended to an unspecified date to be agreed upon by involved parties. USFWS was ordered to prepare a final revised BO by December 1, 2013. On December 12, 2011, the District Court ordered NMFS to complete a draft BO by

October 1, 2014, and a final BO by February 1, 2016. Reclamation has been ordered to review both of the revised RPAs in accordance with NEPA.

The Departments of the Interior and Commerce, and DWR filed a joint motion in the District Court for a 3-year extension of the current court-ordered deadlines. The request included delaying completion of the USFWS and NMFS BOs and the associated NEPA process for 3 years in favor of implementing a collaborative science and adaptive management program (CSAMP) that is largely targeted at key Delta actions included in the RPAs, and as a test run for adaptive management activities included in the BDCP.

The District Court ruled on April 9, 2013, granting a staged extension. All deadlines related to the BOs and the NEPA process were extended by 1 year, with the potential of two additional 1-year extensions if satisfactory progress is demonstrated. The ruling included a requirement that on February 14, 2014, the parties submit a joint report detailing progress on the CSAMP, providing additional information on CSAMP future activities and describing how the results of the CSAMP will be incorporated into the consultation process. In addition, the parties are required to submit schedules on how CSAMP and the consultations will proceed.

These legal challenges have resulted in uncertainty with regard to operational constraints for the CVP and SWP. As a result, evaluations of potential effects of the alternatives in the Draft Feasibility Report were based on available modeling analysis at this time. Despite the uncertainty surrounding future CVP and SWP long-term operations resulting from ongoing reinitiated consultation processes, the 2008 OCAP 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 anticipated that the final BOs issued by the resource agencies will contain similar RPAs. However, if ongoing CVP and SWP long-term operations consultation results in operational conditions that deviate substantially from the 2008 OCAP BA and the 2008 and 2009 BOs, these changes may be considered in the Final Feasibility Report.

San Luis Drainage Feature Reevaluation

In June 2006, Reclamation filed the Final EIS for the San Luis Drainage Feature Reevaluation with the U.S. Environmental Protection Agency (EPA). Reclamation prepared the environmental document, pursuant to NEPA, to evaluate options for providing drainage service to the San Luis Unit of the CVP. The proposed Federal action is to plan and construct a drainage system for the San Luis Unit of the CVP and the general area (of which lands served by the San Luis Unit are a part) that achieves long-term, sustainable salt and water balance in the root zone of irrigated lands. This proposed action would meet the needs of the San Luis Unit for drainage service, fulfill the requirements of a February 2000 Court Order issued in litigation concerning drainage in the San Luis Unit, and be completed under the authority of Public Law 86-488. A ROD was issued in March 2007 (Reclamation 2007a), identifying Reclamation’s decision to select the In-Valley/Water Needs Land Retirement Alternative for implementation. The Feasibility Report was transmitted to Congress on July 8, 2008.

San Luis Reservoir Low Point Improvement Project and San Luis Reservoir Expansion

Reclamation and the Santa Clara Valley Water District (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 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 response to studies that determined B.F. Sisk Dam poses a potential risk of seismic failure, Reclamation also initiated a Safety of Dams Corrective Action Study (CAS) in 2006 to determine a course of action to reduce the seismic risks at the dam. Alternatives evaluated in the CAS included raising the dam and adding abutments, as well as restricting the water level in San Luis Reservoir. Reclamation determined that modifications to the dam embankment and dike, spillway, intake towers, and access bridge to increase storage capacity within San Luis Reservoir and reduce Dam safety risk were technically feasible to construct (Reclamation 2013c).

In December 2013, Reclamation completed the San Luis Reservoir Expansion Draft Appraisal Report (2013c). 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 San Luis Low Point Feasibility Studies to determine (1) actions needed to correct identified dam safety risks, and (2) technical, environmental, economic, and financial feasibility of increasing SOD surface water storage capacity under a wide range of future conditions, including climate change and changes in Delta export and conveyance capacity.

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 cubic feet per second (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 of the Environmental Assessment (EA) and Feasibility Report for the Friant-Kern Canal Capacity Restoration Project was released in June 2011 (Reclamation 2011b) 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.

U.S. Department of Commerce, National Marine Fisheries Service

NMFS is required under the Federal ESA to assess factors affecting listed salmonid species in the Central Valley, identify recovery criteria, identify the entire suite of actions necessary to achieve these goals, and estimate the cost and time required to carry out the actions.

U.S. Environmental Protection Agency

The EPA develops standards and criteria for water quality pursuant to the Clean Water Act (CWA), and issues permits for discharges under the CWA. In the San Joaquin River watershed and Delta, EPA delegates authority for these activities to the Central Valley Region Water Quality Control Board (Central Valley Water Board, formerly CVRWQCB). The EPA is also involved in projects to improve water quality in the Delta and its watershed. Measure "W" (also known as the Watershed Improvement Measure [WIM] and SP-12) is a key performance measure in EPA's Strategic Plan. Under Measure W, EPA is tracking where water quality conditions have improved by using a watershed approach. Two watersheds located within the study area, the Grasslands and Salt Slough watershed and the Lower San Joaquin River watershed, are identified as Measure "W" watersheds. Additionally, under the 2012 San Francisco Bay Delta Action Plan (EPA), seven priority activities were identified to advance the protection and restoration of aquatic resources and ensure a reliable water supply in the Bay-Delta Estuary watershed:

- Strengthen water quality standards to protect estuarine habitat
- Advance regional water quality monitoring and assessment
- Accelerate water quality restoration through Total Maximum Daily Loads (TMDLs)
- Strengthen selenium water quality criteria
- Prevent pesticide pollution
- Restore aquatic habitats while managing methylmercury
- Support the Bay Delta Conservation Plan

Under CWA Section 404, the EPA develops regulations for USACE compliance and reviews permits issued by USACE to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Section 404(c) of the CWA authorizes EPA to veto a USACE decision to issue a permit if a proposed action would have an unacceptable effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.

U.S. Department of the Interior, U.S. Geological Survey, National Water Quality Assessment Program

As part of the National Water Quality Assessment (NAWQA) program initiated by the U.S. Geological Survey (USGS) in 1991, the San Joaquin-Tulare basins study unit was a part of the first decadal cycle of investigations into the quality of water resources conducted to establish existing water quality conditions of streams and aquifers across the Nation. Long-term goals of the NAWQA program are to assess the status of, and trends in, the quality of freshwater streams and aquifers, and to provide a sound understanding of the natural and human factors that affect the quality of these resources. In 2001, NAWQA investigated the quality of water resources in the San Joaquin-Tulare basins again, as part of the second 10-year cycle of the program. While long-term goals remained the same, the emphasis of the renewed investigations shifted from status of water quality to trends in water quality and understanding of natural and anthropogenic factors affecting water quality.

U.S. Department of Defense, U.S. Army Corps of Engineers

The USACE has authority over flood operations and developed the operating rules at Friant Dam and Millerton Lake for flood risk management. In addition to reservoir regulation rules, USACE has conducted various studies and implemented many projects and programs that affect the upper San Joaquin River and its tributaries. Several of the most recent efforts have included the March 1999 Post-Flood Assessment (USACE) and the Sacramento and San Joaquin River Basins Comprehensive Study (Comprehensive Study) (USACE and The Reclamation Board 2002). Additionally, under the CWA Section 404, USACE issues permits to regulate the discharge of dredged or fill material into waters of the United States, including wetlands, and conduct NEPA review of its permitting action.

U.S. Department of the Interior, Bureau of Land Management

The U.S. Department of the Interior, Bureau of Land Management (BLM), San Joaquin River Gorge Management Area (SJRGMA) straddles the San Joaquin River just upstream from Millerton Lake State Recreation Area (SRA) and includes lands on both sides of the San Joaquin River, in both Fresno and Madera counties. BLM management areas are intended to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations. Approximately 7,000 acres of public land are available for public use via Smalley Road from Auberry (BLM 2010). In 2011, BLM completed the Draft Bakersfield Resource Management Plan (RMP) and EIS, which revises the existing RMPs for the Caliente Resource Area, including the SJRGMA and Hollister Resource Area to address the availability of new data and policies, emerging issues, and changing circumstances (BLM 2011). Some of the uses and resources addressed in the plan include oil and gas leasing and development, alternative energy development, cultural resource management and protection, fire management, land disposals, livestock grazing, recreational use, special area designations, and threatened and endangered species management. BLM issued their Bakersfield Proposed Resource Management Plan and Final EIS in August 2012, and the ROD in February 2013.

U.S. Department of the Interior – Fish and Wildlife Service

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.

The San Luis, Merced, and San Joaquin River National Wildlife Refuges (NWR) are located along the San Joaquin River. The San Luis and Merced NWRs do not have approved comprehensive conservation management plans; however, planning was initiated for both NWRs in 2002 (USFWS 2001).

The San Joaquin River NWR has prepared a final comprehensive conservation management plan (USFWS 2006).

State

Following are State studies, projects, programs, and plans relevant to the Investigation.

California Department of Water Resources

DWR owns and operates the SWP and manages ongoing projects or continuing programs relevant to the Investigation.

State Water Project

The SWP delivers water to the Feather River Settlement Contractors and SWP contract entitlements in the Feather River Basin, Bay Area, San Joaquin Valley, Tulare Basin, and Southern California water service areas. The SWP has contracted a total of 4.23 MAF for average annual delivery: about 2.5 MAF for the Southern California Transfer Area; nearly 1.36 MAF for the San Joaquin Valley; and the remaining 370 TAF for the San Francisco Bay, Central Coast, and Feather River areas.

California Water Plan

DWR's *California Water Plan* provides a framework for water managers, legislators, and the public to consider options and make decisions regarding California's water future (DWR 2009d). The plan, which is updated every 5 years, presents basic data and information on California's water resources, including water supply evaluations and assessments of agricultural, urban, and environmental water uses to quantify the gap between water supplies and uses. The plan also identifies and evaluates existing and proposed statewide demand management and water supply augmentation programs and projects to address the State's water needs.

DWR's goal for the *California Water Plan Update 2009* (DWR 2009a) is to meet requirements of the CWC, receive broad support among those participating in California's water planning, and be a useful document for the public, water planners throughout the State, legislators, and other decision-makers (DWR 2009d). As a master plan, it guides the control, protection, conservation, development, management, and efficient use of the water resources of the State (CWC Section 10005(a)).

In January 2009, DWR produced a public review draft of the Water Plan Update (DWR 2009d). The implementation plan contained in the *California Water Plan Update 2009* addresses 13 objectives supported by 92 related actions, which were taken in part from DWR's 2008 climate change white paper

(DWR 2008a). Several other companion State plans were considered in preparing the draft objectives and related actions. Identified objectives address water conservation, recycling, and reuse; conjunctive management of water supply sources; environmental enhancement; flood protection and floodplain enhancement; and management for a sustainable Delta; and identifies several other objectives for management of water resources in California.

DWR and other agencies are currently developing *California Water Plan Update 2013* through rigorous public involvement and State and Federal agency coordination processes.

Conjunctive Water Management Program

DWR's Conjunctive Water Management Program is working with local water agencies and stakeholders throughout the State, including the San Joaquin Valley, to develop partnerships and provide assistance for planning and developing locally controlled and managed conjunctive use programs and projects. Project proposals to be pursued by these local agencies may be considered in the Investigation or in the future without-project conditions.

Central Valley Flood Management Planning Program

The purpose of the Central Valley Flood Management Planning (CVFMP) Program is to conduct sustainable, integrated flood risk management planning for areas protected by facilities of the State-Federal flood protection system in the Central Valley. The program is one of several DWR is implementing within FloodSAFE California (FloodSAFE) to improve Statewide flood risk management and accomplish the goals of Propositions 1E and 84. Several landmark products have been prepared under the CVFMP Program, including a descriptive inventory of State Plan of Flood Control (SPFC) facilities and modes of operation, a Flood Control System Status Report documenting the current condition and performance of SPFC facilities, and the 2012 Central Valley Flood Protection Plan (CVFPP). The 2012 CVFPP was adopted by the Central Valley Flood Protection Board in June 2012, providing a long-term vision for modernizing flood risk management in the Central Valley. CVFPP adoption was supported by a Program EIR. The CVFPP describes current flood risk; defines one primary and four supporting goals for improving flood risk management and related resources; and recommends a State Systemwide Investment Approach for improving the State-Federal flood risk management system. The 2012 CVFPP includes a Conservation Framework outlining approaches for improving ecosystem functions associated with the flood risk management system. The CVFPP is to be updated every 5 years, starting in 2017. The CVFMP Program is currently conducting CVFPP implementation activities that will refine the policies and physical actions recommended in the 2012 CVFPP.

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 SCVWD, which in turn provide service to the cities of Livermore, Dublin, Pleasanton, San Ramon, Freemont, Newark, Union City, Milpitas, Santa Clara, and San Jose (DWR 2009c). The South Bay Aqueduct was the first conveyance facility constructed for the SWP and was designed for a capacity of 300 cfs. Recent flow tests and studies have shown that actual capacity is 270 cfs. The purpose of this project is to increase the capacity of the South Bay Aqueduct 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 Final EIR was published in December 2004 (DWR). The project includes upgrades to the South Bay Pumping Plant, raised linings on open channel sections of the aqueduct, a 450-acre-foot reservoir, and 4 1/2 miles of pipeline connecting it to the South Bay Pumping Plant. The project was completed in 2012.

North Bay Aqueduct Alternative Intake Project

DWR is proposing the North Bay Aqueduct Alternative Intake Project in Solano County (DWR 2009b). An EIR will be prepared through a collaboration of DWR and local water agencies. DWR proposes an alternate intake to the North Bay Aqueduct that would connect to the existing North Bay Aqueduct via an underground pipeline to serve the contractors and users in Solano and Napa counties. Potential alternative intake (diversion) locations may include sites in Yolo and Sacramento counties. The North Bay Aqueduct Alternative Intake Project also involves modifying the existing North Bay Aqueduct to increase its capacity. Planning efforts for this project are in the preliminary stages. Publication of the Draft EIR is anticipated in 2014.

Delta Stewardship Council

The Delta Stewardship Council was established by the California Legislature as part of the comprehensive water legislation, Senate Bill (SB) 1, in 2009 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 council is entrusted to integrate issues, such as water flows, water quality, environmental protection, emergency management, economics, the Delta as an evolving place, conveyance alternatives, upstream impacts, flood risk management and climate change, into one coherent management system. To that end, the Delta Stewardship Council is developing a Delta Plan and EIR to serve as a basis for future findings of consistency by State and local agencies. The Delta Plan will be 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.

The coequal goals will 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. The Draft Delta Plan Program EIR was published in November 2011 and outlines a Delta Plan that includes a suite of 12 regulatory policies and 61 non-binding recommendations, as well as 5 alternative plans (Delta Stewardship Council 2011). During September 2012, the Delta Stewardship Council approved the final draft of the Delta Plan to be the basis for recirculating an additional volume of the Draft Program EIR. The document will also serve as the basis for submittal of a Notice of Proposed Rulemaking to the Office of Administrative Law. The Delta Plan recommends that agencies involved complete the Bay Delta Conservation Plan (BDCP) by December 31, 2014. 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.

California Water Commission

The California Water Commission is tasked with selecting water storage projects for State bond funding toward project benefits "that improve the operation of the state water system, are cost effective, and provide a net improvement in ecosystem and water quality conditions."

The California Water Commission (Commission) is composed of nine members, responsible for advising the Director of DWR, approving DWR rules and regulations, monitoring and reporting on SWP construction and operations, and holding public hearings on proposed SWP facilities. Additionally, the Commission advises congressional appropriations committees on funding for Reclamation and USACE water resource projects in California.

California's comprehensive water legislation, SB 1, enacted in 2009, gave the Commission new responsibilities regarding the distribution of public funds set aside for the public benefits of water storage projects, and developing regulations for the quantification and management of those benefits. If passed by California voters, the Safe, Clean, and Reliable Drinking Water Act (SBX7-2) would provide general obligation bond funds for water infrastructure and for various projects and programs to address ecosystem and water supply issues in California, including funds for Statewide Water System Operational Improvement. Eligible projects for Statewide Water System Operational Improvement funding include surface storage projects identified in the CALFED ROD (CALFED 2000a); groundwater storage projects and groundwater contamination prevention or remediation projects that provide water storage benefits; conjunctive use and reservoir reoperation projects; and local and regional storage projects that improve the operation of water systems in the State and provide public benefits.

The Commission is given statutory responsibilities related to the distribution of these funds. Specifically, Sections 79740(c) and 79744, respectively, state:

> *Projects shall be selected by the Commission through a competitive public process that ranks potential projects based on expected return for public investments as measured by the magnitude of the public benefits provided, pursuant to criteria established under this chapter.*
>
> *In consultation with the California Department of Fish and Game (DFG), the State Water Resources Control Board (SWRCB), and DWR, the Commission shall develop and adopt, by regulation, methods for quantification and management of public benefits described in Section 79743 by December 15, 2012. The regulations shall include the priorities and relative environmental value of ecosystem benefits as provided by the DFG and the priorities and relative environmental value of ecosystem benefits as provided by the SWRCB.*

DWR is currently developing methods to quantify public benefits of water storage projects for consideration by the Commission.

Under the Safe, Clean and Reliable Drinking Water Act, the Commission is further tasked with selecting water storage projects for State bond funding toward project benefits "that improve the operation of the state water system, are cost effective, and provide a net improvement in ecosystem and water quality conditions." If this bond measure passes, these funds may be eligible for public benefits associated with construction and operation of Temperance Flat Dam and Reservoir.

Delta Vision

The Delta Vision process was initiated by the governor of California through Executive Order S-17-06 establishing an independent Blue Ribbon Task Force responsible for the development of a durable vision for sustainable management of the Delta. The work of the Task Force included two phases, the Delta Vision, which was completed in December 2007, and the Strategic Plan, which was completed in 2008. The Delta Vision consists of 12 integrated and linked recommendations that are meant to be implemented together over time. Key recommendations included significant increases in conservation and water system efficiency, new water conveyance and storage facilities, and new governance for the Delta region. The Delta Vision also recommended seven near-term actions, which include improving flood protection, ecosystem restoration, and water supply and reliability.

California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW, formerly California Department of Fish and Game [DFG]) manages California's fish and wildlife resources, overseeing the restoration and recovery of species listed by the California Endangered Species Act (CESA) as threatened and endangered. CDFW participates in conservation planning, environmental compliance and permitting, coordinated resources management planning, and restoration and recovery programs within the study area.

State Water Resources Control Board

The State Water Resource Control Board (State Water Board [formerly SWRCB]) is responsible for allocating surface water rights, setting statewide policy to protect water quality, coordinating and supporting the State's nine Regional Water Quality Control Boards, and enforcing laws and regulations protecting the State's waterways.

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

In August 1978, the State Water Board adopted the Water Quality Control Plan (WQCP) for the Delta and Suisun Marsh and Water Right Decision 1485 (D-1485), requiring Reclamation and DWR to operate the CVP and SWP to meet all of the 1978 WQCP objectives, except a portion of the south Delta salinity objectives. In 1991, the State Water Board issued revised water quality objectives in the *Delta Water Quality Control Plan for Salinity, Temperature, and Dissolved Oxygen* (State Water Board 1991). In May 1995, the State Water Board adopted the *Water Quality Control Plan* for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) (State Water Board 1995) superseding both the 1978 and 1991 plans. Minimum in-stream flow objectives for the San Joaquin River at Vernalis were established under the 1995 Bay Delta Plan established. The 1995 Bay-Delta Plan was amended in 2006; however, the Vernalis in-stream flow requirements remained unchanged from the 1995 Bay-Delta Plan.

The State Water Board is currently updating the Bay-Delta Plan, consistent with the 2009 Delta Reform Act. Phase 1 of this work involves updating San Joaquin River flow and southern Delta water quality requirements included in the Bay-Delta Plan. Phase 2 involves comprehensive changes to protect beneficial uses not addressed in Phase 1. Phase 3 involves changes to water rights and other measures to implement changes to the Bay-Delta Plan from Phases 1 and 2. Phase 4 involves developing and implementing flow objectives for priority Delta tributaries outside of the Bay-Delta Plan updates (State Water Board 2014).

CVP and SWP Water Rights

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.

Beginning in 1996, the State Water Board engaged in proceedings to determine responsibility for meeting water quality standards in the Delta. Because the issues were so complex, the State Water Board divided the water right proceedings into eight phases. The State Water Board completed Phases 1 through 7 of these proceedings in 1999, leading to issuance of Water Rights Decision 1641 (D-1641) in December of 1999 (California Environmental Protection Agency [Cal/EPA], State Water Board 2000). The State Water Board adopted D-1641 as part of the State Water Board’s implementation of the 1995 Bay Delta Plan. D-1641 amended certain water rights, including temporarily amending certain terms and conditions of the CVP and SWP water rights, by assigning responsibilities to the persons or entities holding those rights to help meet certain water quality and flow requirements outlined in the 1995 Bay Delta Plan, including new protections for Delta fisheries.

As a result of the 2009 Delta Reform Act, and as described above, 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.

Groundwater Ambient Monitoring and Assessment Program

The State Water Board manages the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The primary objective of GAMA is to comprehensively assess statewide groundwater quality and gain an understanding about contamination risk to specific groundwater resources. The Groundwater Quality Monitoring Act of 2001 resulted in a publicly accepted plan to monitor and assess the quality of all priority groundwater basins, which account for over 90 percent of all groundwater used in the State. The plan builds on the existing GAMA Program and prioritizes groundwater basins for assessment based on groundwater use. Uniform and consistent study-design and data collection protocols are being applied to the entire State to facilitate efficient statewide, comprehensive groundwater quality monitoring and assessment. Monitoring and assessments for priority groundwater basins are to be completed every 10 years, with trend monitoring every 3 years. The State Water Board is collaborating with USGS and Lawrence Livermore National Laboratory to implement the GAMA Program.

Central Valley Region Water Quality Control Board

The Central Valley Water Board projects, programs, and plans described below include the Surface Water Ambient Monitoring Program (SWAMP), Conditional Waiver of Waste Discharge Requirements for Irrigated Lands and Impaired Water Bodies 303(d) List, and TMDLs.

San Joaquin River Surface Water Ambient Monitoring Program

The Central Valley Water Board's San Joaquin River SWAMP was implemented in October 2000 as part of the statewide effort to assess and monitor California's surface water quality. The SWAMP within the San Joaquin River Basin was designed with a three-tiered monitoring framework: (1) long-term monitoring in the main stem of the river, (2) long-term monitoring in selected tributaries draining major subbasins, and (3) more intensive monitoring on a 5-year rotation within the subbasins themselves.

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 (CCRCD 2005). 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 Water Board. The CWC requires the Central Valley Water Board to prescribe Waste Discharge Requirements (WDR), or waive WDRs, for the discharge. The Central Valley Water Board's Irrigated Lands Regulatory Program has been under development. In December 2002, the Central Valley Water Board adopted Resolution No. R5-2002-0201, which established a new "Conditional Waiver of WDRs for Discharges from Irrigated Lands within the Central Valley Region." The conditional waiver regulatory requirements are considered to be part of an interim program; a Long-Term Irrigated Lands Regulatory Program is being developed.

Irrigated lands are lands where water is applied for producing crops, including row, field, and tree crops, as well as commercial nurseries, nursery stock production, managed wetlands, and rice production. The Central Valley Water Board adopted a waiver of report of waste discharge and WDRs for three reasons:

1. Central Valley Water Board has limited facility-specific information, and limited water quality data on facility-specific discharges.

2. Because of the high numbers of individual dischargers who discharge waste from irrigated lands, it is infeasible to adopt WDRs within a reasonable period of time.

3. Although dischargers of waste from irrigated lands have caused impairment of State waters, specific information is generally not available on the nature and causes of impairment, and management practices that mitigate impairments.

The conditions of the conditional waivers will result in development of new and additional information that could provide a more reasonable basis for adoption of individual or general WDRs, where necessary, in the future.

Impaired Water Bodies 303(d) List and Total Maximum Daily Loads

In 2006, the EPA approved the Central Valley Water Board's 303(d) list for portions of the San Joaquin River downstream from Friant Dam that do not meet, or are not expected to meet, water quality standards, or are considered impaired. Millerton Lake is listed in the draft 2008 update to CWA Section 303(d) listings for mercury (Central Valley Water Board 2009). The 2010 CWA Section 303(d) listings for portions of the San Joaquin River from Friant Dam to the Merced River include invasive species, arsenic, boron, chlorpyrifos, diazinon, dichlorofiphenyl-trichloroethane (DDT), electrical conductivity (EC), *Escherichia coli* (E. coli), Group A pesticides, mercury, selenium, and unknown toxicity (State Water Board 2010). TMDLs and Basin Plan amendments are currently in place for diazinon and chloropyrifos runoff into the San Joaquin River. TMDLs and Basin Plan amendments are currently being developed for selenium, salt and boron, and pesticides. Delta waterways fall within the jurisdiction of both the Central Valley Water Board and the San Francisco Bay Region Water Quality Control Board (San Francisco Bay Water Board, formerly SFBRWQCB. 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, electrical conductivity, Group A pesticides, invasive species, mercury, polychlorinated biphenyls (PCB), and unknown toxicity (State Water Board 2010). 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 2010).

Federal-State

Following are programs and plans relevant to the Investigation that were developed or are being developed as collaborations between Federal and State agencies.

CALFED

CALFED is a collaborative effort among 25 State and Federal agencies and representatives of California's environmental, urban, and agricultural communities to improve water quality, fish and wildlife habitat, and water supply reliability in the Bay-Delta, the hub of the State's water distribution system. The lead CALFED agencies released the Final Programmatic EIS Preferred Alternative on July 21, 2000, followed by the signing of the CALFED Bay-Delta Programmatic ROD on August 28, 2000, establishing a 30-year plan for improving water supplies and the Bay-Delta ecosystem (CALFED 2000a).

The CALFED ROD identified 12 action plans for the Governance, Ecosystem Restoration, Watersheds, Water Supply Reliability, Storage, Conveyance, Environmental Water Account, Water Use Efficiency, Water Quality, Water Transfer, Levees, and Science programs. The CALFED agencies then began implementing Stage 1 of the ROD, including the first 7 years of a 30-year program to establish a foundation for long-term actions. In 2004, the CALFED Bay-Delta Authorization Act (Public Law 108-361) approved the CALFED ROD (CALFED 2000a) as a "general framework for addressing the CALFED Bay-Delta Program" (Section 103 (a) (1)). Further, Public Law 108-361 authorized the Secretary of the Interior to carry out the activities described in Paragraphs (1) through (10) of Subsection (d), which includes "planning and feasibility studies for the following projects requiring further consideration: (II) the Upper San Joaquin River storage in Fresno and Madera Counties" (Section 103 (d) (1) (A) (ii)).

CALFED Surface Water Storage Program

Results of initial evaluations to formulate this program were presented in the Integrated Storage Investigation Report – Initial Surface Water Storage Screening (CALFED 2000b), which assessed and screened numerous potential reservoir sites. Of many potential surface water storage projects considered, five were included in the Preferred Program Alternative for consideration during early phases of CALFED implementation. Reclamation and DWR committed to assume lead agency roles for investigation of these sites and to work with other CALFED agencies in pursuing their implementation. The five surface water storage projects are

Enlarge Shasta Lake, In-Delta Storage, Los Vaqueros Reservoir Enlargement, Sites Reservoir (also known as North-of-the-Delta Offstream Storage [NODOS]), and Upper San Joaquin River Basin Storage.

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 (CMP).

The CMP includes the California Statewide Simulation Model (CalSim II), Delta Simulation Model (DSM2), Sacramento River Water Quality Model (SRWQM), the Salmonid Population Model (SALMOD), LongTermGen (LTGen), SWP Power California (SWP Power), the Least Cost Planning Simulation Model (LCPSIM), and the Statewide Agricultural Production Model (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.

San Joaquin River Restoration Program

San Joaquin River below Friant Dam

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. A litigation Stipulation of Settlement (Settlement) among the NRDC, FWUA, and the U.S. Departments of Commerce and Interior in the case of *NRDC, et al., v. Kirk Rodgers, et al.* was approved in late 2006 by the District Court (NRDC et al. 2006; Reclamation, FWUA, and NRDC 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. Settlement Paragraphs 11 through 16 describe the physical and operational actions considered necessary for achieving the Restoration and Water Management goals.

The Settlement provides for substantial river channel improvements and sufficient 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).

Accomplishing the Restoration Goal will require funding and constructing extensive channel and structural improvements in many areas of the river, including some that have been without flows (except for occasional flood releases) for decades. Restoring continuous flows to the approximately 60 miles of the San Joaquin River will occur in phases through the SJRRP. Planning, design work, and environmental reviews began in 2006, and Interim Flows for experimental purposes began in 2009. Restoration Flows began January 1, 2014. The flows will be increased gradually over the next several years up to the full flows specified in the Settlement, as channel capacity allows. The Settlement continues into perpetuity. After 2026, the District Court, in conjunction with the State Water Board, will consider any requests by the parties for changes to the Restoration Flows.

Reclamation is the Federal lead agency for the SJRRP. DWR is the State lead agency. Along with Reclamation and DWR, NMFS, USFWS, and CDFW are implementing agencies.

The SJRRP is assumed to be implemented in the future without-project conditions and No Action Alternative for the Investigation.

Temperance Flat RM 274 Reservoir would…

- change water management at Friant Dam and affect the Restoration and Water Management goals of the Settlement being implemented through the SJRRP.
- not interfere with the release of Restoration Flows.
- reduce the frequency and magnitude of flood releases from Friant Dam that would occur in excess of water rights, Restoration Flow releases, and water deliveries.
- increase the volume of cold water and improve operational flexibility in the management of Restoration Flows.
- provide additional flow in the San Joaquin River from Friant Dam to Mendota Pool (for water supply exchanges).
- increase the volume of Restoration Flows eligible for recapture at locations downstream of the Restoration Area, under Paragraph 16(a) of the Settlement.
- reduce the availability of $10 water under Paragraph 16(b) of the Settlement and could reduce the effectiveness of projects that would increase the delivery of Paragraph 16(b) water.

**See Chapter 3 for more information regarding the potential effects of Temperance Flat RM 274 Reservoir on the SJRRP.*

Specific efforts under the SJRRP that are of particular importance for achieving the primary objective of enhancing conditions in the San Joaquin River in support of restoring and maintaining naturally reproducing and self-sustaining anadromous fish include fish reintroduction efforts and the Mendota Pool Bypass and Reach 2B Improvements Project.

Fish Reintroduction Efforts

Since 2009, Reclamation, USFWS, CDFW and DWR have been conducting fisheries studies in the San Joaquin River between Friant Dam and the Merced River to evaluate the requirements and the survival of Chinook salmon eggs after spawning, and juveniles during the spring downstream migration. They are also assessing the habitat conditions, including water temperatures, water quality, and spawning gravel. In 2013, the SJRRP completed the second consecutive year of collect-and-transport activities near the Merced River Confluence for fall-run Chinook salmon, with adult Chinook salmon released at Camp Pashayan near Highway 99. On December 31, 2013, NMFS published an Endangered Species Act 10(j) rule for a nonessential experimental population designation for spring-run Chinook salmon in the San Joaquin River between Friant Dam and the Merced River confluence. As a result, the SJRRP anticipates release of Feather River Hatchery spring-run Chinook salmon in second quarter 2014.

Mendota Pool Bypass and Reach 2B Improvements Project

Paragraph 11(a)(1) and 11(a)(2) of the Settlement specify actions to construct the Mendota Pool Bypass and modify Reach 2B. The Mendota Pool Bypass and Reach 2B Improvements Project includes the construction of the Mendota Pool Bypass and channel improvements in Reach 2B of the San Joaquin River to convey at least 4,500 cfs (incorporating new floodplain and related riparian habitat) between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel. The Mendota Pool Bypass would convey at least 4,500 cfs from Reach 2B to Reach 3 and would include a fish barrier to direct adult salmon migrating upriver into the bypass. Modifications to Reach 2B would include levee setbacks to increase channel and floodplain capacity and provide floodplain habitat. Currently, Reclamation is working with landowners adjacent to Mendota Pool and the San Joaquin River to acquire agricultural easements necessary for project implementation.

Bay Delta Conservation Plan

The BDCP is being prepared through a collaboration of Federal, State, and local water agencies, Federal and State fish agencies, environmental organizations, and other interested parties. The goal of the BDCP is to identify water flow and habitat restoration actions to recover endangered and sensitive species and their habitats in the Delta while improving California's water supply reliability.

The BDCP is a Habitat Conservation Plan (HCP) intended to provide for the conservation of species and habitats covered by the plan. HCPs and Natural Community Conservation Plans (NCCP) are planning documents required as part of permit applications under Section 10(a) of the ESA and California Natural Community Conservation Planning Act (NCCPA). The BDCP is intended as a comprehensive conservation strategy for the Delta, designed to advance the coequal planning goals of restoring ecological functions of the Delta and improving water supply reliability for large portions of California.

A range of alternatives for providing species/habitat protection and improving water supply reliability as part of the BDCP will be evaluated through development of an EIS/EIR. Lead agencies for the EIS/EIR are DWR, Reclamation, USFWS, and NMFS, in cooperation with CDFW, EPA, and USACE. The BDCP Draft EIS/EIR was released for public review and comment in December 2013.

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. An isolated facility could improve water quality for urban and agricultural water users and could eliminate reverse flow in the Delta and improve Delta water quality and flow by releasing water to south Delta channels. Increasing surface water storage in the upper San Joaquin River Basin could allow for increased system flexibility and further use of new Delta conveyance facilities, providing for even greater increases in water supply reliability.

Millerton Lake Resource Management Plan and General Plan

The Millerton Lake RMP/General Plan (GP) Final EIS/EIR was completed in 2010 (Reclamation and California Department of Parks and Recreation [State Parks] 2010). The RMP/GP is a long-term plan that guides future actions in the plan area and is based on a comprehensive inventory of environmental resources and facilities and input from State Parks; local, State, and Federal agencies; and the general public. The purpose of the RMP/GP is to provide a program and set of policy guidelines necessary to encourage orderly use, development, and management of the surrounding lands. The RMP/GP provides outdoor recreational opportunities, enhanced by Millerton Lake and its shoreline, compatible with the surrounding scenic, environmental, and cultural resources. In addition, the RMP/GP proposes uses that will be compatible with the obligation to operate the reservoir for delivery of high-quality water (Reclamation and State Parks 2010). Under the Preferred Alternative in the RMP/GP EIS/EIR, current recreational uses and public access at Millerton Lake would be enhanced to attract more visitors and increase recreational opportunities, while protecting natural resources with new or modified land and recreation management practices (Reclamation and State Parks 2010).

San Joaquin River Salinity Management Plan and Grasslands Bypass Project Extension

Reclamation has a Management Agency Agreement (MAA) 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 MAA 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, which is designed to improve water quality in the channels used to deliver water to wetland areas and the San Joaquin River. Before the Grassland Bypass Project was implemented, drainage water from farms in the 97,000-acre Grassland Drainage Area was discharged into the San Joaquin River through Salt Slough and other channels used to deliver water to wetland areas. This drainage water contains high concentrations of selenium, salts, boron, and other constituents that are harmful to wildlife (Reclamation 2004b).

The Grasslands Bypass Project Extension (2010 – 2019) extends the San Luis Drain Use Agreement to allow time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives and waste discharge requirements by December 30, 2019; continues the separation of unusable agricultural drainage water discharged from the Grasslands Drainage Area from wetland water supply conveyance channels for 2010 – 2019; facilitates drainage management that maintains the viability of agriculture in the Grasslands Bypass Project Area; and promotes continuous improvement of water quality in the San Joaquin River.

Delta-Mendota Canal/California Aqueduct Intertie

The Delta-Mendota Canal (DMC)/California Aqueduct Intertie consists of a pumping plant and pipeline connection between the DMC and the California Aqueduct in the Delta. The intertie could be 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. The intertie includes a 450 cfs pumping plant at the DMC that allows water to be pumped from the canal to the California Aqueduct via an underground pipeline. Reclamation and DWR have completed NEPA and CEQA documentation for this project. The Notice of Intent (NOI)/Notice of Preparation (NOP) was released in 2006, public scoping meetings were held in August 2006, and the Draft EIS was released for public comment in July 2009. The Final EIS and ROD were filed in December 2009 and construction began in October 2010. The project was completed in May 2012.

Lower San Joaquin River Feasibility Study

The Lower San Joaquin River Flood Feasibility Study is a cooperative effort among USACE, the State Central Valley Flood Protection Board, and San Joaquin Area Flood Control Agency (SJAFCA) to determine needed improvements for future flood protection systems in an effort to reach or exceed 200-year flood protection. The feasibility study is a multi-year, $10 million study that covers the southern part of San Joaquin County along the San Joaquin River, up to and through Stockton, as well as the watersheds east of Stockton (SJAFCA 2013). The draft feasibility report and EIS is currently scheduled to be completed in 2016.

South Delta Improvements Program

The South Delta Improvement Program (SDIP) is a series of proposed actions to improve water quality and protect salmon in the southern part of the Delta while allowing the SWP to operate more effectively to meet water needs. DWR and Reclamation completed the Final EIS/EIR for the SDIP and entered the permitting phase for the installation and operation of permanent operable gates in the south Delta (DWR 2013b). ESA consultation for the operation of the permanent operable gates proposed by the SDIP was included in the OCAP. The 2009 NMFS BO specifically directs DWR to halt SDIP implementation. Consultation for the SDIP cannot be reinitiated until after 3 years of fish predation studies at the south Delta temporary barriers. DWR could proceed with construction after permits have been acquired. There currently is not a schedule for project completion (DWR 2013b).

Franks Tract Project

Reclamation and DWR are proposing to implement the Franks Tract Project to improve water quality 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 2010a). The Franks Tract Project has been delayed.

Regional and Local

Following are regional and local activities relevant to the Investigation.

San Joaquin River Exchange Contractors Water Authority Water Transfer Program 2005 – 2014

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) and Reclamation completed an EIS/EIR to support a 10-year program, from 2005 to 2014, to allow the transfer of up to 130 TAF of substitute water from the Exchange Contractors to other water users (Reclamation and San Joaquin River Exchange Contractors Water Authority 2004). A maximum of 80 TAF of water would be developed from conservation measures, including tailwater recovery and groundwater pumping, and a maximum of 50 TAF would be developed from temporary land fallowing.

San Joaquin River Exchange Contractors Water Authority Water Transfer Program 2014 – 2038

The Exchange Contractors and Reclamation completed a EIS/EIR to support a 25-Year Water Transfer Program, from 2014–2038, 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).

Vernalis Adaptive Management Program and San Joaquin River Agreement

The Vernalis Adaptive Management Program (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. 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 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. Merced Irrigation District has and will continue to meet its fall 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. The goal of the San Joaquin Tributary Settlement Process 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.

Big Creek Facilities Relicensing

Southern California Edison (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. The Federal Energy Regulatory Commission (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).

Kerckhoff Hydroelectric Project

The Pacific Gas and Electric Company (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.

Friant Water Users Authority and Metropolitan Water District of Southern California Partnership Studies

FWUA and Metropolitan Water District of Southern California (MWD) entered into a partnership, based on an approved set of principles, to investigate the potential of enhancing water supply and affordability in the eastern San Joaquin Valley while improving water quality for Southern California water users. The partnership was based on the desire by both parties to investigate joint water management projects that could be implemented for mutual benefit of the agencies, their members, and water users. Studies performed as a part of this partnership include potential enlargement of Mammoth Pool Reservoir and exchange opportunities between Friant Division of the CVP and Delta water supplies.

Additional studies by FWUA and MWD considered operations to accomplish exchanges that would deliver high-quality water from the Friant Division of the CVP to MWD in exchange for water supplies delivered from the Delta. Information from these studies provided preliminary operational assumptions for the Investigation related to the integration of Friant Division facilities with other CVP and/or SWP facilities.

Integrated Regional Water Management

In 2002, the State passed SB 1672, the Integrated Regional Water Management Planning Act, to provide bond funds to regional water management work groups statewide. The purpose of Integrated Regional Water Management (IRWM) is to comprehensively address water supply, quality, flood risk 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 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.

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 identified 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 Grasslands 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.

San Joaquin River Parkway Master Plan

The San Joaquin River Parkway Master Plan was certified and adopted in December 1997 by the San Joaquin River Conservancy (SJRC). The plan 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. The San Joaquin River Parkway is a planned 22-mile natural area and wildlife corridor extending from Friant Dam to State Route 99 on both sides of the San Joaquin River, and includes portions of Fresno and Madera counties and the City of Fresno (SJRC 2000).

The SJRC is mandated to implement the San Joaquin River Parkway Master Plan. Implementation of the plan includes acquiring approximately 5,900 acres of land from willing sellers at fair market value; improving, operating, and managing those lands for public enjoyment consistent with protection of natural and cultural resources; and protecting, enhancing, and restoring riverine and floodplain habitat and ecological diversity (SJRC 2013).

The SJRC issued a NOP of the Draft EIR for the San Joaquin River Parkway Master Plan Update in June 2013. The Master Plan Update development and implementation may consist of acquisition of lands; revegetation, restoration, and enhancement of habitats on lands; and development, operation, and maintenance of trails (SJRC 2013).

City of Stockton Delta Water Supply Project

The Delta Water Supply Project is a new supplemental high-quality water supply for the Stockton metropolitan area, diverting Delta water from a new intake on the San Joaquin River. A raw water pipeline along Eight Mile Road was built to convey the Delta water to a new drinking water treatment plant. The water treatment plant was completed and dedicated on May 30, 2012.

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 Water Storage District (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 the expansion of the facility is complete.

The program’s board of directors comprises local farmers who are elected to 4-year terms, and serve the agricultural area in Semitropic WSD. The district is located between the CVP Friant-Kern Canal and the SWP California Aqueduct, near Wasco, California, in Kern County. The bank’s geographical location and sandy soil composition make it an ideal location for a groundwater banking program.

The Semitropic WSD groundwater banking program currently banks 700 TAF of water with a total expanded capacity of 1.65 MAF; approximately 450 TAF of storage are available for use. Semitropic WSD could provide a guaranteed 290 TAF per year to banking partners with a maximum withdrawal rate of 423 TAF per year (delivered into the California Aqueduct), and could recharge a guaranteed 140.5 TAF per year with a maximum of 400 TAF per year. Water could be recovered from groundwater storage quickly with high-flow wells that pump water at 300 cfs (405 gallons per minute) (Semitropic WSD 2004).

Total capacity, recharge, and withdrawal rates and totals are based on the intake facility's expansion project, which is currently permitted and ready for construction. Once the facility is completed, the water bank's capacity will be equivalent to approximately 18 percent of the entire SWP yield (Semitropic WSD 2004).

Fresno County HCP/NCCP

In 2008, USFWS awarded a grant to Fresno County to support the development of an HCP/NCCP through baseline surveys and inventories, document preparation, outreach and similar planning activities. Fresno County is developing a multi-species HCP/NCCP to conserve agricultural lands and natural habitats that may be at risk from urban development.

Chapter 2
Water Resources and Related Conditions

Initial steps of the plan formulation process for Federal water resources studies and projects, consistent with the P&G (WRC 1983), study authorizations, and pertinent Federal, State, and local laws and policies, are as follows:

- Specifying water resources problems, needs, and opportunities to be addressed

- Inventorying, forecasting, and analyzing existing and likely future conditions in the study area

Following is a description of each of these steps.

Water and Related Resources Problems, Needs, and Opportunities

Problems and needs to be addressed by the Investigation were identified in the CALFED ROD (2000a) and from stakeholder input. The primary purposes identified in the CALFED ROD for developing and managing additional water supplies from the upper San Joaquin River Basin include contributing to restoration of the San Joaquin River, improving water quality in the San Joaquin River, facilitating additional conjunctive water management, and supporting water exchanges that improve the quality of water deliveries to urban communities. The *NRDC, et al., v. Kirk Rodgers, et al.* Settlement in 2006 triggered a substantial change in the without-project conditions for the Investigation, including updating operations to account for SJRRP Restoration Flow requirements. Based on the overall authority of the Investigation, concerns expressed about existing and likely future water and related resources issues, and the Settlement, the following is a description of identified major water resources problems, needs, and opportunities that could be addressed in the feasibility study.

Water Supply Reliability and Operational Flexibility

Improved water management flexibility is needed to meet current and future challenges associated with increasing population, environmental needs, and climate change. An integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs.

California's water supply system faces critical challenges with demands exceeding supplies for urban, agricultural, and environmental water uses across the State. The *2009 California Water Plan Update* (DWR) concludes that California is facing one of the most significant water crises in its history, drought impacts are growing, ecosystems are declining, water quality is diminishing, and climate change is affecting statewide hydrology. Compounding these issues, Reclamation's *Water Supply and Yield Study* (2008b) describes dramatic increases in population, land-use changes, regulatory requirements, and limitations on storage and conveyance facilities further straining available water supplies and infrastructure to meet water demands. Resulting unmet water demands have increased competition for water supplies among urban, agricultural, and environmental uses.

Water supply reliability and operational flexibility problems and needs for the CVP Friant Division and SOD contractors, similar to those throughout the State, are associated with large annual hydrologic variations in water availability, regulatory constraints, and the limited capacity of current water storage and conveyance facilities. Projected demands exceed supply for agriculture, urban, and environmental purposes.

The Friant Division of the CVP provides surface water supplies to many areas that also rely on groundwater, and was designed and is operated to support conjunctive water management to reduce groundwater overdraft in the eastern San Joaquin Valley. Annual allocation of water to Friant Division long-term contractors varies widely in response to hydrologic conditions (Figure 2-1). During dry periods when surface water deliveries are reduced, many water contractors rely heavily on groundwater to meet water demands. Although surface water deliveries from Friant Dam help reduce groundwater pumping and contribute to groundwater recharge, the groundwater basins in the eastern San Joaquin Valley remain in a state of overdraft in most years (i.e., more groundwater is pumped out than is replenished either naturally or artificially). The continued general downward trend of groundwater levels reveals that considerable water supply reliability problems remain. Moreover, it is expected that the continued downward trend in groundwater levels may result in localized areas of impaired groundwater quality, and may ultimately reduce water use and irrigated acreage in the San Joaquin Valley.

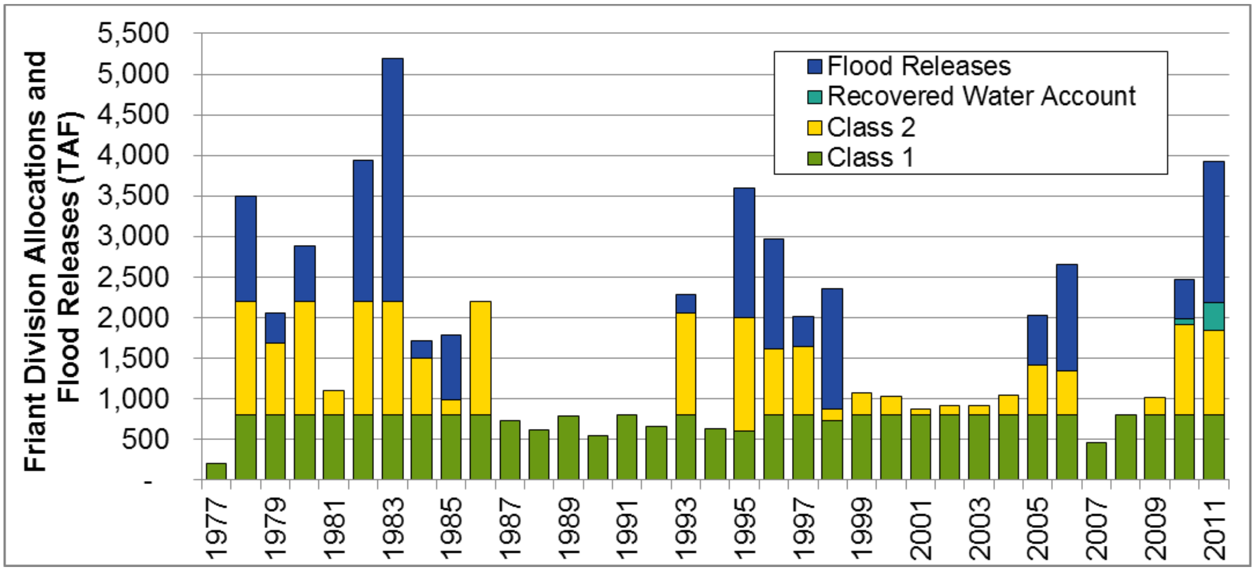


Figure 2-1. Friant Division Allocations and Flood Releases, 1977 – 2011

The following subsections discuss the identified key issues related to water supply reliability in California, including current and estimated water shortages, anticipated effects of population growth and climate change on water supply and demand, and limitations on system flexibility. The final subsection discusses strategies for meeting future statewide water supply needs.

Estimated Water Supply Shortages

Projecting accurate and quantified water supply and shortages in California is complex; there are numerous variables and, just as important, numerous opinions regarding these variables. Table 2-1 shows estimated water demands, available supplies, and shortages for the Central Valley and the State under existing conditions (Reclamation 2008b). Current water supply shortages for the State are estimated at 2.3 MAF and 4.2 MAF for average and dry years, respectively. As shown in Table 2-2, without further investment in water management and infrastructure, future statewide shortages are expected to increase to approximately 4.9 MAF and 6.1 MAF in average and dry years, respectively, by 2030. Representative demands for dry and average years were based on water use data from the *2005 California Water Plan Update* (DWR 2005), adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies. Shortages were determined on a regional basis, assuming that limitations on conveyance and storage would prevent surpluses from one region or use category from filling shortages in another.

Additionally, through implementation of the Settlement, average total system water deliveries from Friant Dam are expected to be reduced by about 150 TAF per year, or approximately 15 percent to 19 percent of deliveries under existing conditions. The Settlement does not detail all of the specific actions to achieve the Water Management Goal, nor does it identify specific quantities of water supply to be replaced, thereby reducing the flexibility of the system to meet demands.

Table 2-1. Estimated Water Demands, Supplies, and Shortages under Existing Conditions

Item[1]	Hydrologic Basin						State of California	
	Sacramento		San Joaquin		Two-Basin Total			
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population[3]	2.9		2.0		4.9		36.9	
Water Demand (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.9	9.0
Agricultural	8.7	8.7	7.0	7.0	15.7	15.7	34.2	34.2
Environmental	11.9	9.4	3.1	2.3	15.0	11.7	17.5	13.9
Total	21.5	19.0	10.7	9.9	32.2	28.9	60.6	57.1
Water Supply (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.8	8.4
Agricultural	8.7	8.6	6.9	7.0	15.6	15.6	33.2	32.0
Environmental	11.5	8.7	2.5	1.8	14.0	10.5	17.5	12.6
Total	21.1	18.2	10.0	9.4	31.1	27.6	60.6	53.0
Total Shortage (MAF)[4]	0.4	0.8	0.7	0.5	1.1	1.3	2.3	4.1

Notes:
1 Water demands, supplies, and shortages are from the *Water Supply and Yield Study* (Reclamation 2008b).
2 Representative dry and average year supplies and demands were based on adjusted water use and supply data from the *2005 California Water Plan Update* (DWR 2005).
3 Population estimates are from the California Department of Finance (2010)
4 Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between total demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.
Key:
MAF = million acre feet

Table 2-2. Estimated Water Demands, Supplies, and Shortages for 2030

Item[1]	Sacramento and San Joaquin Hydrologic Basins – Two-Basin Total		State of California	
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population (million)[3]	10.5		49.2	
Water Demand (MAF)				
Urban	2.4	2.5	11.9	12.0
Agricultural	15.0	15.0	31.4	31.4
Environmental	14.9	11.7	17.5	14.0
Total	32.3	29.2	60.8	57.4
Water Supply (MAF)				
Urban	1.5	1.5	8.4	8.0
Agricultural	15.6	15.6	32.8	31.5
Environmental	14.0	10.5	16.3	12.6
Total	31.1	27.6	57.5	52.1
Total Shortage (MAF)[4]	1.8	2.2	4.9	6.1

Notes:

[1] Water demands, supplies, and shortages are from the *Water Supply and Yield Study* (Reclamation 2008b).

[2] Representative dry and average year supplies and demands were based on water use and supply data from the *2005 California Water Plan Update* (DWR 2005) adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies.

[3] Population estimates are from the California Department of Finance (2010)

[4] Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.

Key:
MAF = million acre feet

Potential Effects of Population Growth on Water Demands

A major factor in California’s future water picture is population growth. California’s population is expected to increase by just over 34 percent by 2050 (California Department of Finance 2010) and could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. Some portion of increased population in the Central Valley would occur on lands currently used for irrigated agriculture. Water that would have been needed for these lands for irrigation would instead be used to serve replaced urban demands. However, this would only partially offset the required agricultural-to-urban water conversion needed to sustain projected urban water demands, since much of the growth would occur on nonirrigated agricultural lands.

The *2009 California Water Plan Update* (DWR) estimates changes in future water demands by 2050 considering three different population growth scenarios as well as climate change. Table 2-3 shows results of this study for an average water year (DWR 2009a). The first scenario (Current Trends) assumes that recent population growth trends will continue until 2050. The second scenario (Slow and Strategic Growth) assumes that population growth will be slower than currently projected. The third scenario (Expansive Growth) assumes that population growth will be faster than currently projected, with nearly 70 million people living in California in 2050. Estimated reductions in agricultural water demands in Table 2-3 represent decreases in future agricultural water demands due to conversion from agricultural to urban land uses. Under the Current Trends and Expansive Growth scenarios, as much as 3 MAF and 8 MAF, respectively, of increased demand is projected, adding to the current water shortages estimated in Table 2-1.

Table 2-3. Estimated Annual Change in Water Demand in California for 2050 Considering Different Population Growth Scenarios

Item	Current Trends	Slow and Strategic Growth	Expansive Growth
Population (million)	59.5	44.2	69.8
Irrigated Crop Acreage (million)	8.6	9	8.3
Water Demand Change[1] (MAF)			
Urban	7	2	11
Agricultural	-4.5	-5.5	-4
Environmental	1	2	1
Total	3	-1.5	8

Source: DWR 2009a

Note:

[1] Water demand change is the difference between the average demands for 2043—2050 and 1998—2005.

Key:

MAF = million acre-feet

Potential Effects of Climate Change on Water Supply and Demand

Another potentially significant factor affecting water supply reliability is climate change. Potential impacts due to climate change are many and complex (DWR 2006a), varying through time and geographic location across the State (Reclamation 2011a). Changes in geographic distribution, timing, and intensity of precipitation are projected for the Central Valley (Reclamation 2011a), which could broadly impact rainfall-runoff relationships important for flood management as well as water supply. Additionally, when climate change is considered in projections of future water demand, annual water demand is higher than under a repeat of historical climate (DWR 2009a). Other possible impacts range from potential sea-level rise, which could impact coastal areas and water quality, to impacts to overall system storage for water supply.

A reduction in total system storage is widely predicted to occur with climate change. Precipitation held in snowpack makes up a significant quantity of total annual supplies needed for urban, agricultural, and many environmental uses. It is expected that in the future, climate change may significantly reduce water held in snowpack in the Sierra Nevada (Reclamation 2011a, DWR 2009a). Further potential for reductions in water conservation space in existing reservoirs in the Central Valley is anticipated because of increasing needs for additional space for flood management purposes. These potential reductions could significantly impact available water supplies. During drought periods, supplies could be further reduced, and expected shortages would be significantly greater. Possible effects of climate change on water supply in California are discussed in greater detail in the Modeling Appendix Attachment C.

System Flexibility

In addition to concerns about future water supply and demand, California's Federal and State water systems lack flexibility in timing, location, and capacity to meet the multiple purposes of the projects. The flexibility of the CVP and SWP has diminished over time as population continues to grow and environmental and ecosystem commitments and requirements continue to increase (Reclamation 2008b). Complicating this issue is the variability associated with water resources in California, coupled with anticipated changes in future supply and demand. Variability and uncertainty are the dominant characteristics of water resources in the State (Delta Stewardship Council 2012). Precipitation in California is seasonably, temporally, and spatially variable. In addition, urban, agricultural, and environmental water users have variable needs for quantity, quality, timing, and place of use. The water and flood systems face the threat of too little water to meet needs during droughts and too much water during floods, respectively. Challenges are greatest during drought years, when agricultural and environmental water becomes less available, and a greater reliance on groundwater results in overdraft (DWR 2009a).

Additionally, Delta vulnerabilities introduce opportunities related to system flexibility. More than half of Californians rely on water conveyed through the Delta for at least part of their water. The Delta faces extraordinary risks in both the near term and the long term, including earthquakes, river floods, sunny day levee failures, and continuing subsidence and sea-level rise (DWR 2009a). Previous analyses suggest that a catastrophic levee failure would result in cessation of pumping capacity for as much as 18 months, causing $30 billion to $40 billion in economic damage to the State (DWR 2009a).

Increasing CVP/SWP operational constraints have led to growing competition for limited system resources between various users and uses. Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. For example, the CVPIA, implemented in 1993, dedicated 800 TAF of CVP water supplies to the environment as well as additional water supplies for the Trinity River and wildlife refuges. Table 2-4 illustrates the impacts of the CVPIA, modeled using CalSim II, on urban and agricultural water deliveries to the north and south of the Delta. Dry year agricultural water deliveries were particularly impacted with deliveries to agricultural users, both NOD and SOD, reduced by about 50 percent.

Current CVP and SWP operational conditions are described in the 2008 *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP* (USFWS 2008b) and the 2009 *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (NMFS 2009), collectively known as the 2008/2009 BOs. The 2008/2009 BOs have resulted in increased Delta pumping constraints and other operational restrictions, coupled with drought conditions, and have even further decreased CVP deliveries. As competition for limited resources grows, water management flexibility and adaptability will be even more necessary in the future.

Table 2-4. Impact of CVPIA on CVP Deliveries

CVP Contract Deliveries	All Years			Driest Years		
	Pre-CVPIA (TAF)	Post-CVPIA (TAF)	Percent Change	Pre-CVPIA (TAF)	Post-CVPIA (TAF)	Percent Change
NOD Urban	176	167	-5%	166	145	-13%
NOD Agriculture	279	234	-16%	169	84	-50%
SOD Urban	134	122	-9%	114	96	-16%
SOD Agriculture	1,588	1,137	-28%	931	471	-49%
Total	2,176	1,660	-24%	1,381	796	-42%

Source: Reclamation 2008b
Notes:
[1] Deliveries were modeled using CalSim II. Key:

Key:
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
NOD = north of Delta
SOD = south of Delta
TAF= thousand acre-feet

San Joaquin Valley Refuge Water Supply

Securing a reliable water supply of sufficient quality has long been recognized as an important component for sustaining wetland habitats in the Central Valley and waterfowl of the Pacific Flyway, and supporting other wildlife species that depend on wetland habitat (Reclamation, et al. 2001). Of the 19 Central Valley refuges and managed wetlands, 10 SOD refuges and managed wetlands are served via Mendota Pool along the San Joaquin River. These refuges and managed wetlands include Grassland Resource Conservation District (GRCD), Los Banos Wildlife Area (WA), Mendota WA, Volta WA, the North Grasslands WA Complex’s Salt Slough and China Island units, and the San Luis National Wildlife Refuge Complex’s San Luis, West Bear Creek, Freitas, and Kesterson units.

The CVPIA Refuge Water Supply Program (Section 3406(b)), Reclamation is required to provide firm and reliable water supplies of suitable quality to maintain and improve wetlands and wildlife habitat on 19 specific Central Valley wildlife refuges. Numerous biological benefits have resulted from a reliable year-round water supply that adequately meets the delivery schedule for wetland management on CVPIA refuges (Reclamation 2012). Water supplies developed through the Refuge Water Supply Program also allow refuge managers to “flush” excess salts from wetlands while improving soil quality (Reclamation 2012).

Reclamation is currently implementing activities, such as shifted demand scheduling, reallocation of Level 2 supplies to other refuges, and supply flexibility options that are strategically prioritized, to improve coordinated management of refuge water supplies and lessen impacts to other water users (Reclamation 2012). Additionally, Level 2 diversification opportunities, which could provide mutual benefits to refuges and agricultural water service contractors, are being pursued.

Strategies to Address Water Supply Needs

As noted by Reclamation's *Water Supply and Yield Study* (2008b), the *California Water Plan Update 2009* (DWR 2009a), *A CVP Yield Feasibility Investigation Report: The Delivery Impact of the CVPIA* (Reclamation 2005a), CALFED (2000a), and the *Least-Cost Yield CVP Increase Plan* (Reclamation et al. 1995), an integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs. The *Water Supply and Yield Study* stated that a "variety of storage and conveyance projects and water management actions have the potential to help fill [the] gap" between water supply and demand in California.

The *California Water Plan Update 2009* (DWR 2009a) concluded that California must invest in reliable, high-quality, and affordable water conservation; efficient water management; and development of water supplies to protect public health, and improve California's economy, environment, and standard of living. However, even with major efforts by multiple agencies to address the complex water resources issues in the State, demands are expected to continue to exceed supplies in the future.

To avoid major impacts to the economy, overall environment, and standard of living in California, future water resource plans must consider additional water sources to increase supply reliability for expanding M&I uses and to maintain adequate supplies for agricultural and environmental purposes. Water management flexibility and adaptability will become even more necessary in the future to meet the challenges associated with increasing population, environmental needs, and climate change. Additionally, future water planning for the State should increase urban water use efficiency, recycling municipal supplies, and improving Delta conveyance through programs, such as the BDCP.

San Joaquin River Ecosystem

After construction of Friant Dam and before implementation of the SJRRP, the reach of the San Joaquin River from Friant Dam to the Merced River confluence (Figure 2-2) did not support a continuous riparian and aquatic ecosystem. Friant Dam was authorized and is operated to support two primary purposes: agricultural and M&I water supplies, and flood damage reduction. Since completion of Friant Dam, most of the water in the river was diverted for agricultural and M&I uses, with the exception of releases to comply with Holding Contract requirements upstream from Gravelly Ford, and flood releases. Between Friant Dam and Gravelly Ford, diversions and encroachments by agriculture and urban development led to fragmented riparian habitat and extensive changes in the aquatic ecosystem. Holding Contract requirements between Friant Dam and Gravelly Ford required that streamflow of at least 5 cfs must be maintained past each Holding Contract diversion point, with the last being near Gravelly Ford.

The reach of the lower San Joaquin River, from Mendota Pool to Sack Dam, contains Delta water for delivery to the San Luis Canal Company and wildlife refuges. Between Sack Dam and the confluence with Salt Slough, the primary source of flow in the San Joaquin River was groundwater seepage from adjacent agricultural lands. The reach from Sack Dam to Bear Creek was operationally dry, but this reach benefited from managed wetland development, whereas marshes were drained between Bear Creek and the Merced River. Generally unhealthy ecosystem conditions for the native cold water fishery resulted from lack of reliable flows and poor water quality in the San Joaquin River.

Implementing the SJRRP is expected and intended to alter ecosystem conditions of the San Joaquin River. Accomplishing the Restoration Goal, including the full release of Restoration Flows required under the Settlement, will require funding, and constructing extensive channel and structural improvements in many areas of the river, including some areas that have been without flows (except for occasional flood releases) for decades.. The exact nature of these structural improvements, and magnitude and timing of resulting ecosystem improvements, is the subject of a Programmatic EIS/EIR and multiple related studies prepared by Reclamation and others (SJRRP 2011).

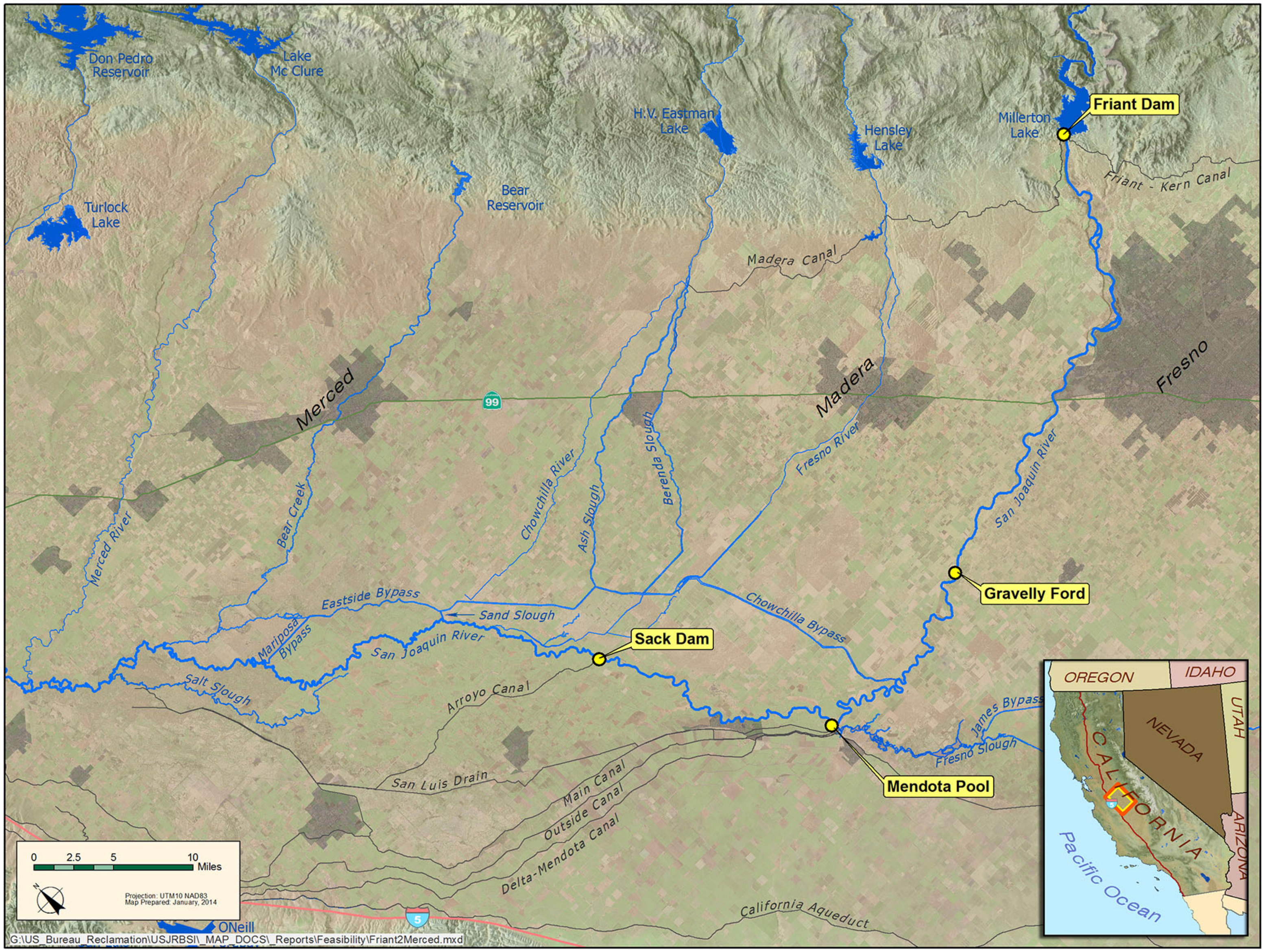


Figure 2-2. San Joaquin River from Friant Dam to Merced River

Interim Flows for experimental purposes began in 2009 and Restoration Flows began January 1, 2014. The flows will be increased gradually over the next several years up to the full flows specified in the Settlement, as channel capacity allows.

The stipulated releases to the San Joaquin River vary by water year type and represent the quantity of flows released from Friant Dam in addition to the volume of flows required to satisfy riparian diversions between Friant Dam and Gravelly Ford and maintain 5 cfs of flow at the Gravelly Ford gage station. There are also provisions for an additional buffer flow of up to 10 percent for release to the river; releases to address unexpected seepage losses; flushing flows to enhance gravel conditions for spawning during wet and normal-wet years; and riparian recruitment flows during wet years.

The Settlement includes the reintroduction of spring-run and fall-run Chinook salmon. The SJRRP implementing agencies have been conducting various fisheries studies on Chinook salmon requirements and habitat conditions in the San Joaquin River between Friant Dam and the Merced River and are performing initial reintroduction activities such as collection and transport of fall-run Chinook salmon and are anticipating release of Feather River Hatchery spring-run Chinook salmon in second quarter 2014.

In addition to flow, success of Chinook salmon populations is known to be affected by water temperature. The SJRRP has developed information on water temperature requirements for Chinook salmon, and the continuing water temperature studies provide the ability to monitor changes to habitat conditions. Water temperatures that are too high, or in some cases too low, can be detrimental to the various life stages of salmon. Elevated water temperatures could negatively impact spawning adults, egg maturation and viability, and pre-emergent fry, substantially diminishing the resulting ocean population and next generation of returning spawners. Stress caused by high water temperatures also may reduce the resistance of fish to parasites, disease, and pollutants. Conversely, water that is too cold would inhibit the growth of juveniles. The ability to manage the necessary volumes of cold water and to release water from Friant Dam at suitable temperatures, especially in drier water years, may be challenges to restoring and maintaining naturally reproducing and self-sustaining anadromous fish.

Flood Damage Reduction

Major storms during the past 3 decades have demonstrated that Friant Dam has little capacity to store water from large runoff events. For example, between 1977 and 2011 flood control releases from Friant Dam totaled almost 17 MAF, and flood releases were made in about 50 percent of the years.

Annual unimpaired runoff at Friant Dam from the upper San Joaquin River basin ranges from about 360 TAF to 4,600 TAF, with an average of 1,800 TAF (water years 1901-2007). Millerton Lake, at approximately 520 TAF in volume, is often undersized to adequately manage annual inflows, underscoring the need for additional storage. Flood operations at Friant Dam are based on anticipated precipitation and snowmelt runoff and the operations of upstream reservoirs. Flood releases from Friant Dam are maintained, when possible, at levels that could be safely conveyed through the San Joaquin River and Eastside Bypass. Generally, flood operations target releases at or below 8,000 cfs downstream from Friant Dam.

Further, the level of flood protection initially provided may not be appropriate for current downstream land uses and development levels. January 1997 flood flows of nearly 60,000 cfs from Friant Dam resulted in levee failures and extensive downstream flooding.

As part of the Comprehensive Study, the USACE assessed system performance during major floods in the last 2 decades. The study found that Friant Dam was effective in reducing damages during floods, but that substantial damages were still experienced during recent flood events (USACE and The Reclamation Board 2002). The Comprehensive Study also developed a set of systemwide tools to simulate flood system performance for the entire San Joaquin River Basin. Under existing conditions, expected annual damages from flooding were estimated as $29 million in the San Joaquin River Basin.

Energy Generation and Management

In 2009, the United States received approximately 7 percent of its electricity from hydropower (EIA 2010). Hydropower is also an important element of power supply in California. On average, hydropower generation constitutes between 9 and 30 percent of California’s annual energy supply, depending on the type of water year (CEC 2003). Due to its ability to rapidly increase and decrease power generation rates, hydropower could be used to support peak power loads in addition to base power loads.

Demands for power are expected to increase as population, industry, and associated infrastructure growth occurs in the future. Over the next 10 years, California’s peak demand for electricity is expected to increase up to 18 percent from about 278,000 gigawatt-hours (GWh) to 328,000 GWh (CEC 2013).

There are, and will continue to be, increasing demands for new electrical energy supplies, including clean energy sources, such as hydropower.

Renewable energy generation from solar and wind facilities is also expected to increase in response to Executive Orders S-14-08 and S-21-09, issued in 2008 and 2009, respectively, which established a goal of using renewable energy sources for 33 percent of the State's energy consumption by 2020 (California Public Utilities Commission 2011). Increased power demand and renewable energy production will increase needs for energy management and storage facilities, like hydroelectric powerplants with water storage, that could provide energy and ancillary services to the grid as needed.

Recreation

As the population of the State of California continues to grow, demands would increase for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. Demands for water-based and land-based recreational opportunities in the San Joaquin River Basin are high. Some of these demands are served by reservoirs on the western slope of the Sierra Nevada. In the primary study area, regional population growth is expected to result in increased demand for recreation at Millerton Lake and increased visitation (Reclamation 2008d).

Recreational boating, Millerton Lake

San Joaquin River Water Quality

Water quality in various segments of the San Joaquin River has been a problem for several decades due to low flow and poor quality discharges from agricultural areas, wildlife refuges, and M&I treatment plants. Over time, regulatory requirements for water quality in the river have become more stringent and the number of locations along the river at which specific water quality objectives are identified and monitored has increased. Water quality conditions in the San Joaquin River would likely improve through implementation of the San Luis Drainage Feature Reevaluation selected alternative for lands draining to the San Joaquin River, SJRRP actions, and various TMDLs, including the San Joaquin River at Vernalis Salt and Boron TMDL and Basin Plan Amendment for the Control of Salt and Boron Discharges into the San Joaquin River upstream from Vernalis. However, the extent of water quality improvements is difficult to anticipate until water quality monitoring and analyses are completed for these actions.

Urban Water Quality

Water pumped from the Delta is the source of drinking water for approximately 25 million people in California. Delta water supplies generally contain elevated concentrations of bromide and organic carbon during late summer and early fall months. This increases drinking water treatment costs in urban areas and limits the use of Delta supplies for blending with other sources. In addition to conflicts among management of Delta water supplies for environmental, agricultural, and urban uses that reduce the reliability of water deliveries from the Delta, an increasing emphasis on facilitating exchanges and operational flexibility would place additional demands on water supplies and conveyance systems. 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 2000a).

Several environmental flow goals and objectives in the Central Valley, including the Delta, have been established through legal mandates to address the impacts of water operations and water quality deterioration on the San Joaquin River Basin and Delta ecosystems and on endangered and threatened fish populations. Planning efforts, such as the BDCP, are intended allow implementation of projects that restore and protect water supply and reliability, water quality, and ecosystem health in the Delta to proceed within a stable regulatory framework. Additional operational flexibility is needed to provide further opportunities to improve San Joaquin River and Delta water quality conditions.

Existing and Likely Future Resource Conditions in Study Area

One of the most important elements of any water resources evaluation is defining existing resource conditions in the affected environment, and how these conditions may change in the future. The magnitude of change not only influences the scope of the problems, needs, and opportunities, but the extent of related resources that could be influenced by possible actions taken to address them. Defining the existing and likely future conditions is critical in establishing the basis for comparing potential alternative plans consistent with P&G, NEPA, and CEQA guidance.

The following section briefly discusses existing conditions in the study area, including existing infrastructure, the physical environment, biological environment, cultural resources, and socioeconomic resources. The discussion of existing conditions focuses on the primary study area, but also provides information about water resources facilities and water deliveries in the extended study area. The primary and extended study areas are defined in Chapter 1.

Existing Condition Summary

This section describes existing conditions for the Friant Division, Friant Dam and Millerton Lake water control facilities, recreation facilities, and other infrastructure in the primary study area. The existing conditions will be described in more detail in the EIS/EIR.

Physical Infrastructure

Physical infrastructure in the study area includes facilities for the Friant Division, Friant Dam and Millerton Lake, recreational facilities and other reservoir area infrastructure, and facilities for flood risk management.

Friant Division of the Central Valley Project

The reservoir facilities at Millerton Lake are part of the Friant Division of the CVP, and their operation affects flow in the San Joaquin River. The Friant Division provides water to over 1 million acres of irrigable land on the east side of the southern San Joaquin Valley. Principal features of the Friant Division include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south to agricultural and urban water contractors. Storage in Millerton Lake below the elevation for canal diversion is about 130 TAF (135 TAF for the Friant-Kern Canal diversion, 130 TAF for the

Friant Dam and Millerton Lake

Madera Canal diversion), resulting in active storage of about 390 TAF. Annual water allocations and release schedules typically result in drawing reservoir storage to near minimum levels by the end of September.

Friant Dam and Millerton Lake

Friant Dam is a concrete gravity dam that impounds Millerton Lake on the San Joaquin River. It is located on the border between Fresno and Madera counties, near the community of Friant, about 20 miles northeast of Fresno.

Friant Dam, owned and operated by Reclamation, was constructed between 1939 and 1942. Three small saddle dams that close low areas along the reservoir rim are located on the south side of the reservoir. Millerton Lake has a volume of 524 TAF, a surface area of 4,905 acres, and an elevation of 580.6. Water deliveries, principally for irrigation, are made through outlet works to the Friant-Kern and Madera canals, which were completed in 1949 and 1944, respectively.

The spillway consists of an ogee overflow section, chute, and stilling basin at the center of the dam. Outlets to the Madera Canal are located on the right abutment; outlets to the Friant-Kern Canal are located on the left abutment. A river outlet works is located to the left of the spillway within the lower portion of the dam. Three powerhouses, owned and operated by the Friant Power Authority (FPA), are located on the canal and river outlets of Friant Dam. The combined capacity of the three powerhouses is 30 megawatts (MW).

Recreational Facilities and Other Reservoir Area Infrastructure

The general locations of facilities and developed lands around Millerton Lake are shown in Figure 1-1. The Millerton Lake SRA, managed by State Parks, contains numerous recreational facilities. The SJRGMA, administered by the BLM, is situated upstream from the SRA and also contains numerous recreational facilities. Three residential developments are located in Fresno County (Lakeview Estates, Winchell Bay, and Sky Harbor); one major development (Hidden View Estates) is located in Madera County. Other residential sites include two homes in the upper Millerton Lake area.

Several roads in the Millerton Lake area provide access to residential areas and recreational facilities. Two PG&E powerhouses, the Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse, are located within 1 mile of the upstream end of

Millerton Lake (Figure 1-1). Water is diverted from Kerckhoff Lake at Kerckhoff Dam and conveyed through tunnels and penstocks to serve the powerhouse.

Flood Risk Management

Friant Dam is the principal flood storage facility on the San Joaquin River, with a dedicated flood management pool of 170 TAF during the flood season of October through March (USACE 1955). Under present operating rules, up to 85 TAF of the flood storage required in Millerton Lake may be provided 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. During flood conditions, Friant Dam is operated to maintain releases to the San Joaquin River at or below a flow objective of 8,000 cfs. Other flood management facilities of the San Joaquin River Basin include levees along the San Joaquin River, Chowchilla Canal Bypass, Mariposa Bypass, and Eastside Bypass; levees along the lower portions of the Fresno River and Ash and Berenda sloughs; Bear Creek; and the Merced, Tuolumne, and Stanislaus rivers.

Physical Environment

Elements of the physical environment in the upper San Joaquin River Basin are described in this section, and include topography, geology, soils, geomorphology, sedimentation, erosion, climate, hydrology, water quality, groundwater resources, air quality, and noise.

Topography, Geology, and Soils

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Millerton Lake is set in the lower foothills of the Sierras and extends from a relatively broad open portion near Friant Dam to a long, narrow reach upstream into the upper San Joaquin River. Elevations in the immediate area of Millerton Lake range from about elevation 310 at Friant Dam to over elevation 2,100 at the upper end of the reservoir. The topography of the San Joaquin River Basin rises to over elevation 12,000 in the upper watershed, located in the Sierra Nevada.

The Investigation study area is located along the western border of the central portion of the Sierra Nevada Province at its boundary with the eastern edge of the Great Valley Province of California. Intrusive Sierra Nevada batholith rocks underlie most of the primary study area. Occasional remnants of lava flows and layered tuff are present in the area at the highest elevations. The San Joaquin River above Millerton Lake passes through medium- to fine-grained metamorphosed granodiorite. Surface weathering has produced some decomposed granite and soils. The primary study area is in the Upland Soils Physiographic Region of the Central Valley.

Geomorphology, Sedimentation, and Erosion

The San Joaquin River upstream from Millerton Lake lies in a steep and narrow canyon, and is known as the Patterson Bend reach. This 9-mile reach has a bedrock channel with an overall average gradient of about 1 percent, many long narrow pools, and an occasional steep cascade. Several small, ephemeral streams enter the San Joaquin River in this reach. The river margins in this reach are steep and rocky and flood flows frequently scour the channel.

The stretch of the river downstream from the Kerckhoff powerhouses is referred to as Millerton Bottoms, after which the river flows into Temperance Flat. Temperance Flat is the only substantial area in upper Millerton Lake with a gently sloping shoreline, shallow water, and well-developed shoreline vegetation. Big Sandy Creek and a few small, unnamed tributaries provide minor flow contributions to Millerton Lake in this reach. The shoreline immediately downstream from Temperance Flat, known as the Big Bend area, has steep sides and is rocky, with little vegetation.

The substrate in the streams and river originating from direct erosion and mass wasting of resistant granite in the upper San Joaquin River watershed is generally composed of large boulders, cobbles of 4 inches or larger diameter, and fine sand, with a small number of intermediate size gravels (SCE 2003). Since natural and cut slopes in decomposed granite erode readily and produce these coarse materials, soil erosion potential is high (FERC 2002). The lack of favorable conditions for chemical weathering in the watershed, and the predominantly coarse-grained parent material, results in the absence of fine-grained silts and clays. Land-disturbing activities, such as road building and timber harvesting, have the greatest potential to increase erosion, resulting in sedimentation in watercourses (SCE 2003).

Climate and Hydrology

The climate of the San Joaquin River Valley is arid to semi-arid with dry, hot summers and mild winters. Higher elevation portions of the watershed have distinct wet and dry seasons. Most of the precipitation falls from November to April, with rain at the lower elevations and snow in the higher regions. Large areas of high elevation watershed supply snowmelt run off during the late spring and early summer months, which is the main contributor to flow in the upper San Joaquin River. Downstream from Friant Dam, the river flows westward toward the center of the valley floor, where it turns sharply northward and flows through the San Joaquin Valley to the Delta. Along the valley floor, the San Joaquin River receives additional flow from the Merced, Tuolumne, and Stanislaus rivers and numerous smaller tributaries.

Upper San Joaquin River flows have been greatly affected by storage and releases of SCE and PG&E power projects. In addition to hydropower generation, reservoirs associated with these projects provide storage, flood management capacity, and recreational opportunities. Annual unimpaired runoff (estimates of flow that would occur at a specific location if upstream facilities were not in place) from the upper San Joaquin River Basin (at Friant Dam) ranges from about 362 TAF to 4,642 TAF, with an average of 1,818 TAF (Water Years [WY] 1901 – 2007).

In the reach between Friant Dam and Gravelly Ford, flow is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. However, agricultural return flows 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 five of the District's 161 drainage basins route stormwater to retention and detention facilities, limiting urban surface runoff. Releases from Friant Dam to the San Joaquin River since 1941 have generally been limited to releases for Holding Contract requirements and flood management releases. As described in the section on likely future conditions, the implementation of the Settlement will change this condition.

The existing conditions include the SJRRP Restoration Flow water releases from Friant Dam, which began January 1, 2014. The flows will be increased gradually over the next several years up to the full flows specified in the Settlement, as channel capacity allows.

Water Quality

Most of Millerton Lake becomes thermally stratified during spring and summer months. Complete mixing of the water column likely occurs during winter months. Water temperatures in Kerckhoff Lake rarely exceed 68 degrees Fahrenheit (°F). Summer water temperatures in the San Joaquin River below Kerckhoff Dam often exceed 75°F because of low streamflow and warming of the FERC-mandated releases from Kerckhoff Dam. During summer, cold water outflows from the Kerckhoff and Kerckhoff No. 2 powerhouses bypass an 8- and 9.5-mile segment of the San Joaquin River through tunnels from Kerckhoff Lake and are returned to the river near the upper portion of Millerton Lake. The colder, denser river inflow submerges at a location referred to as the "plunge point," and continues to flow downstream below the warmer reservoir surface layer (Ford 1990, PG&E 2001).

The upper reaches of the rivers draining to the San Joaquin River Basin originate in large drainage areas high on the west side of the Sierra Nevada. The water in these rivers is generally soft, with low mineral concentrations. Water is nutrient- and mineral-poor due to the insolubility of the granite substrate. As the San Joaquin River flows from the Sierra Nevada foothills below Friant Dam across the eastern valley floor, mineral concentrations steadily increase, largely as a result of depleted freshwater flows, M&I wastewater discharges, salt loads in agricultural drainage and runoff, and loads of other constituents associated with agricultural irrigation and production (DWR 2005). These constituents include nutrients, selenium, boron, organophosphate pesticides such as diazinon and chlorpyrifos, and toxicity of unknown origin.

Downstream from the primary study area, the reach from Gravelly Ford to a location upstream from Mendota Pool (about 17 miles) has been frequently dry historically, except during flood releases. As described in the section on likely future conditions, the implementation of the Settlement will change this condition. The entire stretch of the San Joaquin River from Friant Dam to the Mendota Pool is listed as an impaired water body under Section 303(d) of the CWA, with the main concern being invasive species (State Water Board 2010).

During the irrigation season, most of the water released from the Mendota Pool to the San Joaquin River is imported from the Delta via the DMC, and generally has higher concentrations of total dissolved solids (TDS) than water in the upper reaches of the San Joaquin River. Most of the water released from the Mendota Pool to the San Joaquin River is diverted at or above Sack Dam for agricultural uses. Historically, the San Joaquin River has been often dry between Sack Dam and the confluence with Salt Slough. From Salt Slough to Fremont Ford, most of the flow in the San Joaquin River is derived from irrigation return flows carried by Salt and Mud sloughs. This reach typically has the poorest water quality of any reach of the river. As the San Joaquin River flows downstream from Fremont Ford, water quality generally improves at successive confluences, specifically at those with the Merced, Tuolumne, and Stanislaus rivers. The San Joaquin River below the Mendota Pool is listed as an impaired water body under Section 303(d) of the CWA (State Water Board 2010).

Groundwater Resources

Within the primary study area, the majority of groundwater occurs in fractured bedrock. Localized alluvial material and weathered bedrock have potential to provide groundwater in the area, but large volumes of these materials were not identified within the Auberry-Prather area during a regional study of groundwater resources in eastern Fresno County (Fresno County 2006).

Figure 2-3 shows the locations of groundwater subbasins underlying the San Joaquin Valley within the primary and extended study areas. Groundwater quality throughout the region is suitable for most urban and agricultural uses. Local water quality impairments do exist for such constituents as TDS, nitrate, boron, chloride, and organic compounds (DWR 2003).

Air Quality and Noise

Air quality in the San Joaquin Valley Air Basin (SJVAB) is regulated by the San Joaquin Valley Air Pollution Control District (SJVAPCD), which consists of Merced, Madera, Fresno, Kern, Kings, San Joaquin, Stanislaus, and Tulare counties. The entire SJVAB is designated nonattainment with respect to the national 8-hour and State 1-hour ozone (O_3) standards, national and State particulate matter (PM) standards of 10 microns in aerometric diameter or less (PM_{10}) and 2.5 microns or less ($PM_{2.5}$).

Figure 2-3. San Joaquin Valley Groundwater Subbasins

Noise levels in densely populated areas of the State are influenced predominantly by the presence of limited-access highways carrying extremely high volumes of traffic, particularly heavy trucks. Noise in rural areas, where traffic generally is low to moderate, is measured at considerably lower decibels. Noise at Millerton Lake is generally affected by the presence of boats and personal watercraft.

Hazardous Materials
Metals may be present in inactive and abandoned mines around Millerton Lake, Temperance Flat, and the San Joaquin watershed. A records search did not reveal any sites on the Federal National Priorities List; however, there are several abandoned gold and/or quartz mines in the area.

Agricultural and Important Farmlands
Within the primary study area, there are no farmlands designated as prime farmland, unique farmland, or farmland of statewide importance; however, just downstream from the primary study area there is both prime farmland and unique farmland in Madera County. In the extended study area, the San Joaquin River Basin downstream from Friant Dam to the Delta, the Delta, and the CVP and SWP water service areas are all rich in agricultural resources.

Biological Environment
Elements of the aquatic and terrestrial biological environment in the upper San Joaquin River Basin are described in this section. The discussion focuses on habitat and species, including special-status species.

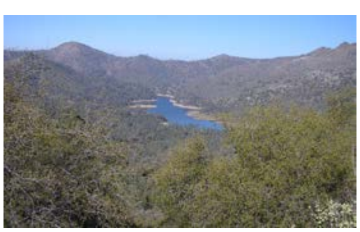
Aquatic and Fishery Resources
The following sections discuss existing aquatic and fishery resources in the primary study area.

Millerton Lake and San Joaquin River below Kerckhoff Dam
Under current reservoir operations, Millerton Lake water levels change by 1 foot or more per day almost 50 percent of days, and change by 2 feet or more about 10 percent of days. 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 also responsible for other fishery management issues, such as limited cover habitat, limited littoral habitat, and shoreline erosion.

Riparian vegetation along most of the San Joaquin River from Kerckhoff Dam to Millerton Lake is poorly developed because the river margins are steep and rocky, and flood flows frequently scour the channel. Some riparian vegetation occurs at the confluence of small streams in the upper portion of this reach.

Most of Millerton Lake becomes thermally stratified during spring and summer months and, therefore, potentially supports a two-stage fishery, with cold-water species residing in deep water and warm-water species inhabiting surface waters and shallow areas near shore.

Most of the commonly occurring species in Millerton Lake are introduced game or forage species. The principal game species are spotted bass (*Micropterus punctulatus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (collectively referred to as black bass) (*Micropterus dolomieu*), bluegill (*Leopomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), and striped bass (*Morone saxatilis*). The principal forage species for most of the game fishes is threadfin shad (*Dorosoma petenense*). Rainbow trout (*Oncorhynchus mykiss*), also an important game species, is frequently abundant in the upper San Joaquin River reach between Millerton Lake and Kerckhoff Dam. Several native nongame species have been collected from the reservoir, including Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis)*, Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Lavinia exilicauda*), hardhead (*Mylopharodon conocephalus*), and white sturgeon (*Acipenser transmontanus*). However, most of the native species have been substantially impacted in recent years (Mitchell pers. com. 2006).



Temperance Flat Area, Millerton Lake

The Millerton Lake population of American shad (*Alosa sapidissima*) is the only known successfully spawning, landlocked population. Because of its unique status, the population has attracted scientific interest and has been intensively studied in connection with PG&E's FERC licensing studies for the Kerckhoff No. 2 Hydroelectric Project (PG&E 1986, 2001).

The San Joaquin River between Millerton Lake and Kerckhoff Dam has spawning habitat for American shad and striped bass. Native fish species in the reach include hardhead, Sacramento pikeminnow, Sacramento sucker, and rainbow trout. Nonnative fish species include smallmouth bass and green sunfish (*Lepomis cyanellus*). 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 pers. com.). In addition to fish, beds of the large, freshwater pearlshell clam (*Margaritifera* spp.) have been found on the river bottom in this reach but the distribution and abundance of this clam are poorly known. The clam is listed as a “Special Animal” by CDFW, with its status in California classified as uncertain.

No aquatic species in the primary study area are federally or State-listed as threatened or endangered. Three species have special Federal and/or State status because they are relatively rare or are declining in abundance and/or distribution: hardhead, hitch, and Kern brook lamprey.

San Joaquin River from Friant Dam to Merced River

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. Throughout the area, physical barriers, reaches with poor water quality or no surface flow, and the presence of false migration pathways have reduced habitat connectivity for anadromous and resident native fishes. In addition to barriers, false migration pathways may impede fish movement in the Restoration Area.

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. Areas where unique and highly endemic fish assemblages once occurred are now inhabited by assemblages composed primarily of introduced species.

Of the approximately 21 native fish species historically present in the San Joaquin River, at least 8 are now uncommon, rare, or extinct, and an entire native fish assemblage – the deep-bodied fish assemblage (e.g., Sacramento splittail [*Poqonichthy macrolepidotus*], Sacramento blackfish) has been largely replaced by nonnative warm-water fish species (e.g., carp, 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.

Vegetation and Habitat Types

The following sections discuss existing vegetation and habitat types in the primary study area.

Millerton Lake and San Joaquin River Below Kerckhoff Dam

Vegetation around Millerton Lake includes annual grassland, oak woodland, and foothill pine oak woodland habitat types. Nonnative annual grassland is common on the north side of the reservoir near Friant Dam, and grades into oak woodland and foothill pine oak woodland pine to the east. The south side of Millerton Lake near Friant Dam supports more forest land than the north side but also contains small patches of grassland and urban areas. Foothill pine oak woodland is found throughout the primary study area, especially in ravines and on north- and east-facing slopes. It intergrades with blue oak woodland, which is more frequent on drier, less shaded sites, most commonly occurring on the north side of Millerton Lake. Interior live oak woodland occurs at the higher elevation limits of the primary study area on steep and rocky, north-facing slopes and becomes more abundant just outside of the primary study area. Buckbrush chaparral is the most common shrub-dominated habitat type in the study area; bush lupine scrub also occurs in the area.

Various riparian communities occur in the area, dominated by species that include white alder (*Aluns rhombifolia*), sycamore (*Plantanus racemosa*), willow (*Salix* spp.), cottonwood (*Populus* spp.), and buttonbrush (*Cephalanthus occidentalis*), and nonnative species, such as Himalayan blackberry (*Rubus armeniacus*), fig (*Ficus* spp.), and Spanish broom (*Spartium junceum*). Riparian vegetation occurs along the San Joaquin River and its intermittent and ephemeral tributaries.

Historically, the area has been affected by manmade and natural disturbances. A number of nonnative species have been intentionally or inadvertently introduced in the course of human settlement in the region, including invasive plants and game fish and wildlife species. Cattle grazing, a traditional land use managed by BLM, is pervasive on public and private lands in the area. Ecosystems in the basin have been extensively affected by fires, and many plant and wildlife species are fire-adapted. Historical records indicate that over half of the upper San Joaquin River watershed had burned before the 1950s. Since then, fire suppression has decreased the number of fires in the study area to infrequent, random events triggered by natural causes (lightning).

A number of rare and listed plant species are known to occur in the primary study area. These include Ewan's larkspur (*Delphinium hansenii* subsp.), Michael's piperia (*Piperia michaelii*), tree anemone (*Carpenteria californica*), and Madera leptosiphon (*Leptosiphon serrulatus*). Two plant species, the elderberry (*Sambucus* spp.) and California pipevine (*Aristolochia californica*), which serve as hosts for invertebrates of interest, are also known to occur in the area.

San Joaquin River from Friant Dam to Merced River

Descriptions of reach-specific physical conditions, plant communities, and sensitive resources by reach are based on the SJRRP PEIR/PEIS and the California Natural Diversity Database (CNDDB) (CDFW, 2013).

Reach 1A

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 vegetation surveys conducted in 2000 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. No special-status plants have previously been documented in Reach 1A (CDFW 2013).

Reach 1B

Reach 1B has a low ratio of natural vegetation per river mile. In 14 miles of channel, there is a little more than 1 square mile of natural habitat present. Woody riparian vegetation is prevalent and occurs mainly in narrow strips immediately adjacent to the river channel. No special-status plants have previously been documented in Reach 1B (CDFW 2013).

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 and 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.

One occurrence of heartscale (*Atriplex cordulata*) has previously been documented in the grasslands on the terraces above the alluvial plain, and outside the identified extended study area in 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 – 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. Lost Hills crownscale (*Atriplex vallicola*) has been documented at the Grasslands Wildlife Management Area (WMA) (CDFW 2013).

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 and 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.

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 ponds 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, 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).

The San Luis NWR and Grasslands WMA in Reach 4B support marsh and emergent wetlands, native grasslands, alkali sink, riparian forests, 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 species affiliated with these habitats have been documented throughout this subreach; however, only one special-status plant, Delta button-celery (*Eryngium racemosum*), has previously been documented in Reach 4B. 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.

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. 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).

Just north of its confluence with Bear Creek, 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 sink, riparian forest, and vernal pool. Delta button-celery has previously been documented within Reach 5 (CDFW 2013). The Great Valley Grasslands State Park and San Luis NWR also support occurrences of other rare and endangered species, although these are not documented in 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*). Farther along this reach, the river flows through the North Grasslands WA, which contains more than 7,000 acres of wetlands, riparian habitat, and uplands.

Wildlife

The following sections discuss existing wildlife resources in the primary study area.

Millerton Lake and San Joaquin River below Kerckhoff Dam

The primary study area hosts a diverse wildlife community, both resident and seasonal. A relatively diverse community of reptile and amphibian species exists in the study area. The western pond turtle (*Actinemys marmorata*), a California Species of Special Concern, is known to occur in several portions of the primary study area. The presence of the nonnative bullfrog (*Rana catesbeiana*) has changed, and continues to dramatically alter, the extant reptile and amphibian community through predation and because of its ability to out-compete native species. The federally listed California tiger salamander (*Ambystoma californiense*) has also been reported in the vicinity of the primary study area, and Critical Habitat has been designated for this species near, but outside of, the primary study area. Limited areas of potential breeding habitat for California tiger salamander have been identified in the San Joaquin River Gorge.

Bald eagles (*Haliaeetus leucocephalus*) are known to winter around Millerton Lake, and a pair has recently been observed nesting in the primary study area. Golden eagles (*Aquila chrysaetos*) and several bird species associated with riparian habitats, including the least Bell's vireo (*Vireobellii pusillus*) and willow flycatcher (*Empidonax traillii*), have been known to occur historically in the primary study area, but have not been recently documented. As in the reptile and amphibian community, a number of nonnative birds are present in the primary study area that influence the native bird community through competition (e.g., European starlings [*Sturnus vulgaris*]) and nest parasitism (e.g., brown-headed cowbird [*Molothrus ater*]).

San Joaquin River near Kerckhoff Powerhouse

The mammalian community has been affected by considerable habitat change associated with livestock grazing, residential development, recreational activity, and suppression of the natural fire regime. A number of special-status bat species have potential to occur in the primary study area, and suitable roost sites occur throughout the area. Other special-status species that may occur in the primary study area include the ringtail (*Bassariscus astutus*), American badger (*Taxidea taxus*), and San Joaquin pocket mouse (*Perognathus inornatus*). Important game species also occur in the primary study area, specifically mule deer (*Odocoileus hemionus*), California quail (*Callipepla californica*), wild turkey (*Meleagris galloparo*), and feral pigs (*Sus scrufa*). The region provides winter range and migratory routes for the San Joaquin deer herd. Hunting of these species contributes substantially to the local economy.

San Joaquin River from Friant Dam to Merced River

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 (*Contopus sordidulus*), black phoebe (*Sayornis nigricans*), yellow-billed magpie (*Pica nuttalli*), bushtit (*Psaltriparus minimus*), Bewick's wren (*Thryomanes bewickii*), 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 like 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 (*Microtus californicus*), 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 (*Arundo donax*). 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 (*Circus cyaneus*), mourning dove (*Zenaide macroura*), savannah sparrow (*Passerculus sandwichensis*), and the nonnative ring-necked pheasant (*Phasianus colchicus*). Mammal species that use grasslands include deer mouse (*Peromyscus maniculatus*), California vole, California ground squirrel (*Otospermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), and coyote (*Canis latrans*). Common amphibians and reptiles associated with grasslands in the San Joaquin Valley include western toad (*Bufo boreas*), western fence lizard (*Sceloporus occidentalis*), 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, 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, pond turtle, Sierran treefrog *(Pseudacris sierra*), and the nonnative American bullfrog. Both submersed 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 (*Pacifastacus ssp.*), or other aquatic organisms, such as river otter (*Lontra canadensis*) 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 (*Charadrius vaciferus*). Other species, such as mallard (*Anas platyrhynchos*) 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 (*Sylvilagus audubonii*).

Within each of the habitat types above, a variety of invasive plants is found. Plant communities 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 may provide roosting and nesting habitat for native birds (e.g., hawks and waterbirds) and insects (i.e., monarch butterflies [*Danaus plexippus*]); 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 (*Rattus norvegicus*), house mouse (*Mus musculus*), house sparrow (*Passer domesticus*), European starling, and rock pigeon (*Columba livi*a).

Cultural Resources

Sixty-nine archaeological sites are documented within the primary study area. These include 57 prehistoric sites, 6 historic-era sites, and 6 sites with both components. In addition, 9 historic-era structures have been formally recorded within the primary study area; four buildings/structures, including Friant Dam, one road, and four hydroelectric power generation features. The study area also encompasses portions of the Squaw Leap Archaeological District, within the SJRGMA managed by BLM. The Squaw Leap Archaeological District was determined eligible for the National Register of Historical Places (NRHP) by the Keeper on May 5, 1980, and is included on the California Register of Historic Resources.

Within the primary study area, a variety of religious, economic, historic, and other values could be identified for Native American groups. Sixteen groups, including those listed by the Native American Heritage Commission (NAHC), represent Native American interests in the study area.

Federally recognized tribes have 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.

The NAHC reviewed its sacred lands file and identified a sacred land filing within the primary study area; its location is confidential. Forty-two sensitive areas were identified by Native Americans as of August 1, 2006, including six directly adjacent to the study area, six within the current boundaries of Millerton Lake, and 30 within the primary study area, for cultural resources evaluations.

Paleontological Resources

Based on a record search conducted at University of California Museum of Paleontology (2011), there are no previously recorded fossil localities within or adjacent to the primary study area. Of the rock formations found within the primary study area, Turlock Lake Formation and Mehrten Formation are considered to be of high paleontological sensitivity. Holocene-age formations, Tertiary volcanic pyroclastic rocks, and Mesozoic and Paleozoic rock formations are considered to be of low paleontological sensitivity.

Socioeconomic Resources

This section describes socioeconomic resources in the study area, including water resources, power and energy, demographics, employment and labor force, land use, traffic and transportation, and recreation and public access. This section focuses on socioeconomic resources of the primary study area, but includes the extended study area where relevant.

Water Supply and Availability

The east side of the San Joaquin Valley includes numerous streams and rivers that drain the western slope of the Sierra Nevada and flow into the Central Valley. During the past 50 years, water resources of all major rivers have been developed through construction of dams and reservoirs for water supply, flood risk management, and hydropower generation.

Groundwater is a major source of agricultural and urban water supplies in the extended study area. Expansion of agricultural practices between 1920 and 1950 caused declines in groundwater levels in many areas of the San Joaquin River and Tulare Lake hydrologic regions. At a 1995 level of development, annual average groundwater overdraft is estimated at about 240 TAF per year in the San Joaquin River Hydrologic Region and at about 820 TAF per year in the Tulare Lake Hydrologic Region (DWR 1998). Historical groundwater use has resulted in land subsidence in the southwest portion of the region.

Central Valley Project

The CVP, approved by President Franklin Roosevelt on December 2, 1935, is the largest surface water storage and delivery system in California, covering 29 of the State’s 58 counties. Operated by Reclamation, the CVP consists of 20 reservoirs with a combined storage capacity of nearly 11 MAF; 11 power plants, 500 miles of major canals and aqueducts, and many tunnels, conduits, and power transmission lines (Reclamation 2004a). The CVP irrigates about 3 million acres of farmland (Reclamation 2008b), supplies water to more than 2.5 million people and businesses, and is also the primary source of water for much of California's wetlands (Reclamation 2008b).

CVP operations are divided into nine divisions. NOD operations include the Trinity, Shasta, Sacramento River, and American River divisions, known collectively as the Northern CVP System. SOD operations, the Delta, West San Joaquin, and San Felipe divisions, are known collectively as the Southern CVP System. Operations of the Eastside and Friant divisions of the CVP differ from the divisions in the Northern and Southern CVP systems in that their water deliveries are not linked to Delta pumping operations.

The Northern CVP and Southern CVP supply irrigation, M&I, and refuge water to more than 250 long-term water contractors in the Central Valley, Santa Clara Valley, and Bay Area. For most water users, water service contracts represent a supply supplemental to local sources, including groundwater. Northern CVP and Southern CVP water service contracts total 3,326 TAF/year (DWR and Reclamation 2007).

During development of the CVP, the United States entered into two types of long-term agreements with many major water right holders: the Sacramento River Settlement Contractors and the Exchange Contractors. Sacramento River Settlement Contractors primarily claim water rights on the Sacramento River. Because of the major influence of Shasta Dam operations on flows in the Sacramento River, these water right claimants entered into contracts with Reclamation. Most of the agreements established the quantities of water the contractors are allowed to divert from April through October without payment to Reclamation, and a supplemental CVP supply allocated by Reclamation. CVP contracts with the Sacramento River Settlement Contractors total 2,194 TAF per year (DWR and Reclamation 2007).

The Exchange Contractors are contractors who receive CVP water from the Delta via the Mendota Pool. Under Exchange Contracts, the parties agreed not to exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. These exchanges allow water to be diverted from the San Joaquin River at Friant Dam for use by water service contractors in the eastern San Joaquin Valley and Tulare Lake Basin. CVP contracts with the Exchange Contractors total 840 TAF per year (DWR and Reclamation 2007).

Friant-Kern Canal

Friant Division of the Central Valley Project

The Friant Division of the CVP encompasses 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. Friant Dam is operated as an annual reservoir, meaning all water supplies available in a given year are allocated with the expectation of delivery. River releases are made to satisfy downstream Holding Contract diversions. Streamflow of at least 5 cfs must be maintained past each Holding Contract diversion point, with the last being near Gravelly Ford. Under current conditions, specific releases are not made to the San Joaquin River to maintain fishery conditions downstream from Friant Dam. Friant Division contracts total 2,201 TAF per year.

Class 1 contracts, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to good-quality groundwater. 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. In addition to Class 1 and Class 2 water deliveries, Reclamation Reform Act of 1982 water is provided in Section 215 of the Act, which authorizes the delivery of unstorable irrigation water that would be released in accordance with flood management criteria or unmanaged flood flows. Delivery of Section 215 water has enabled groundwater replenishment at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

State Water Project

The SWP, planned and operated by DWR, was originally designed to deliver irrigation water to Southern California and to large San Joaquin Valley farms. It provided water to farmers in the San Joaquin Valley that were ineligible for CVP water because of acreage limitations in Federal reclamation law. The SWP provides water to 25 million Californians and 750,000 acres of irrigated farmland (DWR 2010a). SWP deliveries are allocated 70 percent to M&I use and 30 percent to agricultural use (DWR 2008b). The SWP includes 34 storage facilities, reservoirs, and lakes; 20 pumping plants; 4 pumping-generating plants; 5 hydroelectric powerhouses; and about 701 miles of open canals and pipelines (DWR 2010a). The SWP's 21 primary reservoirs have a total water storage capacity of 5.8 MAF (DWR 2008b). Major SWP aqueducts include the North Bay and South Bay aqueducts, the California Aqueduct, and the West and Coastal branches of the California Aqueduct.

The SWP delivers water under long-term contracts to 29 public water agencies throughout the State, including the San Joaquin Valley, Tulare Basin, and Southern California service areas (DWR 2010a). The public water agencies, in turn, either deliver water to water wholesalers or retailers or deliver it directly to agricultural and urban water users. Five contractors use SWP water primarily for agricultural purposes (mainly in the southern San Joaquin Valley), and the remaining 24 use the water primarily for municipal purposes (DWR 2008c).

The SWP has contracted a total of 4.16 MAF for average annual delivery (DWR 2008b). SWP contract types include Table A, Article 21, Article 56, and carryover water. The Table A amount is the maximum contractual amount that SWP contractors can request each year, and is given the first priority of delivery. Under shortage conditions, the current SWP policy is to equally impact all Table A water contractors. Between 1997 and 2006, annual water deliveries to SWP contractors averaged 2.9 MAF/year (DWR 2008d), and as little as 1.4 MAF/year in dry years (DWR 2008c).

Population, Employment, and Housing

In the primary study area in 2010, the City of Clovis had the highest proportion of residents identified as white (70.9 percent), while the City of Fresno had the lowest proportion of white residents (49.6 percent). In general, the Fresno Census-County Division (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 25.6 percent in the City of Clovis to 76.7 percent in the City of Madera. The proportions of residents responding as being 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 responding as “some other race” are higher in than the State as a whole. In the extended study area, the white population of Madera County (62.6 percent) was greater than Fresno and Merced counties (55.4 percent and 58.0 percent, respectively) and the State as a whole (57.6 percent). People identifying themselves as Hispanic represented were the largest non-white group in all three counties, accounting for an average of 53.0 percent of the total population. This percentage is substantially higher than the 37.6 percent of the State population identified as Hispanic (U.S. Census Bureau 2010).

The median household income for Fresno and Madera counties and nearby communities is less than the statewide median household income ($60,632). The City of Clovis registered the highest median household income, approximately $65,300. The City of Madera 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). In the extended study area, the overall median household income for Merced County is $43,945. The population percentage in counties and nearby communities below the poverty level does not exceed 50 percent and is not meaningfully greater than the population percentage of the general population in the State (i.e., areas where poverty levels are twice as great as those of the State [28.8 percent]). 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 only Clovis had proportions below the statewide poverty threshold, with 10.4 percent (U.S. Census Bureau 2010).

The unemployment rate for Fresno County was 9.9 percent in December 2007; Madera County's unemployment rate was 8.5 percent during the same period. These rates are both higher than the December 2007 unemployment rate for California (5.9 percent) and the Nation (4.8 percent) (California Employment Development Department 2008). The total number of jobs increased in both counties between December 2006 and December 2007. In Fresno County, the greatest growth occurred in the trade, transportation, and utilities sectors, with the majority of the jobs concentrated in the retail trade. The government sector was responsible for the greatest job increase in Madera County during the same period (California Employment Development Department 2008).

As of 2006, there were a total of 299,578 housing units in Fresno County, and 47,671 in Madera County. The vacancy rate in Fresno and Madera counties was 7.5 percent and 46.8 percent, respectively. From 2000 to 2006, Fresno and Madera counties experienced a 25.2 percent and 56.4 percent increase in the number of vacant housing units, which is higher than the State increase of 7.5 percent (U.S. Census Bureau 2000, 2006).

Power and Energy

The San Joaquin River watershed upstream from Millerton Lake is extensively developed for hydroelectric generation. In this area, PG&E and SCE own and operate several hydropower generation facilities. Hydropower also is generated by the FPA at the Friant Power Plant. In total, the upper San Joaquin River basin has 19 powerhouses with an installed capacity of almost 1,300 MW, which represents approximately 9 percent of the hydropower generation capacity in California.

Land Use

The primary study area, all within Fresno or Madera counties, is composed predominantly of publicly owned lands, although it also comprises private lands, including lands specifically set aside for conservation purposes. Lands in the lower portion of Millerton Lake, near Friant Dam, are either within the Millerton Lake SRA, managed by State Parks, or parcels that are privately held. Several residential areas have been established around Millerton Lake and include a total of more than 440 parcels. Further upstream from Friant Dam, most of the lands surrounding Millerton Lake are managed by Reclamation, State Parks, or CDFW. Private properties in the area include the Sierra Foothill Conservancy (McKenzie Preserve at Table Mountain), some undeveloped parcels, and a few residences. Most lands along the San Joaquin River from Millerton Lake to Kerckhoff Dam are managed by BLM as the SJRGMA. Private lands in this area include parcels associated with the PG&E power facilities, and vacant agricultural land used for cattle grazing.

Transportation and Circulation

Several roads in the Millerton Lake area provide access to residential areas and recreational facilities. Along the south side of the reservoir, Millerton Road connects the community of Friant with Auberry Road. Winchell Cove Road and Sky Harbor Road extend north from Millerton Road into residential areas. Sky Harbor Road continues to the South Fine Gold picnic area within the SRA. Madera County Road 206 and Road 145 on the north side of the lake lead to recreational facilities in the SRA. County Road 216 provides access from north of Millerton Lake to the Hidden View residential area near the confluence of Fine Gold Creek and Millerton Lake.

Wellbarn Road, extending to Spearhead Road from Auberry Road, provides access to Temperance Flat. Smalley Road, which spurs off Auberry Road, provides the main access to the SJRGMA and to the PG&E powerhouses, Kerckhoff and Kerckhoff No. 2. Smalley Road, a paved road, also provides access to the Kerckhoff Powerhouse switchyard, BLM primitive campground, and the San Joaquin River Trail. Powerhouse Road and Bridge connect Fresno and Madera counties across Kerckhoff Lake. Extending from Auberry Road in Fresno County to Road 222 in Madera County, the road and bridge provide access to Wishon Powerhouse for PG&E staff in Fresno County, and to schools in Fresno County for residents in the North Fork area.

Recreation

The Millerton Lake SRA contains about 10,500 acres in total and is one of the most popular recreational areas in the San Joaquin Valley. Millerton Lake, the centerpiece of the SRA, is more than 15 miles in length, has a surface area of about 4,900 acres, and a shoreline of about 63 miles at top of active storage. From 1996 to 2006, the SRA received an average of 440,000 visits per year, with the highest use occurring in May, June, and July. The SRA provides several recreational facilities, most of which are located on the gently sloping southern and northern shores of the lower portion of the reservoir, closest to population centers. Facilities include boat ramps, picnic areas, campgrounds, a marina, and a historic courthouse. The fishing season is open year-round and occasionally bass fishing tournaments are held on the lake. Wildlife viewing within the SRA is enhanced by the biological diversity of the area and the variety of plant and animal species present.

San Joaquin River Trail

Located 5 miles northwest of Auberry, the BLM SJRGMA covers approximately 6,700 acres of land on both the north and south sides of the San Joaquin River. The SJRGMA has experienced a rapid increase in visitation, from historical levels of about 20,000 recreational visits per year, to 60,000 to 70,000 visits the last few years. The SJRGMA offers several educational and recreational facilities, concentrated in the Squaw Leap area on the south side of the river, accessible via Smalley Road from Auberry. Hunting of game species is permitted in the SJRGMA.

Public Health and Safety

At Millerton Lake, water hazards are generally associated with recreational use. Downstream from Friant Dam, water-related hazards may be associated with rapid increases in flow in the San Joaquin River, as during flood events. Operations at Friant Dam have historically attempted to help dampen rapid changes in flow in the San Joaquin River, particularly in the reach between Friant Dam and the Mendota Pool; however, due to the average annual flows through the San Joaquin River are more than three times the size of Friant Dam, some flooding does still occur. Downstream from the Mendota Pool, Friant Dam has a decreasing influence on flow conditions and associated water-related hazards.

Visual Resources

Visual resources in the study area include views of and from Friant Dam and Millerton Lake. There are no highways located in the primary study area that are designated or are eligible for designation as State or County Scenic Highways. California's Scenic Highway Program was created to preserve and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to the highways.

Utilities and Public Service Systems

Various county and local agencies provide the primary study area with solid waste and wastewater removal and management, emergency services, public safety, and law enforcement services. PG&E is responsible for providing electrical and natural gas service to the primary study area. Gas is delivered to the study area through portions of PG&E's 40,000 miles of natural gas pipelines. Many areas scattered throughout Fresno and Madera counties are served by individual septic systems.

Indian Trust Assets

Indian Trust Assets (ITA) are legal interests in property held in trust by the United States for federally recognized Indian tribes or individual Indians. No Indian reservations are located within the primary study area. Indian Trust Lands corresponding to the Big Sandy Rancheria of Western Mono Indians are partially located within the primary study area. Additionally, Indian Trust Lands exist approximately 3 miles east-southeast of Millerton Lake, outside of the primary study area. These lands correspond to the Table Mountain Rancheria, which is the Rancheria of the Chukchansi band of Yokuts and the Monache tribe.

Likely Future Without Project Conditions Summary

Identification of the magnitude of potential water resources and related problems, needs, and opportunities in the study area is based not only on the existing conditions highlighted above but also on an estimate of how these conditions may change in the future. Predicting future conditions is complicated by a variety of factors, including uncertainty regarding future regulatory requirements, and ongoing programs and projects affecting the study area.

This section describes the changes in the environment expected in the study area, assuming that no Federal (or State) actions are implemented to develop and manage additional water supplies in the upper San Joaquin River Basin to address the stated planning objectives. The likely future condition includes actions reasonably expected to occur in the future. This includes projects and actions that are currently authorized, funded, and permitted. Predicting future changes to the physical, biological, socioeconomic, and cultural environments in the primary and extended study areas requires predicting changes that will result through implementation of the Settlement, as well as ongoing programs and projects primarily related to CALFED and the CVPIA. Several additional ecosystem restoration, water quality, water supply, and levee improvement projects are likely to be implemented in the future. Collectively, these efforts may result in changes to San Joaquin River habitat and water quality, Delta water quality, water supply, and levees.

For the purposes of the Investigation, the future without-project conditions include Settlement implementation of SJRRP Restoration Flows. The future without-project conditions do not include any specific projects or actions to develop additional local conveyance and storage capacity under the Settlement, as such actions are not included in the SJRRP alternatives and would require separate project-specific planning, design, and environmental compliance processes.

As described above, several projects are being implemented or are expected to be implemented in the future in the primary and extended study areas. Various other projects and programs are expected to be implemented in the future, including CVP contract renewals and further implementation of CVPIA(b)(2) water accounting, and land development plans and projects in the primary and extended study areas. The baselines for analysis of future conditions without project implementation include reasonably foreseeable actions with current authorization, complete funding for design and construction, and complete environmental permitting and compliance. Other programs currently in the planning phases could also potentially influence the Investigation in the future. A prominent example is the State of California's BDCP. This project has not been included in the evaluation of the alternative plans for the Investigation because there has not been a specific decision to implement BDCP at this time. Additional emerging concerns and trends such as climate change may also influence the likely future conditions.

The No-Action Alternative, as described later in this report, is considered to be the basis for comparison with potential alternative plans, consistent with the Federal P&G (WRC 1983) and NEPA guidelines.

The remainder of this chapter describes some of the future changes in physical, environmental, socioeconomic, and cultural conditions expected to occur in the primary and extended study areas.

Physical Environment

Physical conditions in the primary study area are expected to remain relatively unchanged in the future. No changes to area topography, geology, or soils are foreseen. Without major physical changes to the river systems upstream from Friant Dam (which are unlikely), hydrologic conditions would probably remain unchanged. Some speculation exists that regional hydrology would be altered should there be substantial changes in global climatic conditions. Scientific work by others in this field of study is continuing.

Physical changes to the San Joaquin River from Friant Dam to the Merced River are expected to be implemented through the Settlement. These changes include levee modifications associated with improving habitat conditions in the San Joaquin River, and channel capacity changes to accommodate Restoration Flows.

Settlement implementation will result in changes in hydrologic conditions in the San Joaquin River below Friant Dam through changed releases to the San Joaquin River. The Settlement includes a set of six different Restoration Flow hydrographs that vary in shape and volume according to annual unimpaired runoff in the basin. Average annual flood releases from Friant Dam are also anticipated to decrease through Settlement implementation.

A serious consequence of long-term groundwater overdraft in the San Joaquin and Tulare Lake hydrologic regions is land subsidence, or a drop in the natural land surface. Land subsidence results in a loss of aquifer storage space and may cause damage to public facilities such as canals, utilities, pipelines, and roads. Continued groundwater overdraft and land subsidence is expected to continue in the future, as the availability of surface water supplies remains uncertain and deliveries consistently fall below requests (USGS 2013). For example, flows to the San Joaquin River from Friant Dam pursuant to the Settlement have reduced surface water supplies available for irrigation.

Much effort has been expended to control the levels and types of herbicides, fungicides, and pesticides that can be used in the environment. Further, efforts are underway to better manage the quality of runoff from urban environments to major stream systems. Water quality conditions in the future without-project conditions upstream from Friant Dam are expected to generally remain unchanged and similar to existing conditions. However, with implementation of the San Luis Drainage Feature Reevaluation selected alternative, the Settlement, and various TMDLs, water quality conditions downstream from Friant Dam in the future are expected to improve over existing conditions.

Most of the air pollutants in the primary and extended study areas would continue to be influenced by both urban and agricultural land uses. As the population continues to grow, with about 4 million additional people expected in the Central Valley by 2030, and agricultural lands converted to urban centers, a general degradation of air quality conditions could occur.

It is unclear to what extent potential changes to the region’s climate could occur in association with global climate change. As the population continues to grow and agricultural lands are converted to urban and industrial uses, a general degradation of air quality conditions could occur. However, because of technological innovation and stringent regulations, air quality could improve over time. While similar types and sources of hazardous materials and waste are likely to be present in the future, increasing population will likely increase the potential for hazardous waste issues. Similarly, an increasing population will likely affect increases in environmental noise and vibration.

Biological Environment

As described earlier, Settlement implementation will include the restoration and maintenance of fish populations in "good condition" in the main stem 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. Additional efforts are underway by numerous agencies and groups to restore various biological conditions throughout the study area. Accordingly, major areas of wildlife habitat, including wetlands and riparian vegetation areas, are expected to be protected and restored. However, as population and urban growth continues and land uses are converted to urban centers, wildlife and plants dependent on native habitat types may be adversely affected.

Through the efforts of Federal and State wildlife agencies, populations of special-status species in the riverine and nearby areas are estimated to generally remain as under existing conditions. Although increases in anadromous and resident fish populations in the San Joaquin River are likely to occur through implementation of projects such as the SJRRP, some degradation may occur through other actions that reduce San Joaquin River flows or elevate water temperatures.

Cultural Resources

In the vicinity of Millerton Lake any paleontological, archaeological, historic, or ethnographic resources currently affected by erosion due to reservoir fluctuations would continue to be impacted. These archaeological sites, and others situated around the perimeter of the existing reservoir, and other accessible locations within the primary study area (both documented and undocumented), would continue to be subject to collection and occasional inadvertent effects from recreation. The Native American community members would continue their ceremonies within the primary study area and would be able to maintain their traditional spiritual connection to the primary study area. They would also continue to gather plant and animal species from historically important areas. Fossils and artifacts located around the perimeter of the existing reservoir will continue to be subject to collection by recreationalists. Similarly, conditions related to the cultural environment downstream from Friant Dam are unlikely to change significantly.

Socioeconomic Resources

The State's population is estimated to increase from approximately 37 million in 2005 to about 44 million by 2020, and to approximately 60 million by 2050. Between 2011 and 2050, Fresno and Madera counties are expected to continue their historic growth trends. According to the California Department of Finance (2007, 2010), Fresno County's population is expected to increase by 105 percent by 2050 to a total of approximately 1,928,411 residents. This represents approximately twice the expected percent increase in population as for the State as a whole. Growth in Madera County during this period is expected to be even faster than in Fresno County. Madera County's population is expected to increase by 172 percent by 2050 to a total of approximately 413,569 residents.

To support these expected increases in population, some conversion of agricultural and other rural land to urban uses is anticipated. More transportation routes are likely to be constructed to connect the anticipated population increase in the Central Valley to transportation infrastructure. Anticipated increases in population growth will also impact visual resources as areas of open space on the valley floor are converted to urban uses.

Increases in population would increase demands for electric, natural gas, and wastewater utilities; public services such as fire, police protection, and emergency services; and water-related and communication infrastructure. The increase in population, and the aging "baby boomer" generation would increase the need for health services. The region's superior outdoor recreational opportunities and moderate housing cost are expected to attract increasing numbers of retirees from outside the region and the State. An increasing population would produce employment gains, particularly in retail sales, personal services, finance, insurance, and real estate. Recreation is expected to remain an important element of the community and regional economy.

Anticipated increases in population growth in the Central Valley will also significantly increase demands on water resources systems for additional and reliable water supplies, energy supplies, water-related facilities, recreational facilities, and flood management facilities, as summarized in Table 2-2. As shown in the table, estimated future shortages of water supplies in drought years are expected to be substantial.

Increases in population and water demand are expected to continue well beyond the planning horizon of the Investigation.

Potential future water shortages, however, may be greater than shown in Table 2-2. Implementation of the Settlement requires the use of approximately 185 TAF of former-Friant Division water supplies per year, or approximately 15 to 20 percent of pre-Settlement supplies, for the purposes of restoring salmon in the San Joaquin River. It is also anticipated that implementing Settlement Restoration Flows would affect water levels at Millerton Lake and FPA power generation at Friant Dam in the future without-project conditions.

In April 2006, the Orange Cove Irrigation District filed an application with FERC to augment the generating capacity of a small turbine on a river outlet diversion to a fish hatchery by using Restoration Flow releases from Friant Dam. In March 2008, Orange Cove Irrigation District informed FERC of a partnership with the FPA to construct the new powerhouse. The proposal adds 1.8 MW in capacity, although this may increase in the future. This potential increase in generation has not been evaluated to date.

Chapter 3
Plan Formulation

The plan formulation process for Federal water resources studies is identified in the P&G (WRC 1983) and consists of the following deliberate and iterative steps:

1. Specify the water and related land resources problems, needs, and opportunities to be addressed.

2. Identify existing and projected future resources conditions likely to occur in a study area.

3. Define problems, needs, and opportunities to be addressed, and develop planning objectives, constraints, and criteria as the basis for formulating potential management measures and potential alternative plans to meet planning objectives within planning constraints.

4. Evaluate the potential effects of alternative plans.

5. Compare alternative plans.

6. Select a plan for recommendation to decision makers based on the comparison of alternatives and rationale for implementation or no action.

The planning process is led by a multiple-agency planning team, and involves the input and participation of concerned stakeholders, advisory groups, regulatory agencies, and members of the general public. This Draft Feasibility Report documents the plan formulation process as the basis for decision making by the Secretary of the Interior and Congress. Cooperating agencies and entities, including the State, will participate in this decision making.

Progress and results of the Investigation have been documented in a series of interim reports that will culminate in a Feasibility Report and an EIS/EIR. The Feasibility Report is the final planning report in the feasibility study process and builds on the results and findings of the previous interim planning.

The complete plan formulation approach and feasibility study process for the Investigation is illustrated in Figure 3-1 and described below:

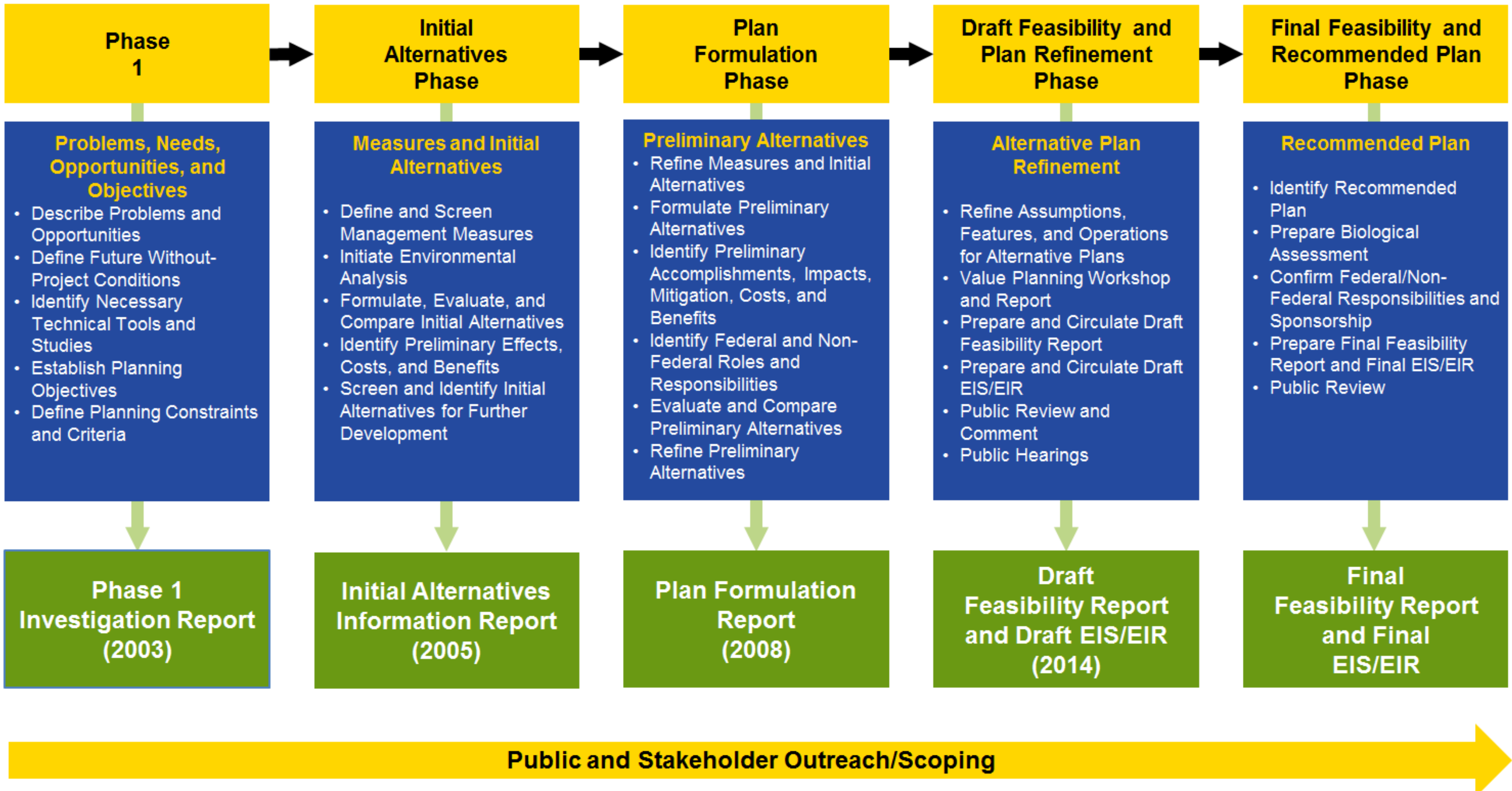


Figure 3-1. Plan Formulation Process

- **Phase 1 –** This phase identified and addressed 17 possible reservoir sites in the eastern San Joaquin Valley and selected 6 for continued study. Formal initiation of environmental compliance processes also began in this phase.

- **Initial Alternatives Phase –** This phase evaluated 24 reservoir measures (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. Four reservoir sites were selected for continued study.

- **Plan Formulation Phase –** Plan formulation phase analyses refined initial alternatives to four groupings of Alternative Plans, based on two dam site locations and inclusion/exclusion of a new Trans Valley Canal. The four groupings of alternative plans were then evaluated based on P&G planning criteria, ability to address planning objectives, and meet planning constraints and considerations. The Temperance Flat RM 274 Reservoir grouping of alternative plans (without the Trans Valley Canal) was retained for further evaluation.

- **Draft Feasibility and Plan Refinement Phase –** This phase focuses on further physical features and operations refinement of the alternative plans to identify a plan suitable to be recommended for implementation. This phase includes preparing and circulating a Draft Feasibility Report and Draft EIS/EIR.

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

Reclamation, DWR, and cooperating agencies carried out public and stakeholder outreach activities throughout the plan formulation process, as shown in Figure 3-1.

Planning Objectives

This section discusses Federal and State planning objectives, and objectives, constraints, considerations, and criteria specific to the Investigation.

Federal and State Objectives

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).

The federal objective to be implemented through the *Principles and Requirements for Federal Investments in Water Resources* (P&R) (CEQ 2013) is:

> *The Federal objective, as set forth in the Water Resources Development Act of 2007 (Public Law 110-114, Section 2031), specifies that Federal water resources investments shall reflect national priorities, encourage economic development, and protect the environment by:*
>
> - *seeking to maximize sustainable economic development;*
> - *seeking to avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and*

- *protecting and restoring the functions of natural systems and mitigate unavoidable damage to natural systems.*

In consideration of the many complex water management challenges and competing demands for limited Federal resources, Federal agencies investing in water resources should strive to maximize public benefits, particularly compared to costs. Public benefits encompass environmental, economic, and social goals, including monetary and non-monetary benefits, and allow for the inclusion of quantified and unquantified benefits. Stakeholders and decision makers expect the formulation and evaluation of a diverse range of alternative solutions. Such solutions may produce varying degrees of benefits and/or impacts relative to the three goals specified above. As a result, trade-offs among potential solutions will need to be assessed and properly communicated during the decision-making process.

As a partner with the Federal government, DWR requires that economic analyses conducted for 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 California's SB 1.

The CALFED ROD (2000a) provides a programmatic framework for participating Federal and State agencies to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

> The California Water Commission has new responsibilities under California's comprehensive water legislation, Senate Bill 1, regarding the distribution of State funds for the public benefits of water storage projects, and is developing regulations and guidelines to quantify and management of those benefits.

Planning Objectives

On the basis of the problems, needs, and opportunities identified and defined in Chapter 2, study authorities, and other pertinent direction, including information contained in the August 2000 CALFED ROD (2000a) and supporting documents, primary and secondary planning objectives were developed. Primary objectives are those for which specific alternatives are formulated to address. The primary planning objectives are considered to have coequal priority, with each pursued to the maximum practicable extent without adversely affecting the other. 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 Planning Objectives:
  - Increase water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in the Friant Division, other San Joaquin Valley areas, and other regions.
  - Enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River in support of restoring and maintaining naturally reproducing and self-sustaining anadromous fish (i.e., spring-run and fall-run Chinook salmon [*Oncorhynchus tshawytscha*]) and other fish populations.
- Secondary Planning Objectives:
  - Reduce frequency and magnitude of flood releases from Friant Dam.
  - Maintain the value of hydropower attributes.
  - 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. Examples include water resource planning efforts, such as the CALFED ROD. 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). Additional authorization was given in the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361). Based on Section 227 of the CWC, 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 2000a) 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 2000a), 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. In addition to objectives for potential additional storage in the upper San Joaquin River Basin, the Preferred Program Alternative in the ROD includes four other potential surface water and various groundwater storage projects to help reduce the gap between water supplies and projected demands. Expanding water storage capacity is critical to the successful implementation of all aspects of the program. Water supply reliability rests on capturing peak flows, especially 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 ROD also includes numerous other projects to help improve the ecosystem functions of the Bay-Delta system. Alternative plans should address the goals, objectives and programs of the CALFED ROD (2000a).

Laws, Regulations, and Policies
Numerous laws, regulations, executive orders, and policies need to be considered, among them: the P&G, NEPA, Fish and Wildlife Coordination Act, Clean Air Act, CWA, National Historic Preservation Act, California Public Resources Code, ESA and CESA, CEQA, CVPIA, and the San Joaquin River Restoration Settlement Act. See Chapter 6 for more details.

Statewide Water Operation Planning Considerations
A set of assumptions for operations of the CVP and SWP for the No-Action Alternative and alternative plans was developed in 2012 assuming that current system facilities and operational constraints would not change for the without-project conditions. Federal planning guidance was used to make assumptions about which future projects and plans may or may not be implemented; and correspondingly, which should be included or excluded from these models and evaluations. The most up-to-date information and assumptions are used for the operations modeling at each phase of the Investigation.

Some key areas of uncertainty potentially affecting operational analyses for the Investigation include implementation of the SJRRP Restoration Goal and Water Management Goal on the operations of Friant Dam and the San Joaquin River, and changes in Delta export regulations or policies resulting from the BOs for the Coordinated Long-Term Operation of the CVP and SWP, new ESA and CESA listings, or recommendations from various planning processes for the Delta, including the Delta Vision, Delta Plan, and the BDCP.

Modeling studies will be updated to reflect changes in water operations resulting from ongoing CVP and SWP long-term operations consultation and other relevant water resources projects and programs, including, potentially, BDCP efforts. The results of these updated studies will be considered further in the Final Feasibility Report.

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Other Planning Considerations

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

- A direct and significant geographical, operational, and/or physical dependency must exist between major components of alternatives.
- 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).
- Alternatives should account for mitigation of affected hydropower generation value.
- Alternatives should consider issues raised in coordination with other Federal and State agencies.
- Alternatives should avoid any increases in flood damages or other substantial hydraulic effects to areas downstream on the San Joaquin River.
- Alternatives should either avoid potential adverse effects to environmental, cultural, and historical resources or include features to mitigate unavoidable effects.
- Alternatives should not result in a substantial adverse effect to existing and future water supplies, or related water resources conditions.
- Alternatives should either avoid potential adverse effects to recreational resources or include features to mitigate unavoidable effects.
- Alternatives should be formulated and evaluated based on a 100-year period of analysis.

- Construction costs for 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).

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

Criteria

The Federal planning process in the P&G also includes four specific criteria for consideration in formulating and evaluating alternatives: completeness, effectiveness, efficiency, and acceptability (WRC 1983).

- Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others.

- Effectiveness is the extent to which an alternative alleviates problems and achieves objectives.

- Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing specified objectives consistent with protecting the Nation's environment.

- Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local governments, public interest groups, and individuals.

These criteria, and how they apply in helping to compare alternative plans, are described in Chapter 5.

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. Alternative plans are formulated by combining retained management measures that address primary planning objectives, and adding measures that address secondary planning objectives.

Measures Considered

Numerous potential measures to address the planning objectives were identified based on information from previous studies, environmental scoping, and outreach to address the planning objectives and satisfy the applicable planning constraints, considerations, and criteria. Measures were reviewed and refined through Study Management Team (SMT) meetings, field inspections, and coordination with stakeholders.

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 (Table 3-1 through 3-3). Measures addressing secondary planning objectives, which could be implemented in coordination with primary planning objective measure, were grouped according to the specific secondary objectives (Table 3-4).

Of the measures identified, several were selected for development into initial alternatives and alternative plans investigated in this Draft Feasibility Report. Other measures were deleted during Phase 1, the initial alternatives phase, the plan formulation phase, and the Draft Feasibility and Plan Refinement phase of the Investigation. Of 28 measures identified to address both primary planning objectives, 2 were retained for subsequent investigations in this Draft Feasibility Report, and 2 were retained in concept (Table 3-1). Of the 10 measures identified to address only water supply reliability and system operations flexibility, 2 were retained in concept (Table 3-2). Of the four measures identified to enhance water temperature and flow conditions in the San Joaquin River, two were retained for subsequent investigations in this Draft Feasibility Report (Table 3-3). Of 16 measures identified to address secondary planning objectives, 3 were retained for subsequent investigations in this Draft Feasibility Report, and 2 were retained in concept (Table 3-4).

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

Table 3-1. Management Measures Addressing Both Primary Planning Objectives

Measure	Status	Rationale
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.
Increase conservation storage in Millerton Lake by encroaching on dam freeboard	Deleted	Operable gates on the spillway allow for storage in the portion of the top of active storage capacity above the spillway crest. The remaining height to the top of the parapet walls is about 7.5 feet, providing very limited potential to encroach on existing freeboard. This measure was deleted from consideration during the plan formulation phase.
Increase conservation storage in Millerton Lake by reducing flood space	Deleted	The flood management capacity of Friant Dam is lower than originally anticipated. Evaluations suggest that additional flood space would be beneficial in reducing flood damages in downstream areas. Reducing flood space would increase flood damages. This measure was deleted from consideration during the plan formulation phase.
Increase Surface Water Storage in the Upper San Joaquin River Basin		
Enlarge Millerton Lake by raising Friant Dam	Deleted	Raises of up to 140 feet (920 TAF of additional storage) were considered. Evaluations during the initial alternatives phase concluded that this measure would not be carried forward as a stand-alone alternative because the new water supply that could be developed would not likely contribute to planning objectives. A Friant Dam raise of more than 25 feet was deleted from consideration during the initial alternatives phase because it would result in extensive residential relocation, power generation losses, and environmental effects along the San Joaquin River and in the Fine Gold Creek watershed, and was not considered cost effective, compared to other retained water storage measures. A Friant Dam raise of 25 feet combined with one of the other surface water storage measures would not be effective because very limited additional water supply would be provided and because of the impacts to private property and recreation facilities. A dam raise of 25 feet was deleted from consideration during the plan formulation phase.
Enlarge Millerton Lake by dredging lake bottom	Deleted	Very high cost and substantial environmental effects for a small potential benefit. This measure was deleted from consideration during the plan formulation phase.
Construct Temperance Flat RM 274 Reservoir	Retained	Reservoir sizes up to elevation 1,100 feet (2,110 TAF of additional storage) at this site were considered. Retained maximum size at about elevation 985 (1,260 TAF new storage capacity) in IAIR because the incremental new water supply did not appear justified due to substantial additional effects to environmental resources, additional effects to hydropower generation, and higher construction costs. Compared Temperance Flat RM 279 Reservoir alternative plans, Temperance Flat RM 274 Reservoir have greater benefits, greater net benefits, and a higher benefit-cost ratio. This measure was retained through the draft feasibility and plan refinement phase of the Investigation.

Table 3-1. Management Measures Addressing Both Primary Planning Objectives (contd.)

Measure	Status	Rationale
Increase Surface Water Storage in the Upper San Joaquin River Basin (continued)		
Construct Temperance Flat RM 279 Reservoir	Deleted	Reservoir sizes up to elevation 1,300 feet (2,740 TAF of additional storage) at this site were considered. Retained maximum size at about elevation 985 (690 TAF new storage capacity) in IAIR because the incremental new water supply did not appear justified due to substantial additional effects to environmental resources, additional effects to hydropower generation, and higher construction costs. Compared Temperance Flat RM 274 Reservoir alternative plans evaluated during the plan formulation phase, Temperance Flat RM 279 Reservoir alternative plans have lesser benefits, lesser net benefits, and a lower benefit-cost ratio. This measure was deleted during the plan formulation phase of the Investigation.
Construct Temperance Flat RM 280 Reservoir	Deleted	Similar to Temperance Flat RM 279 Reservoir, would result in similar effects on environmental resources, hydropower generation, and water supplies. Total storage capacity would be less and cost would be greater than at RM 279. This measure was deleted during Phase 1 of the Investigation.
Construct Temperance Flat RM 286 Reservoir	Deleted	Reservoir sizes up to elevation 1,400 feet (1,360 TAF of additional storage) at this site were considered. Deleted because environmental effects and net effects to hydropower generation would be greater and construction costs would be similar to comparable storage capacities at other Temperance Flat locations. This measure was deleted during the initial alternatives phase of the Investigation.
Construct Fine Gold Reservoir	Deleted	Reservoir sizes of up to 800 TAF of new storage capacity at this site were considered under configurations that included pumpback from Millerton Lake and/or upstream diversion from San Joaquin River and conveyance to Fine Gold Reservoir in combination with additional upstream storage. Water would be released from Fine Gold Creek Reservoir to Millerton Lake during periods of highest demand for releases from Friant Dam to the San Joaquin River and Friant-Kern and Madera canals. A configuration involving diversion from San Joaquin River in combination with additional upstream storage was deleted during the initial alternatives phase because of substantial impacts to environmental resources and high cost of water supply. Based on relative ability to meet the four P&G criteria, Fine Gold Reservoir surface water storage measure was considered inferior to the Temperance Flat RM 274 and RM 279 surface water storage measures. This measure was deleted during the plan formulation phase of the Investigation.
Enlarge Mammoth Pool Reservoir	Deleted	During the early phases of the Investigation, this measure was under study by the Friant Water Users Authority and Metropolitan Water District of Southern California in a study of water quality exchange opportunities. This measure would have similar costs to Temperance Flat RM 274 but could only provide about half the water supply and therefore, proportionally less benefits. This measure was deleted during the plan formulation phase of the Investigation.

Table 3-1. Management Measures Addressing Both Primary Planning Objectives (contd.)

Measure	Status	Rationale
Increase Surface Water Storage in the Upper San Joaquin River Basin (continued)		
Construct RM 315 Reservoir	Deleted	This reservoir, with a maximum storage capacity of about 200 TAF, would cause greater environmental effects and cost more than other retained storage measures with greater storage capacity. Would require additional downstream storage. Not considered cost effective as a water supply measure. This measure was deleted during the initial alternatives phase of the Investigation.
Construct Granite Project reservoirs	Deleted	Total storage capacity of about 110 TAF from multiple dams and reservoirs would cause greater environmental effects and cost more than other retained storage measures with greater storage capacity. Would require additional downstream storage. Not considered cost effective as a water supply measure. This measure was deleted during the initial alternatives phase of the Investigation.
Construct Jackass and Chiquito Creek reservoirs	Deleted	Total storage capacity of about 180 TAF from multiple dams and reservoirs would cause greater environmental effects and cost more than other retained storage measures with greater storage capacity. Would require additional downstream storage. Not considered cost effective as a water supply measure. This measure was deleted during the initial alternatives phase of the Investigation.
Increase Surface Water Storage in Other Eastern Sierra Nevada Watersheds		
Construct Montgomery Reservoir	Deleted	An off-stream reservoir with a storage capacity of up to about 240 TAF on Dry Creek would store water diverted from the Merced River and provide water in exchange for Friant Division deliveries. Potential exchange partners were not interested in a water supply with potential water quality problems, such as algae, associated with warm water. This measure was deleted during Phase 1 phase of the Investigation.
Modify Big Dry Creek Reservoir for water storage	Deleted	Modifications to the Big Dry Creek Reservoir would allow for water storage. A zoned earthfill embankment dam could create a reservoir with approximately 30 TAF of storage; however, due to seepage concerns and insufficient inflow, the total storage capacity has not been tested. Consequently, uncertainty remains regarding the existing dam’s ability to store more than a few TAF of water. Modifications to enable long-term storage may require extensive reconstruction. This measure was deleted during Phase 1 of the Investigation.
Enlarge Pine Flat Lake by raising Pine Flat Dam	Deleted	Water stored in about 120 TAF of additional storage space in Pine Flat Lake would be exchanged for Friant Division deliveries. Potential partners were not interested in exchanges that would affect Kings River water rights. This measure was deleted during Phase 1 of the Investigation.
Construct reservoir on Mill Creek	Deleted	Water diverted from Pine Flat Reservoir and stored in this new off-stream reservoir with a storage capacity of up to 200 TAF would be exchanged for Friant Division deliveries. Potential partners were not interested in exchanges that would affect Kings River water rights. In addition, this measure could cause immitigable environmental effects to sycamore alluvial woodland habitat. This measure was deleted during Phase 1 of the Investigation.

Table 3-1. Management Measures Addressing Both Primary Planning Objectives (contd.)

Measure	Status	Rationale
Increase Surface Water Storage in Other Eastern Sierra Nevada Watersheds (continued)		
Construct Rogers Crossing Reservoir on the Kings River	Deleted	Water stored in Rogers Crossing Reservoir, with a storage capacity of up to 950 TAF, would be exchanged for Friant Division deliveries. Potential partners were not interested in exchanges that would affect Kings River water rights. In addition, this measure would inundate a federally designated Wild and Scenic River and a California-designated Wild Trout Fishery. This measure was deleted during Phase 1 of the Investigation.
Construct Dinkey Creek Reservoir on a tributary to the Kings River	Deleted	Water stored in Dinkey Creek Reservoir, with a storage capacity of up to 90 TAF, would be exchanged for Friant Division deliveries. Potential partners were not interested in exchanges that would affect Kings River water rights. In addition, this measure would cause substantial adverse effects to regional transportation and adversely affect high-value fishery areas in downstream areas. This measure was deleted during Phase 1 of the Investigation.
Construct Dry Creek Reservoir on a tributary to the Kaweah River	Deleted	Water diverted from Lake Kaweah and stored in a 70 TAF offstream reservoir would be exchanged for Friant Division deliveries. This measure could cause immitigable environmental effects to sycamore alluvial woodland habitat. This measure was deleted during Phase 1 of the Investigation.
Raise Terminus Dam	Deleted	Previously authorized for construction by the U.S. Army Corps of Engineers; the dam raise was completed in 2004. This measure was deleted during Phase 1 of the Investigation.
Raise Success Dam	Deleted	Previously authorized for construction by the U.S. Army Corps of Engineers; the dam raise was cancelled in 2011 due to seismic concerns. This measure was deleted during Phase 1 of the Investigation.
Construct Tulare Lake Storage and Conveyance Facilities	Deleted	Development of reservoir storage in the Tulare Lake bed to store flood flows from eastside rivers and recirculated supplies for use as an integrated surface water and groundwater storage facility. Substantial institutional arrangements and limitations to the use of water supplies transferred and stored in Tulare Lake. This measure was deleted during the plan formulation phase of the Investigation.
Increase Surface Water Storage off the Friant-Kern Canal		
Construct reservoir in Yokohl Valley	Deleted	A new reservoir with a capacity of up to about 800 TAF would store water conveyed from Millerton Lake via the Friant-Kern Canal. Deleted because of conveyance limitations in the Friant-Kern Canal, potential that water quality problems associated with warm water would preclude water transfers, potential environmental effects, and likely low willingness of local landowners to participate. This measure was deleted during the initial alternatives phase of this Investigation.
Construct Hungry Hollow Reservoir on Deer Creek	Deleted	A new reservoir with a capacity of up to about 800 TAF would store water conveyed from Millerton Lake via the Friant-Kern Canal. Deleted because of potential high costs associated with poor foundation conditions, conveyance limitations in the Friant-Kern Canal, and the presence of a potentially immitigable sycamore alluvial woodland habitat. This measure was deleted in Phase 1 of the Investigation.

Table 3-1. Management Measures Addressing Both Primary Planning Objectives (contd.)

Measure	Status	Rationale
Increase Groundwater Storage		
Increase conjunctive management of water in the Friant Division	Retained in Concept Only	Conjunctive management in the Friant Division occurs by increasing groundwater recharge with additional Class 2 deliveries or the development of local surface water supplies. Potential to combine with other measures involving development of San Joaquin River supplies, such as increasing surface water storage in the upper San Joaquin River Basin. Because specific potential conjunctive management projects have not been identified, this measure was retained in concept only through the draft feasibility and plan refinement phase of the Investigation.
Construct and operate groundwater banks in the Friant Division	Retained in Concept Only	Groundwater banks operated as allocable water supplies in the Friant Division could provide water for river releases. Because specific potential projects have not been identified, this measure was retained in concept only retained in concept only through the draft feasibility and plan refinement phase of the Investigation.

Key:
CALFED = CALFED Bay-Delta Program
elevation xxxx = elevation in feet above mean sea level
IAIR = Initial Alternatives Information Report (Reclamation 2005b)
RM = river mile
TAF = thousand acre-feet

Table 3-2. Management Measures Addressing Primary Planning Objective of Increasing Water Supply Reliability and System Operational Flexibility

Measure	Status	Rationale
All Measures Listed in Table 3-1	Retained/Deleted	All measures listed in Table 3-1 also address the Planning Objective of increasing water supply reliability and system operational flexibility
Perform Reservoir Operations and Water Management		
Integrate Friant Dam operations with SWP and/or CVP outside Friant Division	Retained in Concept Only	Integrating operations of Friant Division facilities with SWP and/or CVP facilities through water exchanges could improve water supply reliability and urban water quality. Opportunities with existing facilities are limited. Potential to combine with other measures relating to increasing surface water storage in the upper San Joaquin River Basin. This measure was retained in concept only through the Draft Feasibility and Plan Refinement Phase because operating conditions under the 2008/2009 BOs make integration less feasible. Integration opportunities under alternate future conditions with more flexible CVP and SWP Delta export operations may be assessed in the Final Feasibility Report.
Modify diversion to Madera and Friant-Kern canals	Retained in Concept Only	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. Would support planning objectives. Because specific operations for groundwater banking have not been defined, this measure is retained in concept only through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Capture downstream San Joaquin River flow released from Friant Dam	Deleted	Downstream capture of regulated San Joaquin River flows could increase water supply reliability in the Friant Division of the CVP, other CVP service areas, and SWP. This measure deleted because it is the subject of separate evaluation by the SJRRP.
Reduce Water Demand		
Implement water conservation and water use efficiency methods in excess of those in the without-project condition	Deleted	Opportunities to apply large-scale water conservation measures in the Friant Division are limited because conveyance losses and excess water application returns to groundwater for use in subsequent years. This measure was deleted during the plan formulation phase of the Investigation.
Retire agricultural lands	Deleted	Does not address planning objectives and consideration/criteria. On a large scale, could have substantial negative effects on agricultural industry. This measure was deleted during the plan formulation phase of the Investigation.
Increase Transvalley Conveyance Capacity		
Construct Trans Valley Canal	Deleted	Potential to combine with other measures, including integration of Friant Dam operations with CVP and SWP, and increasing surface water storage in the upper San Joaquin River Basin. This measure was deleted during the plan formulation phase of the Investigation.

Table 3-2. Management Measures Addressing Primary Planning Objective of Increasing Water Supply Reliability and System Operational Flexibility (contd.)

Measure	Status	Rationale
Perform Water Transfers and Purchases		
Transfer water between Friant Division water users	Deleted	Does not address planning objectives or considerations/criteria. An ongoing practice among Friant Division water users to maximize use of Friant Division water deliveries. This measure was deleted during the plan formulation phase of the Investigation.
Enhance Delta Export and Conveyance		
Expand Banks Pumping Plant	Deleted	Does not address planning objectives or considerations/criteria. Would likely be accomplished with or without additional efforts to develop new sources. This measure was deleted during the plan formulation phase of the Investigation.
Construct DMC/CA Intertie	Deleted	Currently under construction. This measure was deleted during the plan formulation phase of the Investigation.
Improve Delta export and conveyance capability through coordinated CVP and SWP operations	Deleted	JPOD is being actively pursued in other programs. This measure was deleted during the plan formulation phase of the Investigation.

Key:
Banks Pumping Plant = Henry O. Banks Pumping Plan
CVP = Central Valley Project
DMC/CA = Delta Mendota Canal/California Aqueduct
JPOD = joint point of diversion
SJRRP = San Joaquin River Restoration Program
SWP = State Water Project

Table 3-3. Management Measures Addressing Primary Planning Objective of Enhancing Water Temperature and Flow Conditions in the San Joaquin River

Measure	Status	Rationale
All Measures Listed in Table 3-1	Retained/Deleted	All measures listed in Table 3-1 also address the 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.
Construct Water Temperature Management Devices		
Construct temperature control devices on Friant Dam canal outlets	Deleted	Selective withdrawal of warm water for releases to the Madera and Friant-Kern canals from upper levels of Millerton Lake could conserve cold water in Millerton Lake, but does not manage cold water in reservoirs upstream from Millerton Lake. This measure was deleted during the plan formulation phase of the Investigation.
Construct temperature control device on Friant Dam river outlet	Deleted	Selective withdrawal of warm water for releases to the San Joaquin River could improve the management of cold water in Millerton Lake, but does not manage cold water in reservoirs upstream from Millerton Lake. This measure was deleted during the plan formulation phase of the Investigation.
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.

Table 3-4. Management Measures Addressing Secondary Planning Objectives

Measure	Status	Rationale
Reduce Frequency and Magnitude of Flood Releases from Friant Dam		
Change objective flood release from Friant Dam	Deleted	Specific operations have not been defined, and in general, the potential flood risk management benefits resulting from a change in the objective flood release from Friant Dam are obtained incidentally through implementing the Temperance Flat Reservoir measures. This measure was deleted during the plan formulation of the Investigation.
Increase flood storage space in or upstream from Millerton Lake	Retained	May be compatible with the planning objectives. 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.
Maintain the Value of Hydropower Attributes		
Modify existing or construct new generation facilities at Friant Dam canal outlets	Deleted	Measures addressing opportunities associated with the Enlarge Millerton Lake measure, such as modified or new generation facilities at Friant Dam canal outlets, are not being considered for further evaluation in the Investigation. This measure was deleted during the plan formulation phase of the Investigation.
Modify existing or construct new generation facilities at Friant Dam river outlet	Deleted	Orange Cove Irrigation District filed on April 19, 2006, requesting Federal Energy Regulatory Commission approval of an amendment of license for the Fishwater Release Project to add a powerhouse with a single turbine generator with a capacity of 1.8 megawatts. This measure was deleted during the plan formulation phase of the Investigation.
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.
Extend Kerckhoff tunnels around new surface water storage measures	Deleted	Would involve extending the Kerckhoff No. 2 tunnel and constructing a new powerhouse downstream from either the Temperance Flat RM 279 or RM 274 dam sites. Would increase capability to recover lost generation. This measure was deleted during the Draft Feasibility and Plan Refinement Phase of the Investigation because the flow capacity and energy generation potential were considered too low to justify the expense.
Construct pumped-storage facilities	Deleted	Could be combined with hydropower generation facilities associated with Temperance Flat reservoirs. Would require participation by a non-Federal partner with an interest in power development and management. This measure is less cost effective than constructing conventional hydropower generation facilities alone, and was deleted during the Draft Feasibility and Plan Refinement Phase of the Investigation.
Maintain and Increase Recreation Opportunities in the Primary Study Area		
Replace or upgrade recreation 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 recreation uses at Millerton Lake State Recreation Area. This measure was retained through the Draft Feasibility and Plan Refinement Phase of the Investigation.
Develop new management plan for Millerton Lake State Recreation Area	Deleted	Millerton Lake Resource Management Plan/General Plan was published by Reclamation in 2012 under a separate study. This measure was deleted during the plan formulation phase of the Investigation.

Table 3-4. Management Measures Addressing Secondary Planning Objectives (contd.)

Measure	Status	Rationale
Improve San Joaquin River Water Quality Downstream from Friant Dam		
Reduce salt discharge to San Joaquin River	Deleted	Currently being implemented under the San Joaquin Valley Drainage Management Program. This measure was deleted during the plan formulation phase of the Investigation.
Recirculate Delta-Mendota Canal deliveries to the San Joaquin River	Deleted	Would increase flows and could improve water quality from Mendota Pool to the Delta. Would not provide flows in the reach from Friant Dam to Mendota Pool. Independent ongoing study authorized by Public Law 108-573. This measure was deleted during the plan formulation phase of the Investigation.
Increase flows in tributaries to lower San Joaquin River	Deleted	Would increase flows and improve water quality from Mendota Pool to the Delta, but would not provide flows to the reach from Friant Dam to Mendota Pool. This measure was deleted during the plan formulation phase of the Investigation.
Release water from Friant Dam to improve river water quality	Deleted	Conflicts with planning objective of increasing water supply reliability. This measure was deleted during the plan formulation phase of the Investigation.
Improve Quality of Water Supplies Delivered to Urban Areas		
Treat poor quality groundwater	Deleted	High implementation costs, limited application and benefits. This measure was deleted during the plan formulation phase of the Investigation.
Integrate Friant Dam operations with SWP and/or CVP outside the Friant Division	Retained in Concept Only	Same as described in Table 3-2.
Construct desalination facility	Deleted	Limited application as a dry-year supply, high unit cost, and potential environmental effects from treatment byproducts. This measure was deleted during the plan formulation phase of the Investigation.

Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
RM = river mile
SWP = State Water Project

In the discussion of management measures, the term "enhancement" specifically refers to restoration actions that improve environmental conditions above the future without-project condition. Correspondingly, the term "mitigation" refers to restoration actions that compensate or offset project impacts, returning conditions back to a similar level as the future without-project condition. The relationship among restoration, enhancement, and mitigation is illustrated in Figure 3-2.

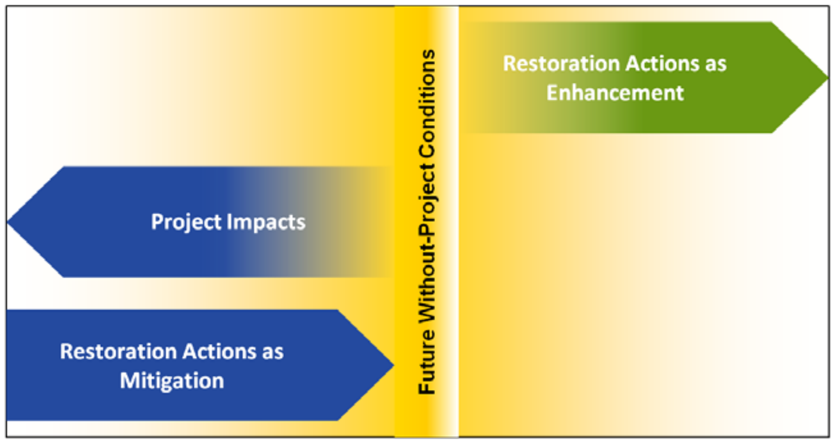


Figure 3-2. Conceptual Schematic of Restoration Actions as Enhancement Versus Restoration Actions as Mitigation

It should be noted that measures that did not directly address the planning objectives, or were otherwise dropped from consideration and further development as alternative plan components under certain circumstances, may be incorporated into alternative plans as mitigation measures. This is primarily because some measures may be found potentially effective in mitigating adverse impacts.

Measures Retained for Inclusion in Draft Feasibility Report Alternative Plans

Measures retained through the Draft Feasibility and Plan Refinement Phase for further consideration in Draft Feasibility Report alternative plans are summarized below.

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 3-1.

Additionally, measures to increase groundwater storage retained in concept only are described.

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.

Construct 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 alternatives (Reclamation 2003, 2005b, and 2008a). 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 3-3.

Evaluations conducted during the plan formulation phase led to selection of the Temperance Flat RM 274 Reservoir as the preferred surface water storage measure for further development and inclusion in alternative plans in the Draft Feasibility and Plan Refinement Phase. 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, 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 at this site were considered in previous phases of the Investigation. Reservoir sizes corresponding to elevations higher than elevation 985 were not retained because the incremental new water supply provided did not appear justified in light of substantial additional effects to environmental resources, additional effects to hydropower generation, and higher construction costs (Reclamation 2005b).

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 2003).

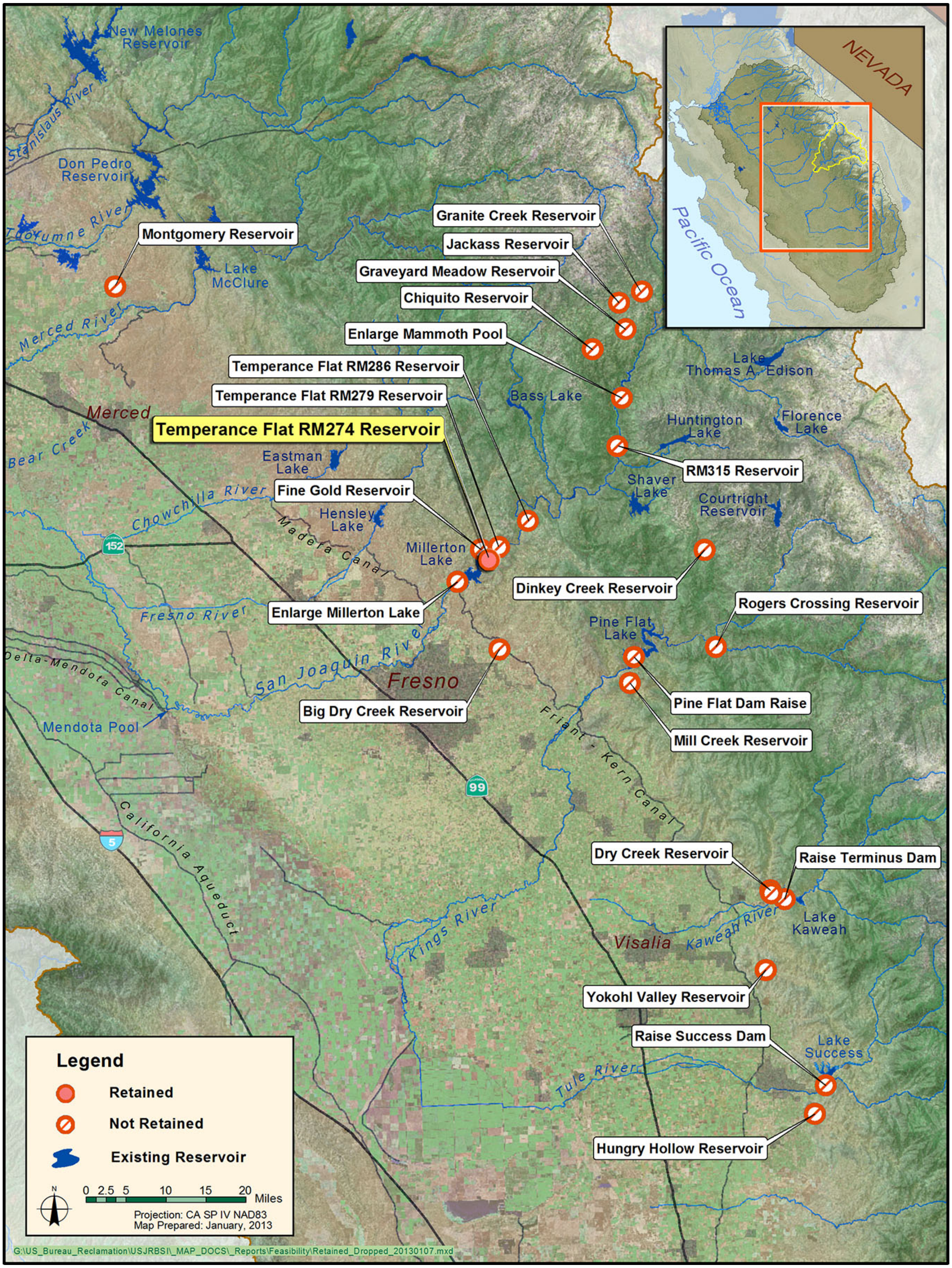


Figure 3-3. Surface Water Storage Measures Considered

Increase Conjunctive Management of Water in the Friant Division and Construct and Operate Groundwater Banks in the Friant Division

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. 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 (2000a).

During plan formulation, DWR conducted a San Joaquin Valley Conjunctive Water Management Opportunities analysis and identified several potential conjunctive management or groundwater storage projects in the San Joaquin Valley that could be considered in any regional water resources study (DWR 2006b). Fifteen potential groundwater storage projects in the San Joaquin Valley were identified that appear to have high potential for implementation. Recommended potential conjunctive management and groundwater storage projects are located in Madera, Kings, and Kern county groundwater basins (DWR 2006b). These potential projects have not yet been evaluated to determine their ability to contribute to Investigation objectives, and would require considerable additional data development for site-specific analysis. Thus, the measures related to increasing groundwater storage were retained in concept only and are further described in the Plan Formulation Appendix.

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 perform reservoir operations and water management.

B.F. Sisk Dam and San Luis Reservoir

Operation of San Luis Reservoir, a joint CVP/SWP facility, could be integrated with new upper San Joaquin River Basin storage to improve water supply reliability.

Integrate Friant Dam Operations with State Water Project and/or Central Valley Project outside Friant Division

Integration of Friant Dam operations with the SWP and CVP outside the Friant Division could provide opportunities for exchange of water supplies, allowing greater optimization of system operations for improved water supply reliability and improved water quality of supplies delivered to urban areas. Water supply reliability improvements may be limited by available conveyance capacity in existing trans-valley conveyance facilities and available SOD storage capacity. Increasing surface water storage in the upper San Joaquin River Basin, along with expansion of existing conveyance facilities and/or construction of additional trans-valley conveyance, would substantially increase potential water supply. Operating conditions under the 2008/2009 BOs, however, make integration less feasible, and this measure is not evaluated in the Draft Feasibility Report. Alternate future conditions with more flexible CVP and SWP Delta export operations would likely result in significantly greater estimates of water supply reliability from Temperance Flat RM 274 Reservoir (see Plan Formulation Report, Reclamation 2008a) and may be assessed in future studies. Thus, the integration measure was retained in concept only.

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. This measure would support planning objectives; however, because specific operations for groundwater banking have not been defined, this measure is retained in concept only.

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 (1) perform reservoir operations and water management, and (2) 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

Selective level intake structures (SLIS) could be constructed on the intakes for dams associated with measures to increase surface water storage in the upper San Joaquin River Basin. The SLIS would allow selective withdrawal of cold or warm water from these upper reservoirs for temperature management, thereby contributing to restoration of the San Joaquin River by enhancing temperature conditions for species that require cold water during specific 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 recreation 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 provides 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 2005b).

Construct New Hydropower Generation Facilities on Retained New Surface Water Storage Measures

The construction of new surface water storage facilities presents 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 at Millerton Lake. 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 alternatives.

Draft Feasibility Report Measures Summary

Alternative plans considered in the Draft Feasibility Report fundamentally consist of constructing new surface water storage facilities and operating them primarily to address the primary planning objectives of increasing water supply reliability and enhancing temperature and flow conditions in the San Joaquin River. Measures to address secondary planning objectives were also included in alternative plans (Table 3-5). Measures that were retained in concept only, such as increasing groundwater storage, are not explicitly included in alternative plans evaluated in the Draft Feasibility Report because of a lack of specific information needed to evaluate the measures further.

Table 3-5. Management Measures Retained for Alternative Plans in Draft Feasibility Report

Planning Objective	Resources Management Measure	
	Feature/Activity	Description
Primary Planning Objectives		
Increase Water Supply Reliability and 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
	Modify Storage and Release Operations at Friant Dam	Optimize existing system of reservoirs by modifying Friant Dam operations
Enhance Water Temperature and Flow Conditions	Balance Water Storage in Millerton Lake and New Upstream Reservoirs	Manage water levels and targets between Millerton Lake and new reservoir
	Construct Selective Level Intake Structures on New Upstream Dams[1]	Selectively withdraw cold or warm water from new reservoir

Table 3-5. Management Measures Retained for Alternative Plans in Draft Feasibility Report (contd.)

Planning Objective	Resources Management Measure	
	Feature/Activity	Description
Secondary Planning Objectives		
Reduce Flood Releases from Friant Dam	Increase Flood Storage Space in or Upstream from Millerton Lake	Increase incidental flood storage space by constructing dam in upstream portion of Millerton Lake at River Mile 274
Maintain Hydropower Attributes Value	Construct New Hydropower Facilities on Retained New Surface Water Storage Measures	Generate hydropower with new powerhouse using releases from new reservoir
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 Feasibility Report alternative plans, and rationale for some of the measures and options considered and deleted during plan refinement. It should be noted that mitigation measures have not been completely identified at this stage in the Investigation and will be further developed for the Final Feasibility Report and EIS/EIR.

Evaluations conducted during previous phases of the Investigation and documented in the Phase 1 Investigation Report (Reclamation 2003), IAIR (Reclamation 2005b), and Plan Formulation Report (PFR) (Reclamation 2008a) led to the selection of the Temperance Flat RM 274 Reservoir as the preferred surface water storage site for further development and inclusion in alternative plans in the Draft Feasibility and Plan Refinement Phase. Previous phases of the Investigation evaluated 22 separate storage sites, in addition to the 52 sites considered in the CALFED Initial Surface Water Storage Screening (2000b) (See Figure 3-4).

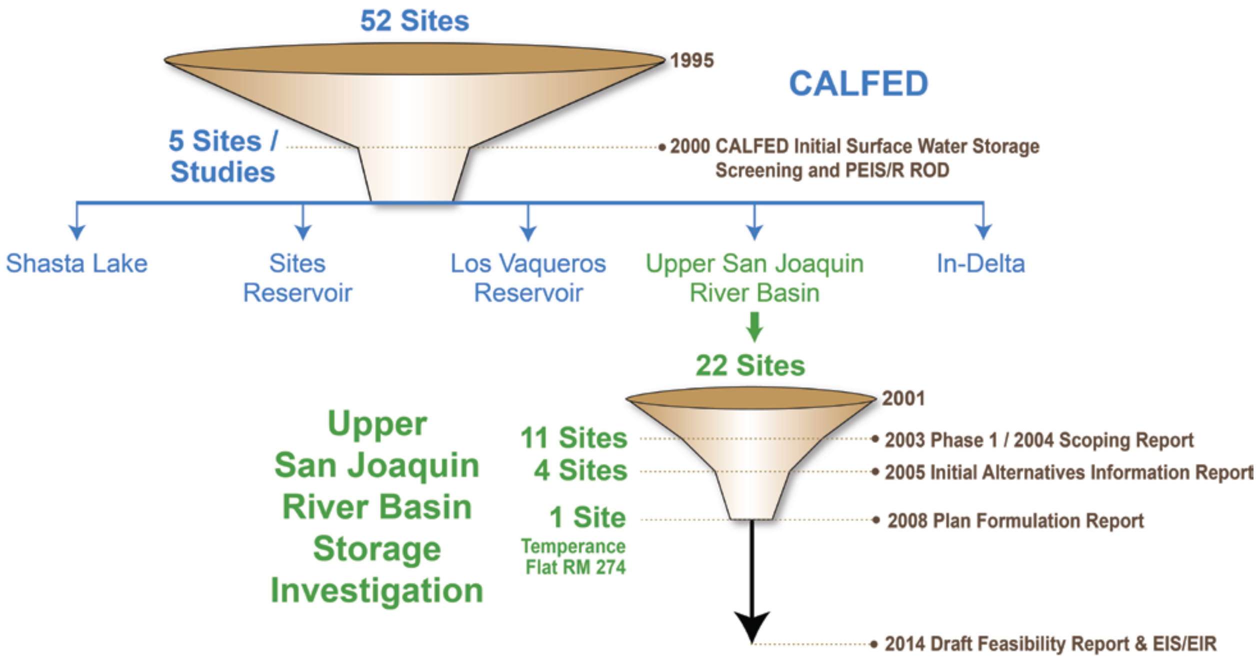


Figure 3-4. CALFED and Investigation Process Leading to Selection of Temperance Flat RM 274 Reservoir Site

Since selection of Temperance Flat RM 274 Reservoir for feasibility analysis, various planning activities have taken place to study a range of potential alternative variations at the site. Temperance Flat RM 274 Reservoir was evaluated under a range of operational priorities, beneficiaries, and feature configurations to illustrate trade-offs in the plan formulation process and test the sensitivity of alternative plan accomplishments, benefits, and costs to the various conditions. The following sections describe project feature refinements and iterations of potential operation scenarios that led to development of alternative plans described in Chapter 4.

Physical Features Development Process for Alternative Plans

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 alternatives. This section summarizes development of the main physical features of 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 Engineering Summary Appendix.

Dam and Appurtenant Structures

The PFR included alternatives with an embankment dam type; 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. Proposals specific to the dam included assessment of a thinner straight RCC dam, a curved RCC dam, and a new spillway configuration (Reclamation 2011c). 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 2013b).

Diversion and Outlet Works

After the PFR, 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 (tunnel would be used for diversion and river outlet works permanent releases) (Reclamation 2009b, 2010b). The value planning study concluded that the 30-foot diversion tunnel and rockfill cofferdams built to elevation 580 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 2013b).

Hydropower Generation

Initial PFR appraisal-level designs for hydropower generation included an extended Kerckhoff No. 2 Powerhouse tunnel to supply water from Kerckhoff Dam to the proposed powerhouse (Reclamation 2008a). 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 mitigation 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 is uneconomical given the variability in operations and head range (Reclamation 2011c). The design team also rejected the proposal to relocate the powerhouse to the toe of the dam because it would create congestion and schedule limitations at the construction site (Reclamation 2013b). Additional economic evaluations were performed in the Draft Feasibility and Plan Refinement Phase to reinforce the viability of onsite power facilities, which are considered as necessary mitigation to meet the project objectives.

Reclamation selected Power Option 1 as the preferred onsite hydropower mitigation option for feasibility-level designs (see Attachment D of the Engineering Summary Appendix). 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 mitigation requirements. In addition to Power Option 1, some alternatives will include additional power mitigation costs to fully mitigate 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. 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 2011c). 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 alternatives with higher Temperance Flat RM 274 Reservoir minimum carryover storage targets. For lower minimum carryover alternatives, the SLIS cost was not as cost effective, and a low-level intake structure (LLIS) was included in the design (Reclamation 2013b).

Other Construction Areas

Since the PFR designs, access and haul road alignments were updated to account for changes in locations of permanent facilities and construction phasing of diversion tunnel, outlet works, valve house, and powerhouse. Changes to other construction areas, such as the aggregate quarry, batch plant, and staging area were minimal.

Affected Existing Infrastructure

An appraisal-level assessment was performed during the feasibility phase to protect Millerton Lake shoreline recreational facilities from inundation, modify facilities to replace affected areas (i.e., relocate facilities on site), or abandon facilities and replace them at other suitable sites (i.e., relocate facilities off site). Reclamation also developed and refined features to replace affected recreational facilities in the SJRGMA. An assessment of impacts to various local utilities was also performed during this phase of the Investigation.

Operations Development Process for Alternative Plans

Operations were refined after the PFR 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 options
- Temperature management options
- Water supply beneficiaries (Friant Division, CVP SOD contractors, CVP wildlife refuges, SWP M&I contractors)

> In this report, the term **carryover** refers to the minimum storage target maintained in Millerton Lake and/or Temperance Flat RM 274 Reservoir for multiple purposes.
>
> Minimum carryover storage is assumed not to be delivered for water supply; it would be maintained for public benefits such as cold-water pool, recreation, and emergency water supply, as well as providing a minimum pool for hydropower.

Operation assumptions were combined into a number of preliminary alternatives, which were then evaluated to better understand the inter-relationships and impacts on planning objectives and criteria from various combinations of assumptions. Based on analysis results, alternative plans were then developed for evaluation in this Draft Feasibility Report. The operations variables and reservoir sites considered in each phase of the Investigation analysis are summarized and outlined in Table 3-6.

Table 3-6. Sites and Operations Variables Considered in Each Phase of Analysis

Phase of Operations Analyses		Phase 1 and IAIR	Plan Formulation Report	Draft Feasibility and Plan Refinement Phase: Operation Assumption Evaluation	Draft Feasibility and Plan Refinement Phase: Operation Assumption Refinement	Draft Feasibility and Plan Refinement Phase: Draft Feasibility Report
Reservoir Sites		22 sites	4 sites[1]	Temperance Flat RM 274		
Operations Scenarios		N/A	N/A	30+ scenarios	10+ scenarios	4 alternative plans + No Action
Operations Variables	Minimum Carryover Storage target/ Reservoir-Balancing between Millerton Lake and Temperance Flat	Comparative General Estimate of New Water Supply	Various sizing and balancing configurations	Temperance Flat minimum carryover storage target 100–700 TAF	Temperance Flat minimum carryover storage target 200–450 TAF	Temperance Flat minimum carryover storage target 200–325 TAF
				Millerton Lake minimum carryover storage target 220–445 TAF	Millerton Lake minimum carryover storage target 340 TAF	Millerton Lake minimum carryover storage target 340 TAF
	New Water Supply Beneficiaries		Friant and SWP/CVP (through integration)[2]	Friant/SWP/ CVP Refuges	Friant/SWP/ CVP Refuges	Friant/SWP/CVP SOD/ CVP refuges
	New Water Supply Routing Options		Included potential transvalley conveyance	Generalized analysis; not investigated	FKC (Friant and SWP) SJR (SWP and CVP)	FKC (Friant and SWP) SJR (SWP and CVP)
	Temperature Management		Comparative estimates of cold water volume	TCD/SLIS	SLIS	SLIS on high carryover storage alternative plans
	Hydropower Mitigation	Comparative Estimate of Hydropower Generation in IAIR	Comparative estimates of hydropower generation	2 power options	Single power option	Single power option

Notes:
[1] Four surface water storage measures were considered in Plan Formulation Report; enlarge Millerton Lake by raising Friant Dam, construct Temperance Flat RM 274 Reservoir, construct Temperance Flat RM 279 Reservoir, and construct Fine Gold Reservoir.
[2] CVP and SWP water operations integration was only assessed in the Plan Formulation Report (Reclamation 2008a).

Key:
CVP = Central Valley Project
FKC = Friant-Kern Canal
IAIR = Initial Alternatives Information Report (Reclamation 2005b)
N/A = not applicable
RM = river mile
SJR = San Joaquin River
SLIS = selective level intake structure
SWP = State Water Project
TAF = thousand acre-feet
TCD = temperature control device

Initial Evaluation of Operation Assumptions

During this stage, future without-project conditions were updated to represent operations of the CVP and SWP system under the 2008/2009 BOs instead of the 2004/2005 BOs included in the PFR. Under the 2008/2009 BOs the more restrictive Delta export constraints drastically limited the water supply benefits of integration of the Temperance Flat RM 274 reservoir with the overall SWP/CVP systems. Based on the PFR, with minimal carryover storage in Temperance Flat RM 274 Reservoir, the difference in water supply between scenarios that consider integration under the 2004/2005 BOs and scenarios without integration that develop new water supply from the San Joaquin River only is approximately 70 TAF, and would be even greater with increased carryover storage in Temperance Flat RM 274 Reservoir. Because of the limited benefits of integration under the 2008/2009 BOs, CVP and SWP integration opportunities were not considered further in the development of Temperance Flat RM 274 Reservoir alternative plans.

Thirty sets of operation assumptions were investigated in this stage to better understand how they accomplish planning objectives and meet planning criteria. The analysis evaluated implications and trade-offs within the range of each operation assumption. For example, a range of minimum carryover storage target volumes from 100 TAF to 700 TAF were initially evaluated, with active storage fluctuating above the minimum carryover target. Variations in minimum carryover storage targets demonstrated trade-offs between various planning objectives. Water supply reliability and flood damage reduction improved with smaller minimum carryover storage, while hydropower generation, temperature management, emergency water supply, and recreation increased with greater minimum carryover storage.

Based on the results of this analysis, 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 objectives (water supply and emergency water supply, water temperature, hydropower, recreation).

- Maintain a relatively constant Millerton Lake storage of 340 TAF to balance project objectives (hydropower, recreation, water supply and emergency water supply, water temperature).

- Maintain 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 stage also demonstrated that multiple water supply beneficiaries would likely be necessary for the project to be economically and financially feasible. Scenarios that were tested with a single agricultural beneficiary demonstrated that delivery of all the new water supply to agriculture would not be economically feasible. Further studies did not retain the concept of a single project beneficiary for water supply.

Refinement of Operation Assumptions

Building on insights developed in the previous stage, 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 supply 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 delivery to SWP M&I 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 alternative plans formulated in subsequent stages of operations development for alternative plans. The scenarios in this stage 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 river temperatures, with varying operations and timing. During this stage 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.

Formulation of Alternative Plans

The performance of different sets of operation assumptions determined in the Draft Feasibility and Plan Refinement Phase process were then used to develop four alternative plans or sets of assumptions that would meet planning objectives to varying degrees. Further details regarding formulation of the operations assumptions are included in the following section and the four alternative plans are described in detail along with their potential physical accomplishments in Chapter 4.

Range of Operations Assumptions Included in Alternative Plans

There are a number of operations assumptions and variations in implementing each assumption that affects the performance of the alternatives in meeting planning objectives and criteria. The alternatives formulated through the operations refinement process represent a reasonable 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) multitude of new water supply beneficiaries. Features, operations, and assumptions for Temperance Flat RM 274 Reservoir alternative plans and the No-Action Alternative are described in Chapter 4.

This section contains details of operation assumptions in the alternative plans and how they affect project accomplishments. These major operations variables include Millerton Lake/Friant Dam operations, Temperance Flat 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 significantly affect all potential project accomplishments. Water supply reliability and flood damage reduction are influenced by total carryover storage in the two reservoirs; and river release temperature, hydropower management, and recreation are strongly influenced not only by total carryover storage, but by the balancing of storage between the two reservoirs.

Alternatives Focus

Constants – All alternative plans include constructing Temperance Flat RM 274 Dam and Reservoir.

Variables – The alternatives vary based on operations (conveyance routing, potential beneficiaries, and carryover) and intake feature configurations.

Millerton Lake/Friant Dam Operations

Millerton Lake has historically been operated as an annual reservoir with a diversion dam, with annual fluctuations of up to 110 feet between the Friant-Kern Canal outlet near elevation 470 and the top of active storage at elevation 580, 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, hydropower, and recreation, while only slightly decreasing water supply reliability. The alternative plans in the Draft Feasibility Report consider one Millerton Lake fixed carryover storage target at elevation 550 (340 TAF target storage), which would improve recreation by balancing shoreline and lake use.

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. A range of minimum carryover storage target volumes from 200 TAF to 325 TAF (elevation 671 to 731) is represented in the alternative plans, to support a minimum pool for cold water management, emergency water supply, recreation, and hydropower energy generation. Water levels in Temperance Flat Reservoir would fluctuate significantly above the minimum carryover target level, depending on the time of year and water year type.

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 and SWP contractors and the San Joaquin River to Mendota Pool. Potential beneficiaries of Temperance Flat RM 274 Reservoir new water supply include the Friant Division, CVP SOD agricultural contractors, and SWP SOD M&I contractors. San Joaquin Valley CVP wildlife refuges could also benefit by receiving higher quality San Joaquin River water supplies through Level 2 refuge diversification.

General options for routing water supply to different beneficiaries are shown in Figure 3-5. Delivery of new supplies to the Friant Division considered long-term contract rules, conveyance capacities, delivery patterns, and changes due to the Settlement. The Friant Division would see 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 DMC, or the California Aqueduct. Delivery to SWP M&I contractors was based on the assumption that they would have demand for any amount of water supply delivered from Temperance Flat Reservoir, within conveyance constraints.

New Water Supply Routing

New water supply to the Friant Division 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 M&I water supply could be directly delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. SWP M&I supply could also be delivered via the San Joaquin River and Mendota Pool, exchanged with Level 2 refuge supply or exchange with CVP SOD deliveries, and then via the California Aqueduct. Direct delivery of Temperance Flat RM 274 Reservoir water supply to SWP M&I contractors may require modifications to the place of use for the CVP. Alternatively, Temperance Flat RM 274 Reservoir could be developed as a joint CVP and SWP facility, or the SWP may be added as a CVP contractor to have access to Temperance Flat Reservoir water supply, which would also require institutional changes.

Cross Valley Canal/Friant-Kern Canal Intertie

This intertie could be used to deliver or exchange new water supplies.

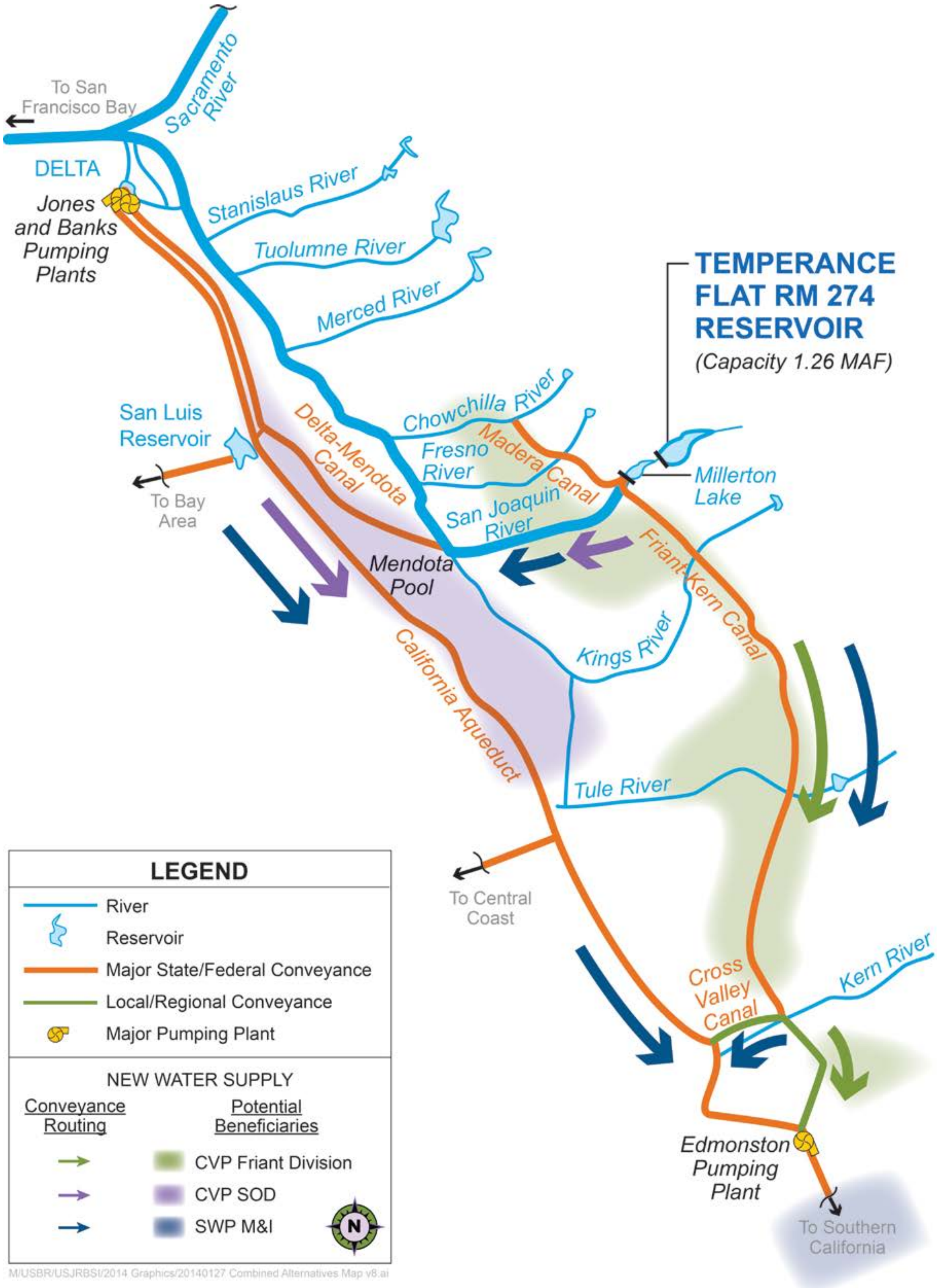


Figure 3-5. Potential Temperance Flat Reservoir Water Supply Beneficiaries and Routing Options

Sensitivities for Operation Assumptions

The process of refining operations assumptions for alternative plans illustrates trade-offs between accomplishments tied to active storage capacity (long-term average water supply reliability and flood damage reduction) and those tied to a minimum carryover storage target (cold water pool, emergency water supply, hydropower generation, and recreation). In addition to the relative balancing of active and carryover storage, the water supply reliability accomplishments of Temperance Flat RM 274 Reservoir are also sensitive to CVP and SWP operating conditions in the Delta, and potential new conveyance in the Delta and between the east side and west side of the San Joaquin Valley.

The SJRRP has an effect on the formulation of alternative plans and is included in the future without-project conditions and No Action Alternative for the Investigation. The Temperance Flat RM 274 Reservoir alternative plans would also affect the Restoration and Water Management goals of the Settlement being implemented through the SJRRP.

This section summarizes the sensitivity of water supply reliability accomplishments of the alternative plans to carryover storage, CVP and SWP operating conditions and conveyance, and the potential effects of the alternative plans on the SJRRP.

Carryover Storage

The alternative plans 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 SBX7-2, and incorporate the various planning objectives for the Investigation.

Long-term average water supply reliability increases with greater active storage and smaller volumes of minimum carryover storage, which would capture more San Joaquin River flood flows for delivery. Table 3-7 summarizes analyses performed to illustrate the sensitivity of Temperance Flat RM 274 Reservoir new water supply to changes in minimum carryover storage.

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

Notes:
[1] Combined total storage capacity = 520 TAF Millerton + 1,260 TAF Temperance Flat = 1,780 TAF.
[2] Active storage capacity = total storage capacity minus minimum carryover storage.
[3] Alternative Plans compared to No-Action Alternative.
[4] All estimates of new water supply/change in deliveries based on CVP and SWP operating conditions with the 2008/2009 BOs.
[5] The values represent the net change in CVP/SWP system-wide deliveries, accounting for new deliveries from Temperance Flat 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.
[6] Values represent the range of new water supply for Alternative plans 1, 2, and 3, which include the same minimum carryover.
[7] Value for new water supply represents Alternative Plan 4.
Key:
BO = Biological Opinion
CVP = Central Valley Project
RM = River Mile
SWP = State Water Project
TAF = thousand acre-feet

For ecosystem improvements, greater active storage correlates to more new water supply and therefore more potential flow-related improvements, while greater carryover storage can support more temperature-related improvements. San Joaquin River ecosystem enhancement for anadromous fish is also 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 is 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 2008/2009 BOs 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 of Temperance Flat RM 274 Reservoir could also be integrated with the broader CVP and SWP SOD export and storage system, as evaluated in the PFR, to provide additional water supply reliability by capturing additional Delta water supply in wet years through exchange. This operation was not included in the draft feasibility phase since operating conditions under the 2008/2009 BOs result in San Luis

Reservoir filling less frequently, which makes integration less feasible. Assumptions regarding CVP and SWP operating conditions in the Delta do not affect the modeled new water supply generated from capturing San Joaquin River flood flows, but do affect changes in Delta exports the ability to develop additional wet year water supply from the Delta through exchange.

Evaluation of operations integration with the CVP and SWP system under future conditions with increased flexibility for CVP and SWP Delta export operations would likely result in significantly greater estimates of water supply reliability from Temperance Flat RM 274 Reservoir. Potential new Delta conveyance would increase the frequency of San Luis Reservoir filling and, correspondingly, increase the use of the available storage space in Temperance Flat RM 274 Reservoir for exchanges. This integrated operation of San Luis Reservoir with Temperance Flat RM 274 Reservoir could improve the ability to manage water supply for multiple purposes.

Increasing “transvalley” conveyance capacity (between the east side and west side of the San Joaquin Valley) through construction of a new major transvalley canal would further enable potential integration between Temperance Flat RM 274 Reservoir and the SWP and/or CVP system outside the Friant Division through water exchanges. A conceptual alignment for the canal could include up to a 1,000 cfs bi-directional connection between the Friant-Kern Canal near Porterville and the California Aqueduct south of the Tulare Lake bed (Reclamation 2008).

Some previous studies of potential Temperance Flat RM 274 Reservoir operations represented conditions with the 2004/2005 BOs, operations integration with the broader CVP and SWP system, and potential changes in transvalley and/or Delta conveyance. These studies, summarized in Table 3-8, illustrate the sensitivity of the new water supply that could be developed to changes in CVP and SWP operating conditions and conveyance.

Integration with CVP and SWP

Integrating operations with the CVP and SWP would include coordinated management of water supplies in Millerton Lake and Temperance Flat RM 274 Reservoir with operations of SWP and other CVP facilities.

- This could involve delivery of water supplies to the Friant Division in combination with water exchanges between the Friant Division and SWP and other CVP service areas. Some SWP or CVP water supplies from the Delta that are diverted to San Luis Reservoir could instead be delivered to water users in the Friant Division, while San Joaquin River water could be stored in the new Temperance Flat RM 274 Reservoir.
- This would provide additional available storage capacity in San Luis Reservoir during wet periods, which could allow capture of additional supplies from the Delta. Accumulated San Joaquin River water supplies would be provided through exchange to SWP and CVP SOD water users when available Delta supplies are less than demand.

With operations integration, Temperance Flat RM 274 Reservoir would not only be operated as an enlargement of Millerton Lake for managing flood or high flows on the San Joaquin River (functioning as a reservoir upstream from the Delta), but also operated as an expansion of SOD offstream storage (like a San Luis Reservoir on the east side of the San Joaquin Valley) to capture additional Delta supplies through exchange (functioning as a reservoir downstream from the Delta).

Source: DWR 2010b

Table 3-8. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir with Varying CVP/SWP Operations and Conveyance

Row ID	CVP and SWP Operations (BOs)	Total Minimum Storage in Millerton and Temperance Flat (TAF)[1]	Integration with CVP and SWP	New Delta Conveyance[2]	New Transvalley Conveyance[3]	Average Annual Change in Deliveries (TAF)[4]
A	2008/2009	230	--	--	--	98[5]
B[6]	2004/2005	230	--	--	--	113[5]
C[6]	2004/2005	230	☑	--	--	158 – 180[7]
D[6]	2004/2005	230	☑	--	☑	240
E[8]	2008/2009	230	☑	--	--	140
F[8]	2008/2009	230	☑	☑		230

Notes: General: Draft Feasibility Report alternative plans assume 2008/2009 BOs with No Integration, No New Delta Conveyance, and No New Transvalley Conveyance, with a total minimum carryover in Temperance Flat and Millerton of 540 to 665 TAF.

[1] Minimum storage in Millerton Lake is 130 TAF; minimum storage in Temperance Flat is 100 TAF.

[2] Assumed capacity and configuration of new Delta conveyance representation not specified in DWR 2010b.

[3] Assumed new 1,000 cfs bi-directional Transvalley canal connecting Friant-Kern Canal and California Aqueduct. Water supply delivery estimate would be smaller with 2008/2009 BOs.

[4] Alternative Plans compared to No-Action Alternative. Values represent the net change in CVP/SWP system-wide deliveries, accounting for new deliveries from Temperance Flat Reservoir and decreases in Delta exports due to the decrease in San Joaquin River flood flows. All scenarios presented assume implementation of the SJRRP.

[5] The 2 scenarios without integration would result in the same water supply developed from Temperance Flat and the same reduction in San Joaquin River flood flows, but the values with 2008/2009 BOs are smaller than with 2005/2005 BOs due to additional reductions in Delta exports.

[6] Source: Reclamation 2008a

[7] A range of values is presented since multiple scenarios were evaluated

[8] Source: DWR 2010b

Key:
BO = Biological Opinion
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DWR = California Department of Water Resources
RM = River Mile
SWP = State Water Project
TAF = thousand acre-feet
Reclamation = Bureau of Reclamation

Compared to the 113 TAF long-term average new water supply that could be developed by Temperance Flat RM 274 Reservoir with minimal carryover storage and no integration with the 2004/2005 BOs (row B), Table 3-8 illustrates that water supply accomplishments would increase with additional flexibility for CVP and SWP Delta export operations (whether through regulatory changes or new Delta conveyance) and with increased transvalley conveyance capacity, as follows:

- Up to 59 percent (67 TAF) increase in water supply with integration under 2004/2005 BOs (row C).
- Up to 112 percent (127 TAF) increase in water supply with integration under 2004/2005 BOs and new transvalley conveyance (row D).

- Up to 24 percent (27 TAF) increase in water supply with integration under 2008/2009 BOs (row E).

- Up to 104 percent (117 TAF) increase in water supply with integration under 2008/2009 BOs and new Delta conveyance (row F).

San Joaquin River Restoration Program

The construction and operation of Temperance Flat RM 274 Reservoir would not interfere with implementation of the SJRRP, but would change water management at Friant Dam and affect the Restoration and Water Management goals of the Settlement being implemented through the SJRRP. Storing water in Temperance Flat Reservoir would reduce the frequency and magnitude of flood flows that would occur in excess of water rights, Restoration Flow releases, and water deliveries. The additional stored water would be managed for several purposes, including facilitating controlled releases of Restoration Flows that otherwise would have been flood flows that would have contributed to or met Restoration Flow targets. It would also capture and store flows that otherwise would have been delivered to the Friant Division Contractors at $10 per acre-foot to reduce the Recovered Water Account (RWA) or released from Friant Dam as flood flows to the San Joaquin River.

Restoration Goal Potential Effects

- Construction and operation of Temperance Flat Reservoir would not interfere with the release of Restoration Flows specified in the Settlement. All Restoration Flow provisions, including flows consistent with the Exhibit B hydrographs, buffer flows, pulse flows, riparian establishment flows, flow ramping, and the management of releases during flexible flow periods, would continue to be implemented as required by the Settlement.

- The increased volume of water stored in Millerton Lake and Temperance Flat Reservoir would increase the volume of cold water and improve operational flexibility in the management of Restoration Flows, and would provide additional flow from Friant Dam to Mendota Pool (for water supply exchanges).

- With Temperance Flat Reservoir, the reduced frequency and magnitude of flood flows in the San Joaquin River would have the following effects on implementation of the Settlement:

  – Losses of gravel from Reach 1 of the San Joaquin River that would occur during high flood flows would be reduced, thereby reducing maintenance costs for gravel replenishment requirements.

  – Sediment accumulation downstream from Reach 1 due to sand mobilization would be reduced, thereby reducing operation and maintenance costs by the SJRRP to preserve the function of the San Joaquin River Flood Control Project.

  – Connectivity with gravel pits in Reach 1 that causes stranding of salmon and other fish would occur less frequently and for shorter duration, thereby potentially reducing the extent of gravel pit isolation that would be implemented as a Phase 2 action of the Settlement.

  – Reduction/elimination of late season flood flows could reduce potential to damage newly established riparian habitat.

  – Reduction of spring flood flows could reduce floodplain rearing habitat for salmonids within Reaches 1 and 2.

- The overall net effects of the alternative plans on the Restoration Goal and San Joaquin River ecosystem would be positive; however, the beneficial effects of the alternative plans from providing improved cold water pool/water temperatures and additional flow could be slightly offset by a reduction in floodplain rearing habitat for salmonids in Reaches 1 and 2.

Water Management Goal Potential Effects

- The capture and storage of flood flows in Temperance Flat Reservoir, beyond those that would have been delivered as $10 water under Paragraph 16(b) of the Settlement, and the subsequent release of portions of the stored water as Restoration Flows would not increase water supply impacts to Friant Division long-term contractors.

- Release of stored flood flows as managed Restoration Flows would increase the volume of Restoration Flows eligible for recapture at locations downstream from the Restoration Area, pursuant to Paragraph 16(a) of the Settlement.

- Using Millerton Lake as a forebay of Temperance Flat Reservoir would reduce or eliminate the exposure of the Friant-Kern Canal and Madera Canal intakes due to releases of Restoration Flows.

- Capture and storage of flows in Temperance Flat Reservoir would reduce the availability of $10 water under Paragraph 16(b) of the Settlement and could reduce the effectiveness of projects that would increase the delivery of Paragraph 16(b) water.

- The Friant Division contractors would be affected by the increase in cost to deliver stored Temperance Flat Reservoir water that would have otherwise been released as $10 water, but with Temperance Flat Reservoir could receive a greater volume of water supply and greater water supply reliability. In addition, the Friant Division contractors would be affected if the volume of water made available from Temperance Flat Reservoir is not made available to them and is stored for other CVP contractors. This would reduce the SJRRP's ability to reduce RWA balances.

Climate Change

All alternative plans, including the No-Action alternative, are projected to be impacted by climate change this century. Sea level rise would impact salinity in the Delta and operations of the CVP and SWP. Hydrological changes would impact the timing and availability of inflows into Temperance Flat RM 274 Reservoir and Millerton Lake. For the Investigation, hydrological impacts of climate change on the No-Action Alternative and an alternative plan were evaluated for projected climate conditions in the year 2060. CalSim II was used to evaluate how an example alternative plan could support the water supply reliability planning objective under projected 2060 sea level and hydrology. By 2060, sea level is projected to rise by an average of 45 cm using empirical models developed by Ramsdorf (2007). The hydrology developed to evaluate the No-Action and an example alternative plan for the preliminary climate change sensitivity analysis represents the central estimate of future climate change for the 30-year climatological periods centered on the analysis year 2060. This preliminary analysis is discussed in further detail in the Modeling Appendix Attachment C.

For the No-Action Alternative, modeling considering climate change estimated that Friant Division Class 1 supplies could decrease by as much as 10 percent on an annual basis, with more severe impacts in dry and critical years. Temperance Flat RM 274 Reservoir could provide the capacity to adapt to changing inflow timing, with the result that less water would be spilled as flood flows, and more could be delivered as water supply, providing long-term average annual as well as dry and critical year benefits. For an example alternative plan, Friant Division Class 1 supplies were simulated to decrease by less than 1 percent on an annual basis in all year types when considering climate change, compared to the conditions with an example alternative plan without using climate change hydrology.

Climate change analyses performed for this report are preliminary and will be revised and expanded for the Draft EIS/EIR and Final Feasibility Report.

Chapter 4
Description of Alternatives

This chapter provides a description of the No-Action Alternative and the components of the four alternative plans evaluated for feasibility in this Draft Feasibility Report. This chapter also presents the physical accomplishments of the alternative plans in comparison to the No-Action Alternative and the potential to improve conditions and accomplish the planning objectives.

Potential Temperance Flat River Mile 274 Dam Site

The alternative plans were formulated to provide a representative range of potential features, operations, and benefits of Temperance Flat RM 274 Reservoir. The alternative plans vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and minimum carryover storage targets) and intake structure type for water temperature management (single low-level or selective-level). Variations in other physical features, such as dam design and construction approach, hydropower mitigation 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 alternative plans. The alternative plans are subject to refinement in the Final Feasibility Report.

- The **No-Action Alternative** considers the future conditions of the study area and the future level of demand in 2030 if an alternative plan is not implemented.

- **Alternative Plan 1** would include constructing a new dam and reservoir at RM 274 in the upstream portion of Millerton Lake, as well as diversion works, a powerhouse, valve house, transmission facilities, development of other construction areas, and relocation of affected existing facilities, all of which are features common to each alternative. Under Alternative Plan 1, Temperance Flat RM 274 Reservoir would provide about 1,260 TAF of additional storage and would provide new water supply to the Friant Division via the Friant-Kern and Madera canals and to SWP M&I contractors via the San Joaquin River.

This alternative 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, and would include an LLIS on Temperance Flat RM 274 Reservoir for releases to Millerton Lake.

- **Alternative Plan 2** would include constructing the same features described in Alternative 1 and providing new water supply to the Friant Division and SWP M&I contractors, and to CVP SOD contractors through routing supply to San Joaquin Valley wildlife refuges for Level 2 diversification (making the same quantity available to CVP SOD contractors from the Delta); and would include the same carryover storage and intake configuration as Alternative Plan 1.

- **Alternative Plan 3** would include constructing the same features described in Alternative 1 and providing new water supply to the Friant Division via the Friant-Kern and Madera canals, to SWP M&I contractors via the Friant-Kern Canal, and to CVP SOD contractors via the San Joaquin River; and would include the same carryover storage and intake configuration as Alternative Plan 1.

- **Alternative Plan 4** would include constructing the same common features described in Alternative 1 and providing new water supply to the Friant Division via the Friant-Kern and Madera canals, and to SWP M&I and CVP SOD contractors via the San Joaquin River; would include 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 665 TAF, and would include an SLIS on Temperance Flat RM 274 Reservoir for temperature management and releases to Millerton Lake.

No-Action Alternative

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 expected to occur in the study area. Reasonably foreseeable actions include actions with current authorization, complete funding for design and construction, and environmental permitting and compliance activities that are substantially complete. The No-Action Alternative is considered to be the basis for comparison of the potential benefits and effects of alternative plans, consistent with the Federal P&G (WRC 1983) and NEPA guidelines. If no alternative plan is determined to be feasible, the No-Action Alternative is the default option. Under the No-Action Alternative, the proposed Federal action 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 Reclamation’s March 2012 CalSim II Benchmark). Under the No-Action Alternative, the reasonably foreseeable actions would be in effect, but the Federal government would take no additional action to address the growing water supply reliability and operational flexibility issues in California, nor take action toward implementing a specific plan to enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River (beyond the SJRRP). Examples of reasonably foreseeable actions included in the No-Action Alternative that are reflected in water supply reliability simulations are shown in Table 4-1. 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’s March 2012 CalSim II Benchmark model for Investigation operations modeling efforts.

Plan formulation efforts and analysis of the alternative plans and the No-Action Alternative described in this chapter are based on CVP and SWP operational conditions described in the 2008/2009 BOs. Modeling studies will be updated, if necessary, to reflect changes in water operations when the Final Feasibility Report is prepared. As described in Chapter 3, all alternatives, including the No-Action Alternative, are formulated and evaluated based on a 100-year project life or period of analysis, consistent with P&G, NEPA, and CEQA.

Table 4-1. Reasonably Foreseeable Actions Included in No-Action Alternative Related to Water Supply Reliability

Reasonably Foreseeable Action	Description of Action	Criteria for Inclusion in No-Action Alternative
South Bay Aqueduct Improvement and Enlargement Project	Increases the capacity of the South Bay Aqueduct to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce SWP peak power consumption.	Included in Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
Contra Costa Water District Alternative Intake Project	Seeks to reduce effects to Contra Costa WD customers from seasonal fluctuations and changing conditions in the Delta by altering diversion timing and location. The total amount of diversions will not change and no significant impacts to other Delta water users are anticipated.	Project was constructed in 2010; included in Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
San Joaquin River Agreement and Vernalis Adaptive Management Program 1999–2011	Implements the SWRCB 1995 *Water Quality Control Plan* for the lower San Joaquin River and the Delta. VAMP, officially initiated in 2000 as part of SWRCB Water Right Decision 1641, is a large-scale, long-term experimental/management program designed to protect juvenile Chinook salmon migrating from the San Joaquin River through the Delta. VAMP is also a scientific experiment to determine how salmon survival rates change in response to alterations in San Joaquin River flows and CVP and SWP exports with installation of the Head of Old River Barrier. Although VAMP expired in 2011, the No-Action Alternative includes the continued operation of VAMP or a program with similar conditions.	Project is complete; a VAMP-like operating condition is included in Existing Condition and Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
Arvin-Edison Canal Expansion	Increases the capacity of Arvin-Edison WSD South Canal, giving MWD the ability to withdraw up to 75 TAF of water from Arvin-Edison WSD during dry years and to store up to a total of 350 TAF of SWP water.	Project is currently authorized, funded, and permitted for implementation

Key:
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
MWD = Metropolitan Water District of Southern California
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet
VAMP = Vernalis Adaptive Management Program
WD = Water District
WSD = Water Storage District

The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the objectives of the Investigation.

Increase Water Supply Reliability and System Operational Flexibility

Delta-Mendota Canal and California Aqueduct

Demands for water in the Central Valley and throughout California exceed available supplies, and the need for additional supplies is expected to grow, as discussed in Chapter 2. The population of California and the Central Valley is expected to increase by approximately 33 percent and 115 percent, respectively, by 2030 (California Department of Finance 2010). 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 SOD water supplies 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 would further strain available water supplies and infrastructure capacity to meet water demands.

Water conservation and reuse efforts are increasing and forced conservation resulting from increasing shortages will continue. In the past, during drought years, many water conservation measures were implemented to reduce the effects of drought. In the future, as more water conservation measures become necessary to help meet even average year demands, the impacts of droughts will be more severe. Besides forced 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 U.S.

Under the No-Action Alternative, a dam at Temperance Flat RM 274 would not be constructed and Friant Dam would continue operating in the future No-Action condition similar 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, but would not be able to meet the expected increased demand in California.

Enhance Water Temperature and Flow Conditions

The SJRRP Restoration Goal is implemented in the No-Action Alternative as full Restoration Flows, increasing flow releases in the San Joaquin River from Friant Dam to the Merced River. As described previously, the Restoration Flow releases to the San Joaquin River stipulated in the Settlement vary by month and water year type.

The ability to manage the necessary volumes of cold water and to release water from Friant Dam at suitable temperatures, especially in drier water years, may present challenges to restoring and maintaining naturally reproducing and self-sustaining anadromous fish. Under the No-Action Alternative, no additional actions, outside of implementation of the Settlement, including releasing Restoration Flows, would be taken to manage cold-water volumes or releases to the San Joaquin River from Friant Dam at improved temperatures for anadromous fish.

Improve Flood Management, Hydropower Generation, Recreation, San Joaquin River Water Quality, Urban Water Quality

Flood system improvements along the San Joaquin River below 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 below Friant Dam will be initiated in the future by Reclamation under the SJRRP.

California's demand for electricity is expected to significantly 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 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 2000a). Under the No-Action Alternative, there would be no actions to increase storage in the upper San Joaquin River watershed to enhance operational flexibility to meet water quality goals in the Delta or facilitate water quality exchanges to improve urban water quality.

Features, Operations, and Assumptions Common to All Alternative Plans

As described in Chapter 3, all alternative plans in this report include constructing Temperance Flat RM 274 Dam and Reservoir in the upstream portion of Millerton Lake (as shown in Figure 4-1). This site was chosen for feasibility-level evaluation after a detailed plan formulation and site selection process considering 22 separate storage sites. Four alternative plans were formulated and evaluated to assess feasibility and provide a range of potential operations and features to address, in varying degrees, Investigation planning objectives. Mitigation measures have not been completely identified at this stage in the Investigation and will be further developed for the Final Feasibility Report and EIS/EIR. The following features, operations, and assumptions are common to all alternative plans. Additional details are in the Engineering Summary Appendix and Modeling Appendix.

Temperance Flat RM 274 Dam and Reservoir

Temperance Flat RM 274 Dam would be an RCC arch gravity dam. The 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. Figure 4-1 shows the extent of Temperance Flat RM 274 Reservoir and related project features in the reservoir area.

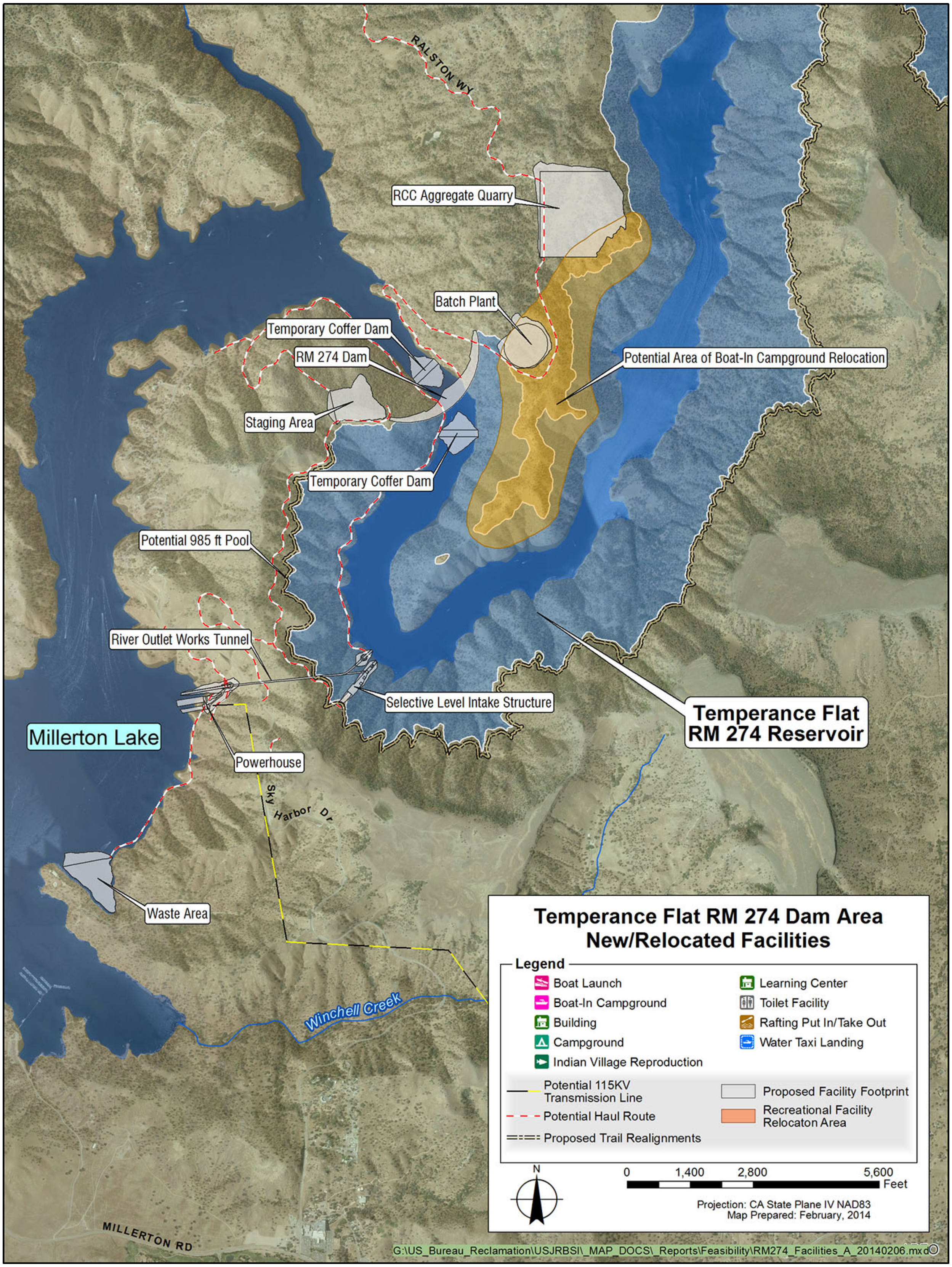


Figure 4-1. Temperance Flat RM 274 Reservoir Project Features

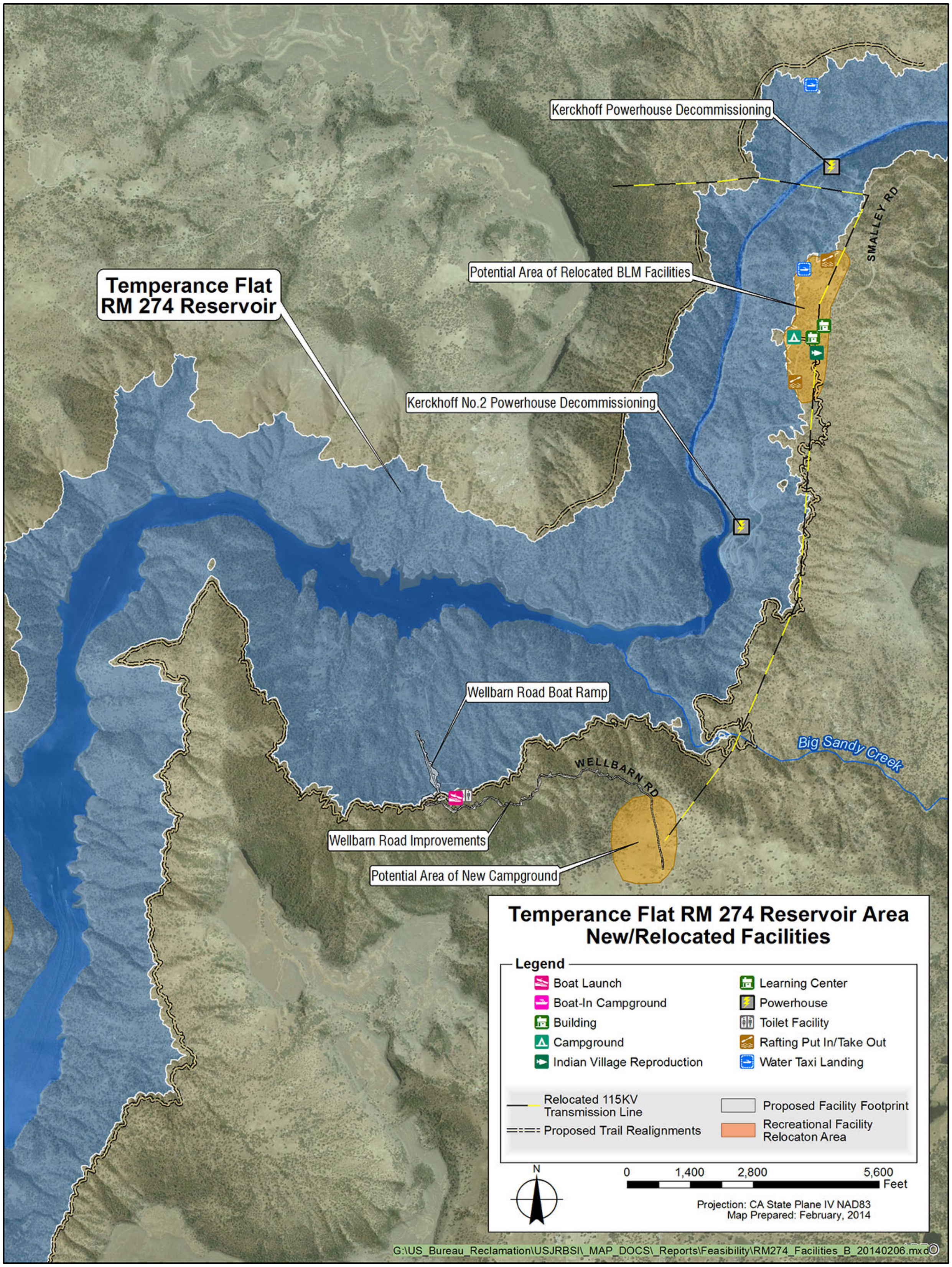


Figure 4-1. Temperance Flat RM 274 Reservoir Project Features (contd.)

The dam would be approximately 665 feet high, from a base elevation of 340 in the bottom of Millerton Lake (San Joaquin River channel) at the upstream face to the dam crest at elevation 1,005. 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.

At a top-of-active-storage elevation of 985, the 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 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 reservoir would reach to about 12 feet below the crest of Kerckhoff Dam.

Diversion Works

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 will later serve as the outlet works tunnel for the reservoir.

Upstream and downstream cofferdams would be required to divert stream flows during construction and to prevent inundation of the site from Millerton Lake. Cofferdams would be sized for estimated diversion flows, and to allow normal operation of Millerton Lake during construction of Temperance Flat RM 274 Dam. Both cofferdams would require a minimum crest elevation of 580 and height of 240 feet to accommodate normal reservoir operation of Millerton Lake and to pass diversion flows.

Intake Structure

All alternative plans will include an intake structure that 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 length, width, and slope of the intake structure, along with number, location, and operability of inlet gates would vary among alternative plans. Alternative-specific arrangement descriptions for the intake structure are included in the alternative-specific sections.

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 cfs. After water has passed through the turbine units, it 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. 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 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 to be 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.

Access Roads

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

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 9.6 miles with two lanes ranging from 12 to 20 feet.

Aggregate Quarry

The aggregate quarry would provide aggregate for the main dam, cofferdam, diversion tunnel, intake structures, and valve house/powerhouse construction. The quarry would be approximately 92 acres in size and located approximately 2,500 feet northeast of the dam's right abutment, outside the proposed inundation area.

Batch Plant

The batch plant site would be located approximately 800 feet east of the dam's right abutment. Most of the batch plant site would be outside the proposed inundation area and approximately 19 acres in size. Cement and pozzolan will likely be delivered by truck to the batch plant, most likely from railroad terminals near Fresno, California.

Staging Area

The 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 aggregate to the dam site.

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 waste rock from diversion tunnel and powerhouse excavation.

Kerckhoff Hydroelectric Project Facilities

Kerckhoff Dam

A Temperance Flat RM 274 Reservoir, with a top of active storage at elevation 985, would inundate the existing Kerckhoff Hydroelectric Project powerhouses, Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse. Kerckhoff Powerhouse is an aboveground facility and its site would be 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 spillway gates at the top of the Kerckhoff Dam. The top of Kerckhoff Dam would be modified to accommodate higher tailwater elevations. 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 many 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 SRA, and the San Joaquin River Trail, which connects the SRA and the BLM SJRGMA. Within the BLM SJRGMA are an extension of the San Joaquin River Trail, two footbridges, primitive campgrounds, and a reproduction Native American village. 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 (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 SJRGMA, as well as Temperance Flat RM 274 Reservoir (e.g., new Wellbarn Road Boat Ramp). Inundated recreational facilities and associated utilities would be relocated before demolition, with the exception of facilities identified for abandonment. Additional details on recreational facilities can be found in the Engineering Summary Appendix.

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 an associated facility is relocated or required to maintain distribution).

CVP and SWP Operations Criteria

The operations modeling of the alternative plans is based on the Reclamation March 2012 CalSim II Benchmark, which represents operations of the CVP and SWP in accordance with the 2008/2009 BOs. The operations and requirements under the 2008/2009 BOs are described in further detail in the Modeling Appendix.

Millerton Lake and Friant Dam Operations

The target water surface elevation for Millerton Lake for all alternative plans is elevation 550 (carryover storage target of 340 TAF). Analyses in the feasibility phase alternatives refinement process demonstrated that, with significant additional storage in Temperance Flat RM 274 Reservoir, water supply and flood storage operations for Friant Dam and Millerton Lake would not be dependent on the historical variable operation to fill and drain the reservoir, and would not be hindered by holding Millerton Lake at a target elevation of 550 feet (340 TAF).

The steady storage level would also support recreation and cold water management better than variable storage or low carryover storage in Millerton Lake. Less fluctuation in Millerton Lake also supports stable tailwater levels for hydropower generation facilities associated with Temperance Flat RM 274 Reservoir. Millerton Lake could still fill all the way to the top-of-active storage capacity at elevation 580.6 (520 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.

Flood Storage Operations

The existing flood control rule curve at Friant Dam specifies that 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, flood space in excess of 85 TAF may be replaced by an equal amount of space in Mammoth Pool.

The required total available flood control storage and operation rules at Millerton Lake were used for the combined Temperance Flat Reservoir and Millerton Lake analysis to maintain the same level of regulatory flood control. The assumption was made that the available flood control storage could be in either reservoir, provided the required flood control storage space was always available between the two reservoirs.

With Millerton Lake operated at elevation 550 (340 TAF) in the alternative plans, 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 and Temperance Flat RM 274 reservoirs would be less than the regulatory flood control limit.

Temperance Flat RM 274 Reservoir would reduce flood flow releases from Millerton Lake compared to the No-Action Alternative. Based on CalSim II simulations, long-term average annual flood releases from Friant Dam in the No-Action Alternative would be 152 TAF and would range from 45 to 53 TAF for the alternative plans. Figure 4-2 shows the estimated annual volumes of Friant Dam flood releases for Alternative Plan 4 as well as reductions from the No-Action Alternative based on CalSim II simulations.

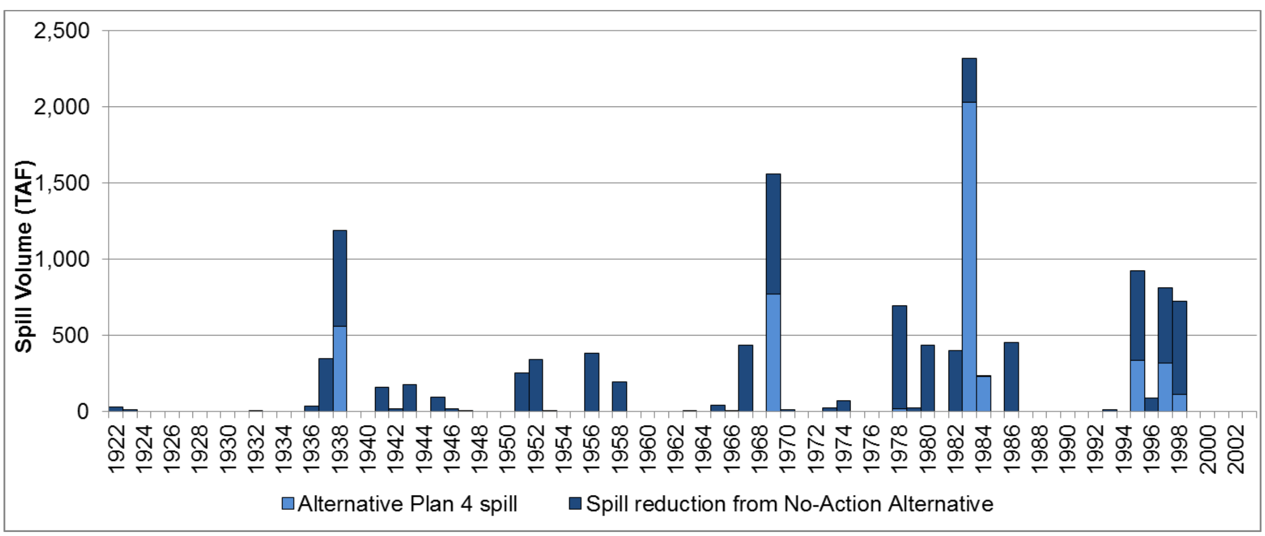


Figure 4-2. Simulated Friant Dam Flood Releases for Alternative Plan 4

Existing and Foreseeable Conveyance Facilities Operations

The alternative plans include existing and foreseeable available cross-valley conveyance capacity in the Cross Valley Canal, Shafter Wasco-Semitropic Water Storage District Connection, and Arvin Edison Canal. Total capacity is shown in the conveyance schematic in Figure 4-3. Further details on available conveyance capacity and modeling assumptions are described in Attachment B to the Modeling Appendix.

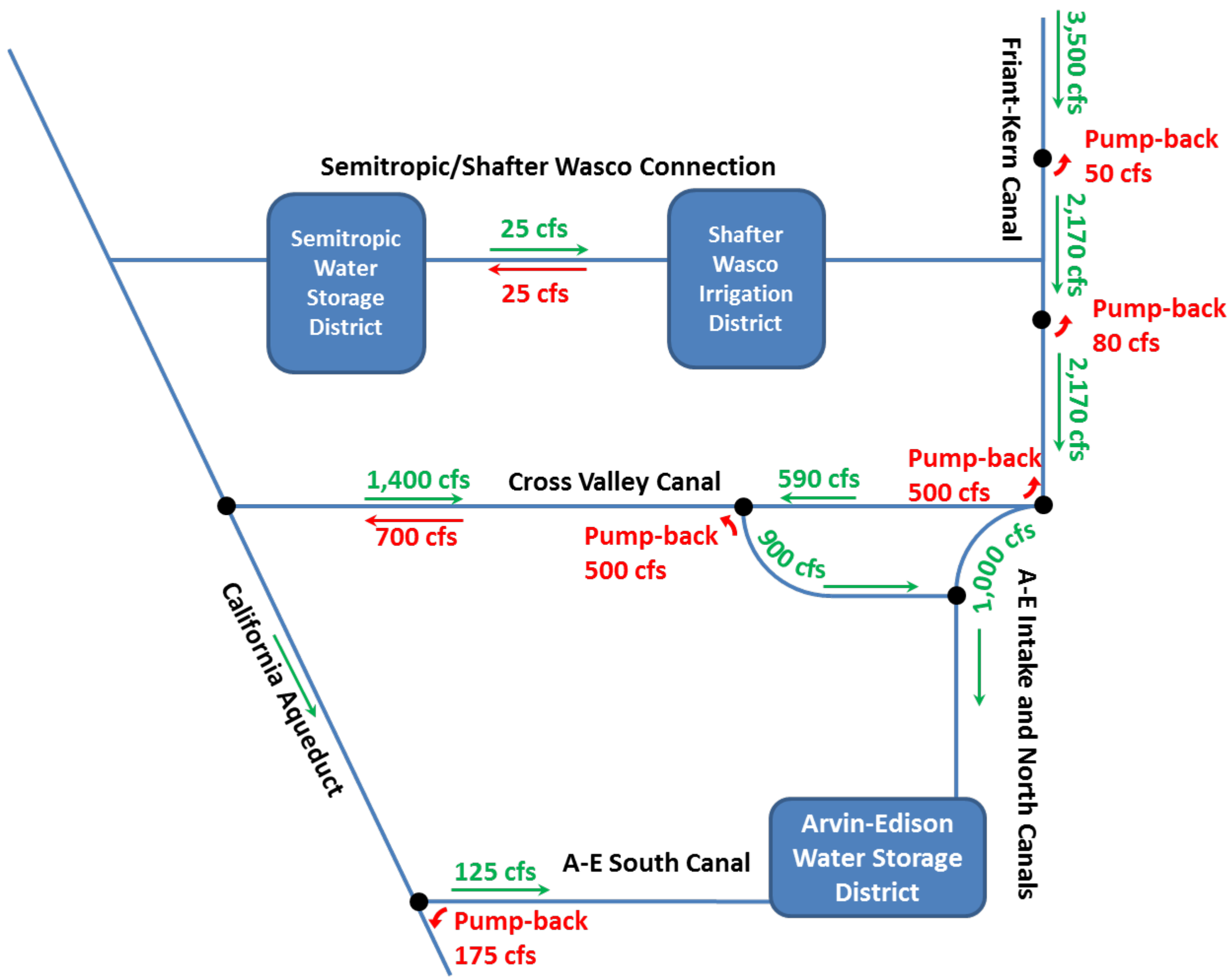


Figure 4-3. Schematic of Major Cross-Valley Conveyance Capacities

Features and Operations Varying Between Alternative Plans

The alternative plans mainly differ in four ways: minimum carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and type of intake structure.

Minimum Carryover Storage Target for Temperance Flat RM 274 Reservoir

The minimum carryover storage target for Temperance Flat RM 274 Reservoir is 200 TAF for Alternative Plans 1, 2, and 3 and 325 TAF for Alternative Plan 4. The higher carryover in Alternative Plan 4 would slightly decrease water supply, but increase emergency water supply, recreation, cold-water pool, and hydropower. The modeling performed to date includes operating Temperance Flat RM 274 Reservoir to always be at or above the carryover storage target, but other carryover options such as variable carryover targets depending on the forecasted water supply may be considered for the Final Feasibility Report. Figure 4-4 illustrates simulated storage volumes for Millerton Lake and Temperance Flat RM 274 Reservoir for alternative plans 1 and 4, and shows the effects of the carryover storage targets on the minimum storage levels.

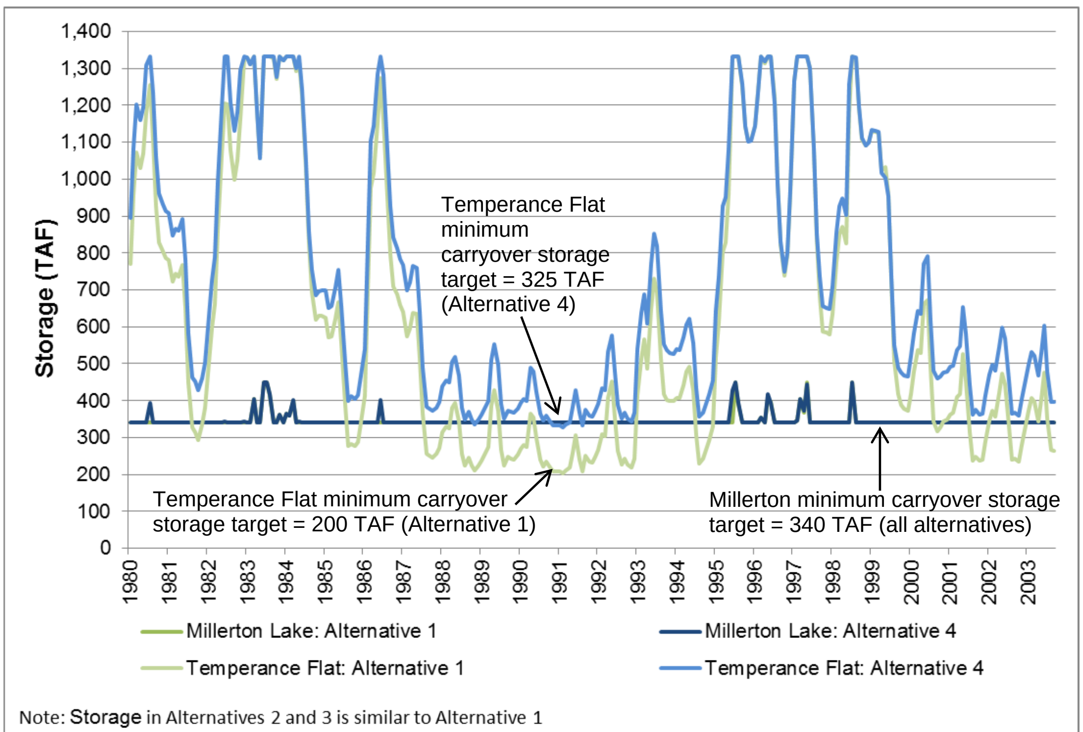


Figure 4-4. Simulated Millerton Lake and Temperance Flat Reservoir Storage

Beneficiaries of New Water Supply

Temperance Flat RM 274 Reservoir could provide water supply to a range of beneficiaries. The alternative plans 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. The Friant Division of the CVP, other CVP SOD contractors, and SWP M&I contractors are considered as beneficiaries in the alternative plans. All alternative plans would deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to the Friant Division and SWP M&I. Alternative Plans 2, 3 and 4 would also deliver new supply to CVP SOD contractors. Details of the new water supply allocated to each beneficiary could be revisited for the Final Feasibility Report.

Routing of New Water Supply

In some cases water deliveries could be routed to the beneficiaries in different ways. New supplies to the Friant Division would be conveyed via the Friant-Kern and Madera canals. New water supply to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool, where it would be exchanged with DMC deliveries of Delta supply to Mendota Pool, freeing the Delta supply for delivery to CVP SOD contractors. New water supply would be delivered to CVP SOD contractors in Alternative Plans 3 and 4.

In Alternative Plans 1, 2, and 4, new water supply to SWP M&I beneficiaries would be routed via the San Joaquin River, and exchanged for Delta supplies at Mendota Pool, allowing an equivalent amount of Delta water supply to be delivered to SWP M&I via the California Aqueduct through another exchange at the San Luis Reservoir Forebay. In Alternative Plan 3, new water supply to SWP M&I beneficiaries 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 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, and 3 include an LLIS, an SLIS is included in Alternative Plan 4 to provide additional flexibility for cold-water pool and Temperance Flat RM 274 Reservoir release temperature management.

Summary of Alternative Plans Features and Operations

Features, assumptions, and operations variables were combined and incorporated into the four alternative plans through the feasibility-phase plan refinement processes described in Chapter 3. The four alternative plans are intended to achieve the planning objectives by balancing water supply reliability and ecosystem enhancement, provide a wide range of potential physical accomplishments and economic benefits related to the planning objectives, and provide benefits to a wide range of potential beneficiaries.

<table>
<tr><th>Alternative Plan</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Millerton Lake Minimum Carryover Storage Target</td><td colspan="4">340 TAF</td></tr>
<tr><td>Temperance Flat Minimum Carryover Storage Target</td><td colspan="3">200 TAF</td><td>325 TAF</td></tr>
<tr><td>Beneficiaries</td><td>Friant Division, SWP M&I</td><td colspan="3">Friant Division, SWP M&I, CVP SOD</td></tr>
<tr><td>Conveyance Routing:
Friant Division</td><td colspan="4">Friant-Kern and Madera canals</td></tr>
<tr><td>CVP SOD</td><td>N/A</td><td colspan="3">San Joaquin River Exchanges at Mendota Pool</td></tr>
<tr><td>SWP M&I</td><td colspan="2">San Joaquin River Exchanges at Mendota Pool</td><td>Friant-Kern, cross-valley conveyance, CA Aqueduct</td><td>San Joaquin River Exchanges at Mendota Pool</td></tr>
<tr><td>Intake Structure Type</td><td colspan="3">Low-level intake structure</td><td>Selective-level intake structure</td></tr>
</table>

Alternative plans vary in four ways: minimum carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and intake structure type.

Features of the alternative plans are summarized in Table 4-2 and operations of the alternative plans are summarized in Table 4-3. A schematic of SOD systemwide operations of the alternative plans is shown in Figure 4-5.

Table 4-2. Summary of Physical Features of Alternative Plans

Alternative Plan	1	2	3	4
Dam and Reservoir				
Temperance Flat RM 274 Dam	RCC gravity arch dam.	Same as 1.	Same as 1.	Same as 1.
Dam Height (feet)	665	Same as 1.	Same as 1.	Same as 1.
Elevation of Dam Crest (feet)[2]	1,005	Same as 1.	Same as 1.	Same as 1.
Elevation of Top of Active Storage (feet)[2]	985	Same as 1.	Same as 1.	Same as 1.
Capacity (TAF)	1,331	Same as 1.	Same as 1.	Same as 1.
Net Capacity Increase (TAF)	1,260	Same as 1.	Same as 1.	Same as 1.
Spillway	665-foot-wide uncontrolled ogee crest spillway.	Same as 1.	Same as 1.	Same as 1.
Diversion Works				
Diversion and Outlet Works Tunnel	30-foot-diameter, concrete-lined tunnel through left abutment.	Same as 1.	Same as 1.	Same as 1.
Upstream and Downstream Cofferdams	Embankment cofferdams to divert stream flows around dam construction site.	Same as 1.	Same as 1.	Same as 1.
Height (feet)	240	Same as 1.	Same as 1.	Same as 1.
Elevation of Cofferdam Crest (feet)[1]	580	Same as 1.	Same as 1.	Same as 1.
Intake Structure				
Low-Level Intake Structure	Inclined reinforced-concrete structure with two low-level fixed-wheel gates.	Same as 1.	Same as 1.	None.
Selective-Level Intake Structure	None.	None.	None.	Inclined reinforced-concrete structure with two low-level fixed-wheel gates and three upper-level fixed-wheel gates.
Powerhouse, Valve House, and Transmission Facilities				
Powerhouse	160 MW powerhouse and tailrace.	Same as 1.	Same as 1.	Same as 1.
Transmission	Transmission line approximately 5 miles southeast to the existing Kerckhoff–Sanger line.	Same as 1.	Same as 1.	Same as 1.
Valve House	At-grade reinforced-concrete structure connected to diversion tunnel and powerhouse.	Same as 1.	Same as 1.	Same as 1.

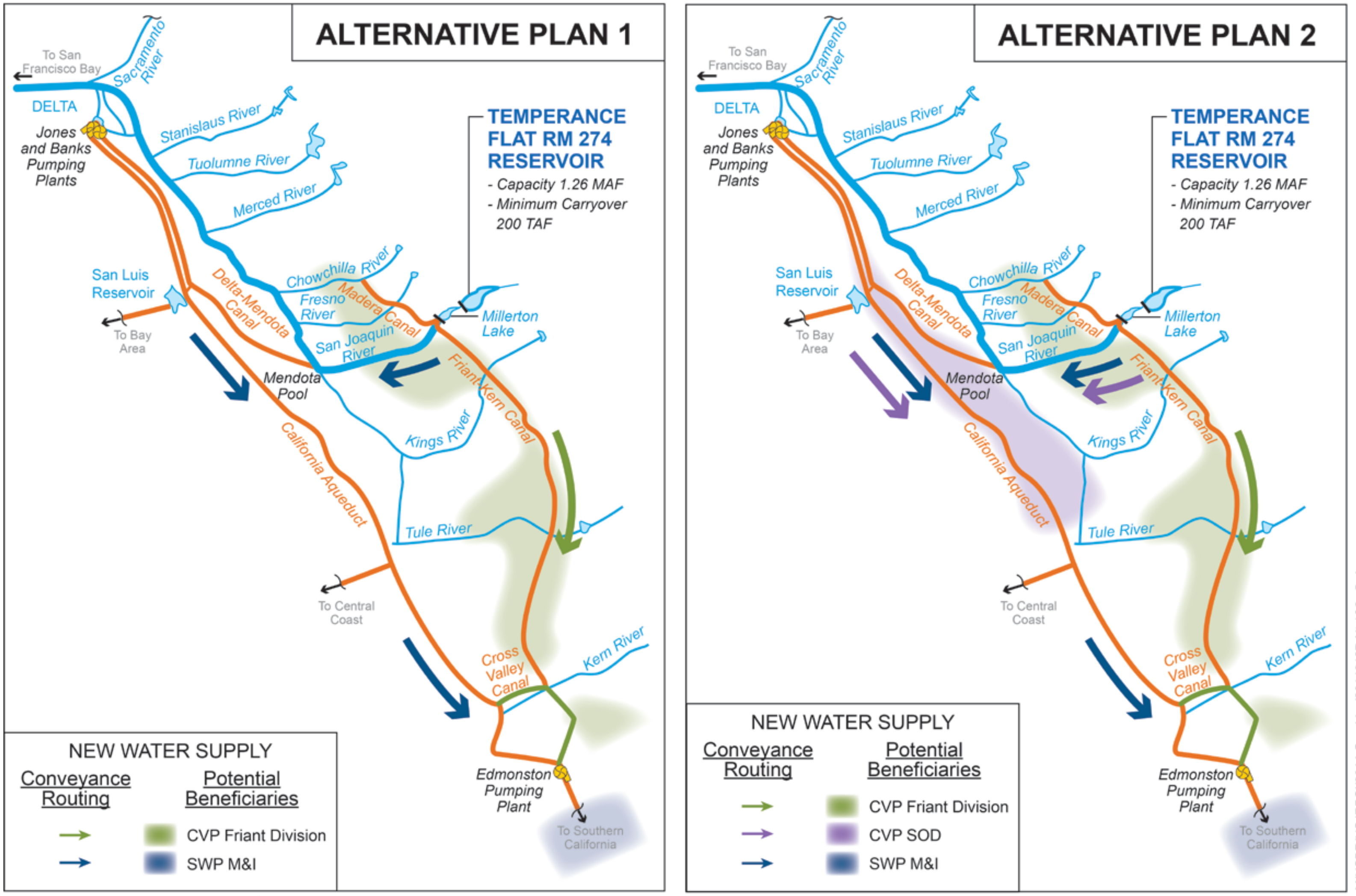
Table 4-2. Summary of Physical Features of Alternative Plans (contd.)

Alternative Plan	1	2	3	4
Other Construction Areas				
Access and Haul Roads	3 permanent access roads (approx. 3.5 miles) and 5 temporary haul roads (approx. 9.6 miles).	Same as 1.	Same as 1.	Same as 1.
Aggregate Quarry	92-acre quarry.	Same as 1.	Same as 1.	Same as 1.
Batch Plant	19-acre plant.	Same as 1.	Same as 1.	Same as 1.
Staging Area	21-acre staging area.	Same as 1.	Same as 1.	Same as 1.
Waste Area	21.5-acre area for waste rock from diversion tunnel and powerhouse excavation.	Same as 1.	Same as 1.	Same as 1.
Affected Existing Facilities				
Kerckhoff Hydroelectric Project Powerhouses	Demolish Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse and restore to near-natural conditions.	Same as 1.	Same as 1.	Same as 1.
Kerckhoff Dam	Raise deck to elevation 1,005 and replace mechanical equipment for gate operations.	Same as 1.	Same as 1.	Same as 1.
Existing Transmission	Relocate inundated portions of Kerckhoff–Le Grand and Kerckhoff–Sanger lines.	Same as 1.	Same as 1.	Same as 1.
Recreational Facilities	Relocate inundated BLM and State Parks facilities. Construct new boat ramp.	Same as 1.	Same as 1.	Same as 1.
Reservoir Area Utilities	Relocate inundated utilities if associated facilities are also relocated.	Same as 1.	Same as 1.	Same as 1.

Notes:

[1] Based on the North American Vertical Datum of 1988.

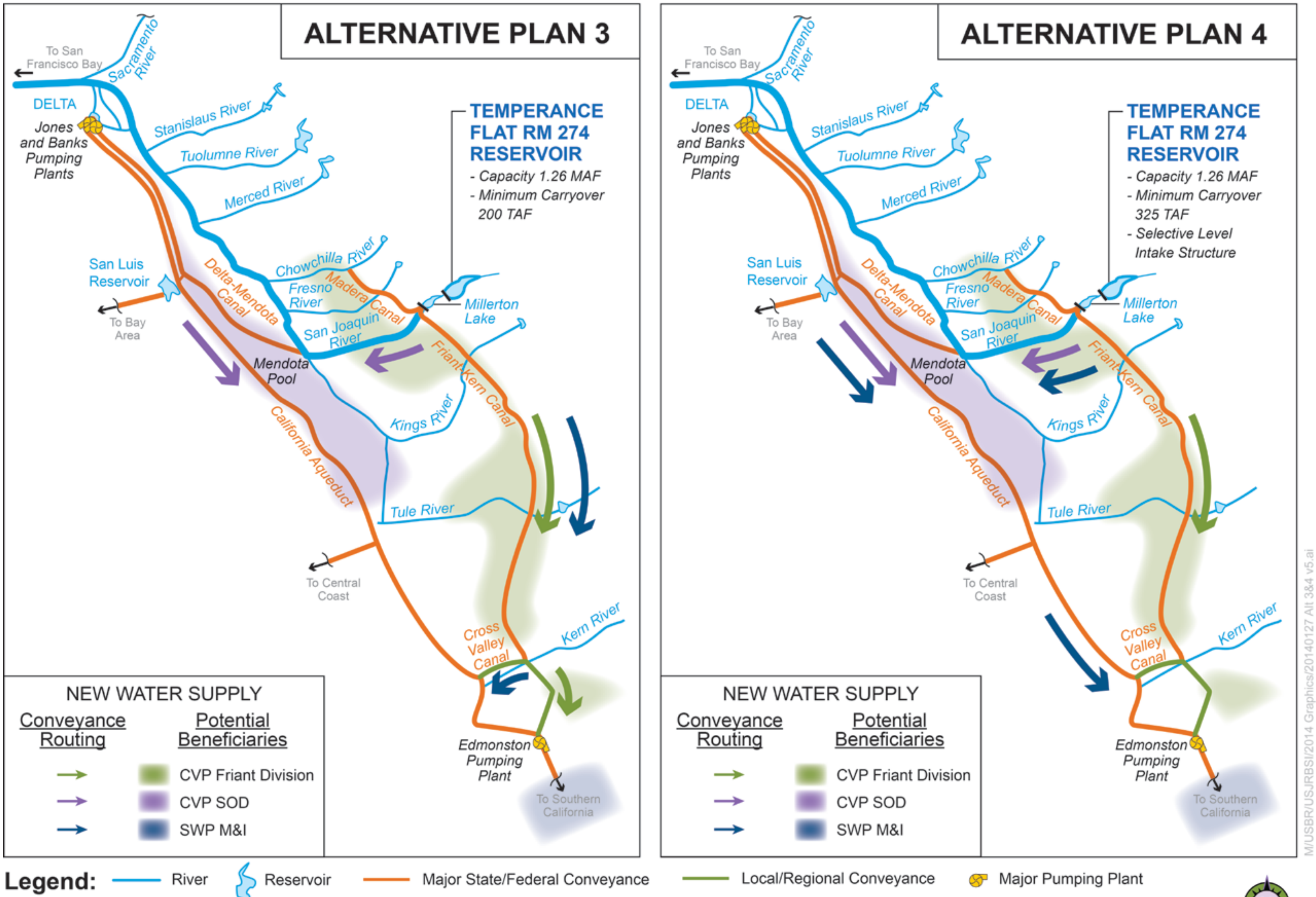
Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
MW = megawatt
RCC = roller-compacted concrete
RM = river mile
State Parks = California Department of Parks and Recreation
TAF = thousand acre-feet



Legend: River — Reservoir — Major State/Federal Conveyance — Local/Regional Conveyance — Major Pumping Plant

Notes:
1. Millerton Lake would be operated at a minimim carryover storage target of 340 TAF in all alternatives.
2. In Alternative Plan 2, San Joaquin Valley CVP wildlife refuges would receive higher quality San Joaquin River water supplies from Temperance Flat Reservoir (Level 2 refuge diversification).

Figure 4-5. South-of-Delta Systemwide Operations of Alternative Plans



Note: 1. Millerton Lake would be operated at a minimim carryover storage target of 340 TAF in all alternatives.

Figure 4-5. South-of-Delta Systemwide Operations of Alternative Plans (contd.)

Table 4-3. Summary of Operations of Alternative Plans

<table>
<tr><th rowspan="3">Alternative Plan</th><th colspan="3">New Water Supply Beneficiaries/Deliveries</th><th rowspan="3">Millerton Lake Minimum Carryover Storage Target (TAF)</th><th rowspan="3">Temperance Flat Minimum Carryover Storage Target (TAF)</th><th rowspan="3">Intake Structure Type [1]</th></tr>
<tr><th>CVP Friant Division</th><th>CVP South-of-Delta</th><th>SWP Municipal & Industrial</th></tr>
<tr><th colspan="3">Conveyance Route</th></tr>
<tr><td>1</td><td rowspan="4">Friant-Kern/ Madera Canals</td><td>N/A</td><td rowspan="2">San Joaquin River [2]</td><td rowspan="4">340 TAF</td><td rowspan="3">200 TAF</td><td>LLIS</td></tr>
<tr><td>2</td><td rowspan="3">San Joaquin River [2, 3]</td><td>LLIS</td></tr>
<tr><td>3</td><td>Friant-Kern Canal</td><td>LLIS</td></tr>
<tr><td>4</td><td>San Joaquin River [2]</td><td>325 TAF</td><td>SLIS</td></tr>
</table>

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 Plan 2 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.
Key:
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
LLIS = low level intake structure
N/A = not applicable
SLIS = selective level intake structure
SWP = State Water Project
TAF = thousand acre-feet

Alternative Plan 1

In addition to the features common to all of the alternative plans (dam and reservoir, diversion works, powerhouse, valve house, transmission facilities, other construction areas, and affected existing facilities), Alternative Plan 1 includes 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 are necessary, but only one would be opened, as necessary, for normal releases; the other would remain closed.

Alternative Plan 1 would provide new water supply to the Friant Division and SWP M&I contractors. New supply to SWP 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 supply could be delivered to SWP M&I 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 2

Alternative Plan 2 would include constructing the same physical features described in Alternative Plan 1. Alternative Plan 2 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. The new supply to SWP 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 supply would be delivered to SWP M&I via the California Aqueduct. The new water supply to CVP SOD would be developed by delivering water supplies to serve CVPIA Level 2 refuge water demands from Temperance Flat RM 274 Reservoir. The water would be released to the San Joaquin River for refuge delivery from Mendota Pool. This water would be released to the San Joaquin River and delivered to Mendota Pool, allowing direct access or exchange with Delta supplies for delivery to CVP SOD contractors.

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 include constructing the same physical features described in Alternative Plan 1. Alternative Plan 3 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. New supply to SWP M&I contractors would be delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. New water supply 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 3 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 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 include constructing the same physical features common to all of the alternative plans, and would also 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 selective 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 are necessary, but only one would be opened, when necessary, for low-elevation releases as driven by temperature objectives; the other would remain closed.

Alternative Plan 4 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. New supply to SWP M&I 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 supply could be delivered to SWP M&I contractors via the California Aqueduct. New water supply 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 665 TAF.

Physical Accomplishments of Alternative Plans

This section summarizes accomplishments and comparative metrics for all alternative plans for the primary planning objectives of increased water supply reliability and system operational flexibility, and enhancement of water temperature and flow conditions in the San Joaquin River; and for the secondary planning objectives of improved flood management, hydropower generation, recreation, San Joaquin River water quality, and urban water quality. Model simulations completed to assess the physical accomplishments are described in detail in the Modeling Appendix. Project costs are further described in the Engineering Summary Appendix, and economic analysis and benefits are further described in the Economic Analysis Appendix.

Increase Water Supply Reliability and System Operational Flexibility

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

Water Supply Reliability

Analyses of Temperance Flat RM 274 Reservoir alternative plans in the draft feasibility phase with operating conditions under the 2008/2009 BOs are focused on developing new water supply by storing wet year water supplies from the San Joaquin River that would otherwise be flood releases from Friant Dam. This operation would provide water supply reliability and operational flexibility to the Friant Division and the CVP and SWP system. The alternative plans were analyzed for water supply to the Friant Division contractors, SWP M&I contractors, CVP SOD contractors, and CVP San Joaquin Valley wildlife refuges, based on CalSim II simulations. Table 4-4 summarizes the long-term average annual change in delivery to the potential beneficiaries in each alternative plan compared to the No-Action Alternative. Table 4-5 lists the long-term average annual change in deliveries systemwide for all water year types for all alternative plans compared to the

No-Action Alternative. The long-term average annual change in systemwide deliveries accounts 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 alternative plans would provide between 61 to 76 TAF per year of additional CVP and SWP systemwide water deliveries, depending on operations.

In addition to carryover storage targets, the magnitude of long-term average water supply reliability accomplishments is strongly influenced by CVP and SWP operating conditions. Evaluation of Temperance Flat RM 274 Reservoir integrated with the broader CVP and SWP SOD export and storage system 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. The sensitivity of the alternative plans' accomplishments and benefits to changes in CVP and SWP operating conditions will be further evaluated in the Final Feasibility Report.

Table 4-4. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir

Alternative Plan	1	2	3	4
Average Annual Change in Deliveries (TAF) [1]				
Friant Division	43	36	38	27
CVP South-of Delta Ag [2]	-10	16	16	16
SWP M&I SOD	40	22	25	21
Total CVP and SWP Change In Delivery [3]	**70**	**71**	**76**	**61**

Notes:
[1] Alternative Plans are compared to 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 alternative plans, the long-term annual average delivery to CVP SOD would be slightly less than the No-Action Alternative. Further refinements are anticipated for the Final Feasibility Report.
[3] Total CVP and SWP delivery includes SWP Ag and CVP M&I, which are not included as water supply beneficiaries, so line items may not sum to totals.

Key:
Ag = agricultural contractors
CVP = Central Valley Project
M&I = municipal and industrial
RM = River Mile
SOD = South of Delta
SWP = State Water Project
TAF = thousand acre-feet

Table 4-5. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir Alternative Plans[1]

Alternative Plan	WY Type San Joaquin Index [2]	Change in System-wide Delivery [3]	Total Friant 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
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**
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**
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**
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**

Note:

[3] 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 Board Decision D-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] Alternative plans are compared to No-Action Alternative.

Key:
Ag = agricultural
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SOD = south-of-Delta
SWP = State Water Project
WY = water year

Emergency Water Supply

Temperance Flat RM 274 Reservoir storage could provide greater water supply reliability to SOD M&I water users in an emergency event and disruption of Delta exports. The Delta Risk Management Strategy (DRMS) Water Acquisitions Model (WAM) was used to estimate average emergency supply from alternative plans that could be provided in the potential event of Delta levee breaches causing varying durations of pumping outages and consequent SOD deficits. Table 4-6 lists the average emergency water supply available under alternative plans for levee breach scenarios with 1, 3, 10, 20, and 30 islands.

Table 4-6. Temperance Flat RM 274 Reservoir Average Water Supply Available for Delta Export After Disruption by Seismic Event

Alternative Plan	1	2	3	4
Levees Breached – 1 Island Scenario (TAF) [1]	28	28	28	28
Levees Breached – 3 Islands Scenario (TAF) [1]	47	47	47	47
Levees Breached – 10 Islands Scenario (TAF) [1]	194	195	195	203
Levees Breached – 20 Islands Scenario (TAF) [1]	368	369	365	361
Levees Breached – 30 Islands Scenario (TAF) [1]	442	443	437	534

Note:
[1] Alternative plans are compared to No-Action Alternative.

Key:
RM = River Mile
TAF = thousand acre-feet

Enhance Water Temperature and Flow Conditions

The planning objective to enhance water temperature and flow conditions in the San Joaquin River considers physical accomplishments for management of reservoir cold-water pool and Friant Dam river release temperatures to improve conditions for San Joaquin River anadromous fish in general, as well as potential to improve habitat for spring-run Chinook salmon in particular.

Ecosystem – Cold-Water Pool and River Release Temperature

The alternative plans 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 alternative plans. Alternative Plan 4 also includes an SLIS to better manage reservoir cold-water pool and San Joaquin River release temperatures for anadromous fish. All the alternative plans would increase the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in alternative plans 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 water temperature conditions for anadromous fish in the San Joaquin River.

The alternative plans would improve San Joaquin River release temperatures from September through December, as shown in Figure 4-6, at the cost of slightly warmer winter releases than in the No-Action. However, in the winter months, release temperatures would still be cooler than needed for anadromous fish (see Modeling Appendix for further detail on reservoir and river temperatures). Inclusion of an SLIS in Alternative Plan 4 reduced modeled release temperatures by up to 5°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 stay below 55°F, a critical temperature for anadromous fish (Figure 4-7).

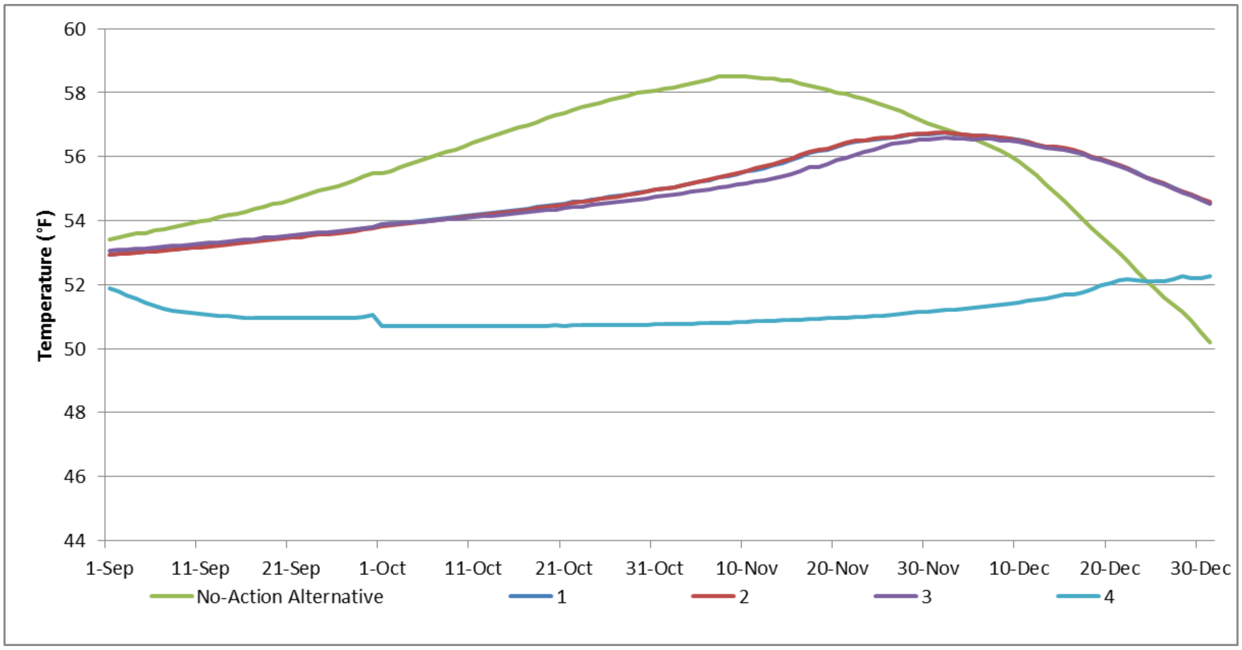


Figure 4-6. Mean Daily September – December Temperature (°F) of Friant Dam Release to San Joaquin River – All Years

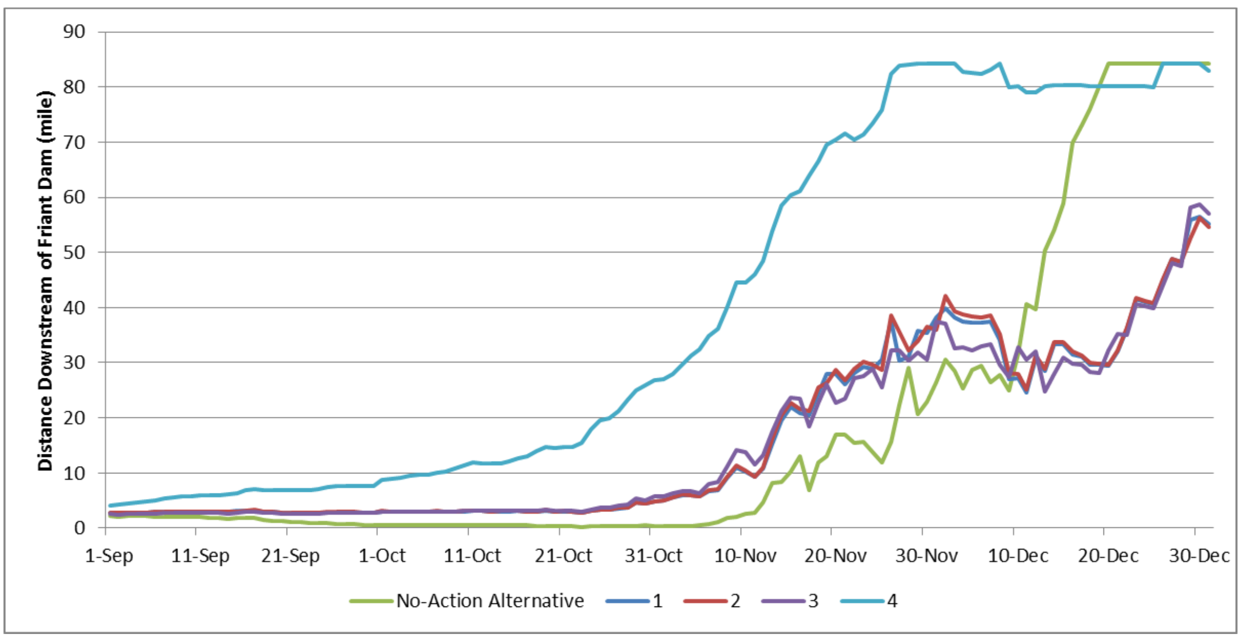


Figure 4-7. September – December Distance Downstream Where Mean Daily River Temperature Less Than or Equal to 55° F – All Years

Ecosystem – Improvement in Spring-Run Chinook Salmon Abundance

The Ecosystem Diagnosis and Treatment (EDT) model was used to estimate potential improvements to San Joaquin River spring-run Chinook salmon habitat that could be achieved by alternative plans. EDT output includes variables describing the productivity and capacity of fish habitat that could develop under flow and water temperature regimes for each alternative plan. Productivity and capacity are both represented in the abundance metric estimated by the EDT model, representing the number of spawning fish the habitat could sustain. Due to uncertainty and limited data regarding the survival of salmon as they migrate below the Merced River to the ocean and then return 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 Attachment A.

Major EDT model outputs:

Productivity represents habitat quality and is based on the density-independent survival rate (i.e. survival without competition) and is a function of temperature, water quality, and food.

Capacity is the maximum abundance that could be supported by the quantity of suitable habitat and the density of fish in that habitat. It is a function of the quantity of habitat, productivity, and food.

Abundance is the best estimate for maximum number of returning/ spawning adult fish that could be supported considering both habitat quantity and quality.

The potential improvements for spring-run Chinook salmon habitat were measured by comparing the abundance for each alternative to that of the No-Action Alternative as a percent improvement in equilibrium abundance. Table 4-7 shows the increase 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 alternative plans are related to a combination of water 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 exchanges).

Table 4-7. Alternative Plans Improvement in Abundance of Spring-Run Chinook Salmon

Alternative Plan	1	2	3	4
Percent Improvement in Long-Term Average Annual Abundance– High SAR [1]	2.8%	2.8%	0.6%	4.9%
Percent Improvement in Dry Year Abundance– High SAR [1]	15.9%	13.2%	14.6%	13.1%
Percent Improvement in Long-Term Average Annual Abundance– Low SAR [1]	0.6%	-0.7%	-0.1%	2.8%
Percent Improvement in Dry Year Abundance– Low SAR [1]	14.0%	9.2%	13.3%	11.1%

Notes: Further details are presented in the Modeling Appendix Attachment A.
[1] Alternative plans are compared to the No-Action Alternative, which varies depending on the SAR.
Key: SAR = smolt-to-adult return rate

Flood Damage Reduction, Hydropower, Recreation, San Joaquin River Water Quality, Urban Water Quality

Secondary planning objectives include improving flood management, maintaining hydropower attributes value, increasing recreational opportunities, improving lower San Joaquin River water quality, and improving urban water quality. Physical accomplishments of the alternative plans regarding flood management, hydropower, recreation, and urban water quality are described below. San Joaquin River water quality improvements would be negligible.

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 4-8 shows the 90 percent exceedence flood storage availability for alternative plans compared to the No-Action Alternative. Available storage in November through March also assumes that up to 85 TAF of flood storage would be available above Temperance Flat RM 274 Reservoir in Mammoth Pool. Alternative plans with lower carryover storage (1, 2, 3) would have more active storage available for flood damage reduction, but all alternative plans, including 4, would have at least 200 TAF more flood storage availability in the flood control period from November to March compared to the No-Action Alternative.

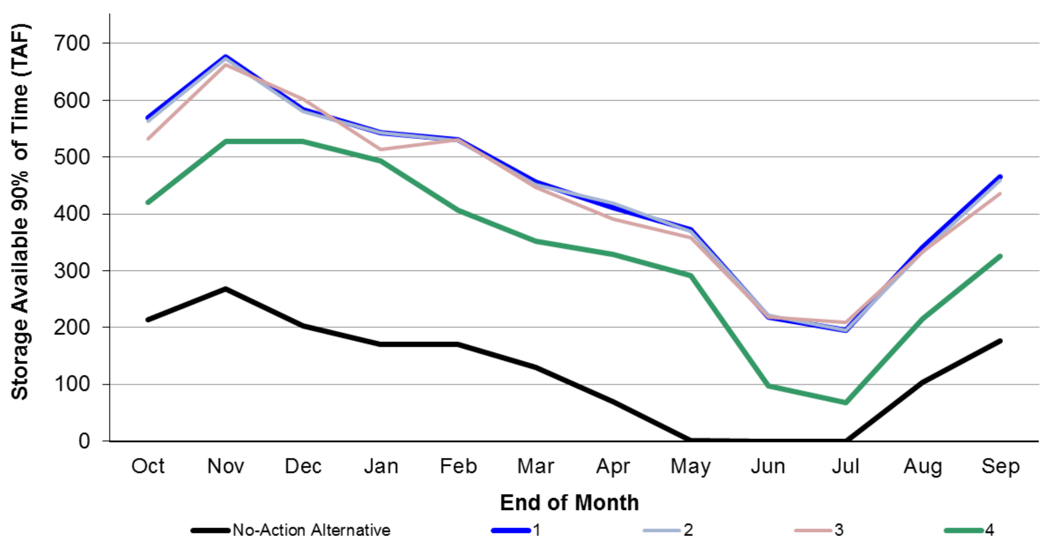


Figure 4-8. 90 Percent Exceedance Flood Storage Availability by Month for All Alternative Plans

Hydropower and Replacement of Impacted Hydropower Value

The ability of alternative plans to replace the value of the Kerckhoff Hydroelectric Project powerhouses would vary greatly, depending on how carryover storage in Temperance Flat RM 274 Reservoir is managed. Alternative Plans 1, 2, and 3 could replace all but 100 GWh/year (83.5 percent to 83.9 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower mitigation. Alternative 4 could replace all but 57 GWh/year (90.8 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower mitigation because of higher carryover storage in Alternative Plan 4 allowing for higher head for power generation. Table 4-8 shows the simulated long-term average hydropower generation change from the No-Action Alternative. All alternative plans would operate Millerton Lake with a fixed water surface at elevation 550 (carryover storage of 340 TAF). The fixed elevation would allow Friant Dam powerhouses to generate an average of 15.7 to 15.8 GWh/year greater than the No-Action Alternative.

Table 4-8. Friant Dam Hydropower Generation and Kerckhoff Hydroelectric Project Onsite Mitigation

Alternative Plan	1	2	3	4
Kerckhoff Hydroelectric Project Onsite Mitigation				
Change in Hydropower Generation from No-Action Alternative (GWh/year)[1]	-102.5	-100.6	-100.3	-57.1
Percent Generation Replacement of Kerckhoff Hydroelectric Project[1]	83.5	83.8	83.9	90.8
Friant Dam Hydropower Generation				
Change in Hydropower Generation from No-Action Alternative (GWh/year) [1]	15.8	15.7	15.7	15.8

Note: [1] Alternative plans are compared to No-Action Alternative. Change in Hydropower Generation = Kerckhoff Hydroelectric Project generation minus Temperance Flat RM 274 Powerhouse generation. Remaining mitigation requirements for Kerckhoff Hydroelectric Project are addressed in project costs.
Key: GWh = Gigawatt-hour
RM = River Mile

Recreational Opportunities

Opportunities for recreational development 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 elevation 540 to 560 feet would allow the best balance of shoreline and reservoir use. All alternative plans would be operated with a fixed Millerton Lake elevation of 550 feet. Boating and waterskiing activities 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 is estimated as proportionate to Millerton Lake average historical visitation, considering the 50 percent exceedence reservoir surface areas. As a much larger reservoir, Temperance Flat RM 274 Reservoir could support 96,400 new visitor-days. Potential Temperance Flat RM 274 Reservoir recreational visitation may be understated because only peak recreation season boating activity participation was estimated, no land-based activity or camping participation was estimated, and no off-season participation was considered. Table 4-9 summarizes the increase in recreational visitor-days for alternative plans, considering recreation at Millerton Lake and Temperance Flat RM 274 Reservoir. Estimates in annual increase in recreational visitor-days range from 113,600 to 130,400.

Table 4-9. Estimated Increase in Recreational Visitor-Days Compared to No-Action Alternative

Alternative Plans	1	2	3	4
Potential Annual Increase in Visitation at Millerton Lake [1] (visitor-days/year)	34,000	34,000	34,000	34,000
Potential Annual Visitation at Temperance Flat RM 274 Reservoir [1,2] (visitor-days/year)	82,200	83,000	79,600	96,400
Total Potential Annual Increase in Recreational Visitation (visitor-days/year)	**116,200**	**117,000**	**113,600**	**130,400**

Notes:
[1] Alternative plans are compared to No-Action Alternative.
[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 recreational and camping facilities would be developed and support these recreational activities.
[2] Annual benefits are considered a conservative estimate because only peak recreational season boating activities economic value was estimated. Land-based recreational and camping activities are also expected at the new Temperance Flat RM 274 Reservoir and this has not been analyzed.
Key:
RM = River Mile

Municipal and Industrial Water Quality

Delivery of San Joaquin River water from Temperance Flat RM 274 Reservoir to SWP M&I water users could improve total water quality of SWP M&I deliveries. Water quality improves by diluting TDS and other water quality constituents in California Aqueduct deliveries with high-quality water from Temperance Flat RM 274 Reservoir. Table 4-10 shows the simulated average annual TDS concentration at the Edmonston Pumping Plant, as well as the change in concentration compared to the No-Action Alternative. Alternative Plan 3 is the only alternative that would deliver water from Temperance Flat RM 274 Reservoir directly to SWP M&I contractors via the Friant-Kern Canal and cross-valley conveyance, providing a positive dilution effect near the Edmonston Pumping Plant. Other alternative plans would deliver SWP M&I supplies from Temperance Flat RM 274 Reservoir via the San Joaquin River and Mendota Pool exchanges, increasing SWP M&I supplies but without any dilution effects in California Aqueduct deliveries.

Table 4-10. Simulated California Aqueduct Average Annual Total Dissolved Solids Concentrations at Edmonston Pumping Plant

Alternative Plan	3
Annual Average California Aqueduct Water Quality at Edmonston Pumping Plant (mg/L TDS)	266.8
Change in California Aqueduct water quality at Edmonston Pumping Plant Compared to No-Action Alternative (mg/L TDS) [1]	-1.7

Note: [1] Alternative Plans are compared to No-Action Alternative. Alternative Plans 1, 2, and 4 were not evaluated for water quality improvements.

Key:
mg/L = milligrams per liter
TDS = total dissolved solids

Summary of Potential Accomplishments

Table 4-11 summarizes the physical accomplishments of alternative plans. Alternative Plan 3 would provide the greatest water supply improvement, both in dry and critical years, as well as over the long term. However, because of the proportion of supply to new beneficiaries, Alternative Plan 1 would provide the greatest long-term new water supply to SWP M&I, while Alternative Plan 3 would provide the greatest volume of new supply to agriculture. Alternative Plan 4 has the greatest potential to improve long-term average abundance of spring-run Chinook salmon, but Alternative Plan 1 has the greatest potential to improve abundance in dry and critical years.

The alternative plans would provide similar levels of emergency water supply and similar levels of increased hydropower energy generation at Friant Dam. Alternative Plan 4 could replace the most Kerckhoff Hydroelectric Project value (91 percent). Only Alternative Plan 3 would improve SWP M&I water quality, due to direct delivery of Temperance Flat RM 274 Reservoir water supply via the Friant-Kern Canal and cross-valley conveyance. Alternative Plan 4 has highest potential for increasing recreation, due to having higher carryover storage compared to other alternative plans. The alternative plans with lower carryover storage (Alternative Plans 1, 2, and 3) would have a greater increase in flood space, up to 361 TAF at 90 percent exceedence in Alternative Plan 1.

The alternatives description provided in this chapter will be further developed to meet NEPA/CEQA requirements for the Draft EIS/EIR. As required by NEPA/CEQA, further information for the project description will include:

- Purpose and need for action and project objectives
- Location of the alternative and project features
- Construction activities and schedule
- Operational changes from and modifications to existing facilities
- O&M of proposed facilities
- Features incorporated into the proposed action's design to avoid or reduce adverse environmental impacts (environmental commitments)

Table 4-11. Physical Accomplishments for Temperance Flat RM 274 Reservoir[1]

Alternative Plan	1	2	3	4
Physical Characteristics				
Temperance Flat RM 274 Reservoir Net Additional Storage Capacity (TAF) [2]	1,260	1,260	1,260	1,260
Total Carryover Storage Capacity (Millerton and Temperance Flat RM 274) (TAF)	540	540	540	665
Temperance Flat Carryover Storage Capacity (TAF)	200	200	200	325
Millerton Lake Carryover Storage Capacity (TAF)	340	340	340	340
Powerhouse Tailrace Elevation and Millerton Lake Carryover Storage Elevation (feet) [3]	550	550	550	550
Potential Physical Accomplishments [4]				
Dry and Critical Year Increase in Total Delivery (TAF)	19	24	30	21
Long-Term Average Annual Increase in Agricultural Delivery (TAF) [5]	30	49	52	41
Long-Term Average Annual Increase in M&I Delivery (TAF)	40	22	24	20
Long-Term Average Annual Increase in Total Delivery (TAF)	70	71	76	61
Long-Term Average Annual Spring-Run Chinook Abundance Increase–High SAR (percent) [6]	2.8%	2.8%	0.6%	4.9%
Dry and Critical Year Spring-Run Chinook Abundance Increase–High SAR (percent) [6]	15.9%	13.2%	14.6%	13.1%
Long-Term Average Annual Spring-Run Chinook Abundance Increase–Low SAR (percent)[6]	0.6%	-0.7%	-0.1%	2.8%
Dry and Critical Year Spring-Run Chinook Abundance Increase–Low SAR (percent) [6]	14.0%	9.2%	13.3%	11.1%
Emergency Water Supply Available during Delta Export Disruption (TAF) [7]	194	195	195	203
Change in M&I Water Quality at Edmonston Pumping Plant (mg/L TDS)	NE	NE	-1.7	NE
Net Increase in Friant Dam Hydropower Generation (GWh/year)	15.8	15.7	15.7	15.8
Replacement of Kerckhoff Hydroelectric Project Value (percent) [8]	81.1%	81.1%	81.1%	91.4%
Increase in Recreation (thousands of visitor-days) [9]	116.2	117.0	113.6	130.4
Increase in Incidental Flood Space (TAF) [10]	361	360	343	236

Notes:
[1] Operations based on Reclamation March 2012 CalSim II Benchmark with 2008/2009 BOs.
[2] Total storage of Temperance Flat RM 274 Reservoir would be 1331 TAF, with 75 TAF overlapping existing Millerton Lake.
[3] Elevation reported in NAVD 88.
[4] Accomplishments are reported as changes in comparison to No-Action Alternative.
[5] Simulated water demands in the Friant Division of the CVP are based on existing Class 1 and Class 2 contracts.
[6] Alternative plans are compared to the No-Action Alternative, which varies depending on the SAR.
[7] Emergency water supply represented by supply available for disruption due to 10-island levee breach.
[8] Impacts to Kerckhoff Hydroelectric Project will be mitigated. Costs include additional mitigation required after onsite replacement.
[9] Sum of potential annual visitor days at Millerton Lake and Temperance Flat RM 274 Reservoir.
[10] Incidental flood space is the flood space available during November through March at the 90 percent exceedance.

Key:
2008/2009 BOs = Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP (USFWS 2008a) and Biological Opinion and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009)
CVP = Central Valley Project
GWh/year = gigawatt hours per year
M&I = municipal and industrial
mg/L = milligrams per liter
NAVD = North American Vertical Datum
NE = not evaluated
SAR = smolt-to-adult return rate
RM = river mile
SWP = State Water Project
TAF = thousand acre feet
TDS = total dissolved solids

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Chapter 5
Plan Evaluation and Comparison

A critically important element of the plan formulation process is the evaluation and comparison of alternative plans. This chapter presents results of this evaluation and comparison of the No-Action Alternative and alternative plans described in Chapter 4. This chapter also (1) presents the rationale for selection of a recommended plan, which will be documented in the Final Feasibility Report; and (2) documents the consistency of the alternative plans with other major water management programs and regulations.

Alternative Plan Evaluation

Four accounts are established to display, and facilitate evaluation of, the effects of alternative plans as required by the P&G (WRC 1983): NED, environmental quality (EQ), regional economic development (RED), and other social effects (OSE). Effects of alternative plans are displayed as the difference in conditions, or differences in metrics under each account, compared to the No-Action Alternative. Economic benefits were quantified for NED and RED accounts. Additional economic benefits of alternative plans that were not quantified are discussed under the EQ, OSE, and other unquantified benefits sections below.

National Economic Development

The objective of NED analysis is to determine the change in net value of the Nation's output of goods and services that would result from implementing each alternative plan. Beneficial and adverse effects are evaluated in monetary terms, and measured in terms of changes in national income among the No-Action and various action alternatives. Beneficial effects in the NED account are (1) increases in the economic value of the national output of goods and services from an alternative plan, (2) the value of output resulting from external economies caused by an alternative plan, and (3) the value associated with the use of otherwise unemployed or underemployed labor resources for the purposes of an alternative plan. Adverse effects in the NED account are the opportunity costs of resources used in implementing an alternative plan. These adverse effects include (1) implementation outlays, (2) associated costs, and (3) other direct costs. Specific guidelines, standards, and procedures used in NED analysis are contained in the P&G (WRC 1983).

The NED account typically includes net benefits to the following categories: agricultural water supply, M&I water supply, flood damage reduction, power (hydropower), transportation (inland navigation and ocean-going vessel navigation), recreation, commercial fishing, unemployed or underemployed labor resources, and other direct benefits.

For this analysis, the NED account includes agricultural water supply reliability, M&I water supply reliability, hydropower, flood damage reduction, and recreation, as well as the other direct benefits categories for anadromous fish survival, M&I water quality improvements, and emergency water supply.

Environmental benefits, including fisheries and ecosystem resources, are typically included in the EQ account if monetary units cannot be attributed to these benefits. However, for this analysis, ecosystem enhancement benefits for anadromous fish habitat improvements were developed as monetary units, and are included in the NED account. The contribution of the various alternatives to ecosystem enhancement can be included in the NED account under the “other direct benefits” category.

Monetized NED Benefits

Estimating the economic benefits of potential effects is critical to establishing economic feasibility and identifying a corresponding alternative plan that maximizes net benefits, consistent with Federal objectives (also called the NED plan). This section identifies valuation methods and valuation estimates for the benefit categories associated with the primary and secondary planning objectives. Additional detail for each of the benefit categories evaluated is included in the Economics Analysis Appendix.

Water Supply Reliability

The CalSim II model was used to estimate potential increases in water supply reliability to the CVP and SWP for the alternative plans. Table 5-1 shows change in water supply in long-term average and dry year average conditions for the alternative plans.

Agricultural Water Supply

Potential increases in agricultural water supply reliability provided by alternative plans are primarily achieved through storing additional San Joaquin River water during wet periods when excess flows would otherwise become controlled or uncontrolled as flood releases or Section 215 supplies (short-term contracts). Agricultural water supply reliability benefits were estimated through applying the "change in net income," method as estimated by the SWAP model, discussed in further detail in the Economic Analysis Appendix. SWAP is run for each alternative plan for wet, normal, and dry conditions. NED benefits are estimated according to the weighted average benefits across the three year types. As can be seen in Table 5-1, average annual agricultural water supply reliability benefits could range from about $18.6 million per year for Alternative Plan 1 to $20.8 million for Alternative Plans 2 and 3.

Table 5-1. Increases in Agricultural and M&I Water Supply Deliveries and Estimated Benefits for Alternative Plans[1]

Alternative Plan	1	2[2]	3	4
CVP/SWP Agricultural Water Supply Reliability				
Average – Dry/Critical Years (TAF/year)[3]	7	10	22	10
Average – All Years (TAF/year)	30	49	52	41
Average Annual Benefit ($ millions)	**$18.6**	**$20.8**	**$20.8**	**$18.9**
CVP/SWP M&I Water Supply Reliability				
Average – Dry/Critical Years (TAF/year)[3]	12	12	6	12
Average – All Years (TAF/year)	40	22	24	20
Average Annual Benefit ($ millions)	**$43.2**	**$24.0**	**$25.7**	**$22.3**
Total Water Supply Reliability[3]				
Average – Dry/Critical Years[3] (TAF/year)	19	24	30	21
Average – All Years (TAF/year)	70	71	76	61
Total Average Annual Benefit ($ millions)[4 5]	**$61.8**	**$44.8**	**$46.5**	**$41.2**

Notes:
[1] Dollar values are expressed in January 2013 price levels.
[2] Agricultural benefits were not modeled in SWAP for Alternative Plan 2, and are based on Alternative Plan 3 values due to the similar average annual deliveries.
[3] Year-types as defined in the San Joaquin Valley Water Year Hydrologic Classification Index.
[4] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[5] Total water supply reliability line items may not sum to totals.

Key:
CVP = Central Valley Project
M&I = municipal and industrial
SWP = State Water Project
TAF = thousand acre-feet

Municipal and Industrial Water Supply

The alternative plans increase water supplies to M&I water users in all water year types. Estimates for dry year and long-term average increases in deliveries to SWP SOD M&I water users are shown in Table 5-1. M&I water users have increasingly participated in the water transfer market to augment supplies. M&I water supply reliability benefits were estimated based on the weighted average benefits across all water year types. The analysis relies on values estimated through application of a water transfer pricing model, and through consideration of the costs associated with conveying the water to the M&I service areas. This method is consistent with the "cost of the most likely alternative" method recommended by the P&G. Average annual M&I water supply reliability benefits could range from about $22.3 million per year for Alternative Plan 4 to $43.2 million for Alternative Plan 1.

Emergency Water Supply

Jones Tract Levee Failure, 2004
Source: California Department of Water Resources

An analysis was performed considering the value of potential emergency water supplies provided by alternative plans and available to SOD residential water users during a Delta water supply outage due to a seismic or other catastrophic event. Potential supply disruptions to SOD water users depend upon a variety of factors, including the risk of a seismic or other catastrophic event, vulnerability of non-Delta water supplies, and the timing and duration of the supply disruption. Supply disruptions in an emergency that occur during prolonged periods of drought are likely to result in significantly higher economic costs than those that coincide with wetter conditions. In addition, supply disruptions that are shorter in duration will, in general, result in lower economic costs to residential water users.

Information regarding the risk of Delta levee failures, potential levee failure scenarios, and associated projected SOD shortages was based on information developed for the DRMS (DWR, USACE, and DFG 2007). This analysis is limited to disruptions as characterized by 1, 3, 10, 20, and 30 Delta island inundation scenarios. Economic benefits from emergency water supplies are measured according to residential users' Water Transfer Program to avoid interruptions in water deliveries. Estimated benefits were weighted according to the probability of Delta water supply disruptions due to each Delta island inundation scenario that was considered. Estimated emergency water supply benefits are presented in Table 5-2.

Table 5-2. Summary of Estimated Emergency Water Supply Benefits of Alternative Plans

Probability of Occurrence[1]	Delta Island Breach Scenario	Alternative Plan			
		1	2	3	4
		Temperance Flat RM 274 Emergency Water Supply (TAF)			
0.107	1-island	28	28	28	28
0.082	3-island	47	47	47	47
0.051	10-island	194	195	195	203
0.032	20-island	368	369	365	361
0.019	30-island	442	443	437	534
Benefit ($ millions)[2]		**$25.9**	**$26.0**	**$25.8**	**$27.1**

Notes:
[1] Probabilities of occurrence were developed by the Delta Risk Management Strategy (DWR, USACE, and DFG 2007).
[2] Dollar values are expressed in January 2013 price levels.
Key:
RM = River Mile
TAF = thousand acre feet

Ecosystem Enhancement Benefits

The Temperance Flat RM 274 Reservoir alternative plans provide opportunities for water temperature management and flow flexibility that could enhance San Joaquin River restoration efforts through additional cold-water storage, various operations strategies, and a potential SLIS. Increasing reservoir storage capacity and managing cold-water releases, including the use of an SLIS, would help to preserve a cold-water pool and allow the release of colder water during late summer and fall months that could improve ecosystem habitat conditions, especially for Chinook salmon. Routing water deliveries from Temperance Flat RM 274 Reservoir via the San Joaquin River to Mendota Pool to benefit wildlife refuges, CVP SOD contractors, or SWP M&I contractors also provides increased flow in Reach 1 of the San Joaquin River, which also provides ecosystem benefits. The level of improvement for salmon is determined through the use of the EDT biological habitat model (the EDT model is described in the Modeling Appendix). The economic benefits from habitat improvement related to temperature and flow are estimated based on the application of benefit transfer methods from applicable studies that addressed habitat improvements, combined with efforts to isolate the contribution of the alternative plans to increasing the probability of success of the anadromous fish restoration efforts.

The EDT model was used to simulate the increase in abundance of spring-run Chinook salmon that could be

Chinook salmon

achieved through temperature and flow improvements in the alternative plans. Abundance represents the number of spawning fish that the habitat improvements could sustain. Due to uncertainty and limited data regarding the survival of salmon as they migrate below the Merced River to the ocean and then return to spawn, results were developed to demonstrate a range of potential results for a low and high potential SAR. Limited data exists on SAR for San Joaquin Chinook and no data exist that could be directly related to a potential spring-run Chinook population in the San Joaquin River. SAR is known to vary widely between years largely controlled by ocean conditions or variation in other environmental conditions. These conditions make the SAR especially uncertain. Without fish in the river presently (although they are included in the forecasted future without-project conditions) an accurate SAR cannot be estimated and used in the model. Consequently, the SAR for the Investigation has been based on expert advice from the SJRRP Fisheries Management Work Group and consistency with observed rates for other anadromous fish in the Sacramento-San Joaquin River system (Barnett-Johnson, et al. 2008, Buchanan, et al. 2013). Results are presented for two SAR levels to demonstrate a range of potential benefits for a low and high survival rate. EDT modeling is further described in the Modeling Appendix Attachment A.

Ecosystem benefits are calculated as a willingness-to-pay of households to reduce the risk of extinction of San Joaquin River Chinook salmon assumed to be present in the No-Action Alternative. The calculation of ecosystem benefits is made for three geographic zones. Table 5-3 presents results for the alternative plans by geographic zone. The ecosystem benefit geographic zone (region of analysis) indicates the population that would be affected or place value on the resource. The results indicate that each alternative plan provides positive ecosystem benefits. Benefits in Zone 1 (the six-county area surrounding and adjacent to the upper San Joaquin River) range from $2.2 million to $4.9 million per year. California level ecosystem benefits (sum of Zones 1 and 2) range from $34.1 million to $75.6 million per year. United States level ecosystem benefits (sum of Zones 1, 2, and 3) range from $224.2 million to $496.9 million per year. Benefits for each subsequent larger zone include the benefits from the previous smaller zone. The benefits consider the capacity for an alternative plan to improve habitat conditions for salmon over a long-term average condition as well as the capacity to decrease the risk of extinction in dry year conditions when the species is most vulnerable.

There is considerable difficulty in valuing ecosystem enhancements due to lack of markets and associated information to provide guidance of value. The flow and temperature modifications resulting from the alternative plans may improve biological conditions and lead to increased survival of salmon populations, and an economic benefit, at least in theory, can be attributed to the alternative plans, associated operations, and cold-water volume. A large confidence interval and lack of precision exists around the ecosystem benefit results and values presented should not be interpreted as precise point estimates. Although there is uncertainty about the total value of ecosystem benefits at different regional levels, the results are reasonable and representative of other studies and literature.

Table 5-3. Average Annual Valuation of Willingness-to-Pay for Salmon Habitat Improvements for Alternative Plans [1, 2]

Alternative Plan	1		2		3		4	
Smolt-to-Adult Ratio	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Improvement in Abundance								
Percent Improvement in Long-Term Annual Average Abundance [3, 4]	0.6%	2.8%	0.4%	2.8%	-0.7%	0.6%	2.8%	4.9%
Percent Improvement in Dry Year Abundance [3, 4]	14.0%	15.9%	9.2%	13.2%	13.3%	14.6%	11.1%	13.1%
Ecosystem Benefits								
6-County Level ($ millions)	$3.9	$2.2	$2.5	$2.2	$2.7	$0.5	$4.9	$3.9
CA Level ($ millions)	$59.6	$34.1	$38.8	$33.9	$40.9	$7.6	$75.6	$59.5
U.S. Level ($ millions)	$391.7	$224.2	$255.2	$222.9	$269.2	$49.7	$496.9	$391.3

Notes:
1 January 2013 price levels.
2 All numbers are rounded for display purposes; therefore, line items may not sum to totals.
3 Alternative plans are compared to No-Action Alternative.
4 Further detail for EDT modeling is presented in the Modeling Appendix Attachment A.
Key:
CA = California

M&I Water Quality

Temperance Flat RM 274 Reservoir alternative plans that route new water supplies to M&I users through the Friant-Kern Canal and cross-valley conveyance (Alternative Plan 3) could improve water quality in the California Aqueduct. The estimate of benefits due to improved M&I water quality reflects the cost savings related to reduction of TDS and other constituents at the receiving water treatment plant. Water quality benefits for Alternative Plan 3 are $2 million annually.

Hydropower

Developing Temperance Flat RM 274 Reservoir would result in the ability to increase hydropower energy generation at Friant Dam generating facilities as well as generate additional hydropower at the Temperance Flat RM 274 Reservoir outlet to mitigate for impacts to the Kerckhoff Hydroelectric Project powerhouses within the inundation area of Temperance Flat RM 274 Reservoir. As can be seen in Table 5-4, construction and operation of Temperance Flat RM 274 Reservoir could result in increased power generation of about 15.7 GWh per year at Friant Dam. Table 5-4, estimated average annual Friant Dam hydropower energy generation benefits of the four plans are $1.6 million. These benefits do not include the energy generation and ancillary services at Temperance Flat RM 274 Reservoir for mitigation of the Kerckhoff Power Project impacts.

Table 5-4. Summary of Friant Dam Hydropower Accomplishment Values for Alternative Plans

Alternative Plan	1	2	3	4
Friant Dam Hydropower Energy Generation				
Change in Hydropower Energy Generation at Friant Dam (Gigawatt-hour/year)	15.8	15.6	15.7	15.7
Average Annual Benefit ($ millions) [1]	**$1.6**	**$1.6**	**$1.6**	**$1.6**

Notes:
[1] Dollar values are expressed in January 2013 price levels.

Recreation

Construction and operation of Temperance Flat RM 274 Reservoir would affect recreation participation by stabilizing the elevation of Millerton Lake water surface throughout the year and specifically during the peak recreational season (April through September). Additionally, creation of a new Temperance Flat RM 274 Reservoir would provide additional water surface acres available for recreational activities in the region. The estimated increase in national recreational value is based on recreational visitor-day values displayed in Table 5-5 below. Table 5-6 compares user days (visitor-days) and estimated recreation values for the No-Action Alternative and each alternative plan. The estimated benefit to recreation ranges from about $6.4 million to $7.4 million per year.

Table 5-5. Recreational Activity Estimated Values per Visitor-Day

Recreational Activity	Value (2013$)
Camping	$45.34
Fishing	$57.49
Hiking	$37.60
Motorboating	$56.41
Picnicking	$50.54
Swimming	$52.03
Waterskiing	$59.76

Source: Loomis 2005

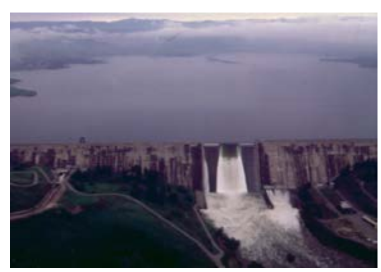
Table 5-6. Average Annual Predicted Visitor-Days and Recreational Values

Alternative Plan	1	2	3	4
Recreation				
Annual Increase in Millerton Lake Visitor Days (1,000) [1]	34.0	34.0	34.0	34.0
Average Annual Benefit ($ millions) [2]	**$1.8**	**$1.8**	**$1.8**	**$1.8**
Annual Increase in Temperance Flat Reservoir Visitor Days (1,000) [1]	82.2	83.0	79.6	96.4
Average Annual Benefit ($ millions) [2]	**$4.8**	**$4.8**	**$4.6**	**$5.6**
Annual Increase in Total Visitor Days (1,000) [1]	116.2	117.0	113.6	130.4
Total Average Annual Benefit ($ millions) [2]	**$6.6**	**$6.6**	**$6.4**	**$7.4**

Notes:
[1] Annual increase in visitation represents increases in recreational participation within the Millerton Lake State Recreation Area below River Mile 274 of the San Joaquin River.
[2] Dollar values are expressed in January 2013 price levels.

Flood Damage Reduction

Increasing the overall storage capacity in the upper San Joaquin River Basin consequently increases the likelihood that there would be storage available for use in flood management over and above the dedicated flood storage space in Millerton Lake. This available storage is called incidental flood storage because the amount of storage is not available in a given month every year, unlike dedicated flood storage, which is governed by the reservoir operations rule curve and is available each year for flood management. The existing flood control space for Friant Dam is assumed to be shared between Millerton Lake and Temperance Flat Reservoir in the alternative plans. The flood damage reduction benefits are not based on dedicating additional space in the alternative plans, but on the available incidental storage. Previous flood damage reduction evaluations completed in the IAIR demonstrated that potential flood damage reduction benefits resulting from incidental availability of flood storage space would be similar to those that would result from the dedication of additional flood storage space.



Friant Dam flood releases, January 1997

The annual flood damage reduction for the incidental flood space was estimated using results from the USACE Hydraulic Engineering Center Flood Damage Assessment model (HEC-FDA) estimated annual damage (EAD) values developed for the San Joaquin River, as documented in the Flood Damage Reduction Appendix to the IAIR (Reclamation 2005b) and indexed to January 2013 price levels.

The increase in incidental flood space is the increase in 90 percent exceedence storage above the No-Action Alternative that occurs during the November to January flood season. The EAD for each alternative plan is determined by interpolating between values for given flood storage volumes from the HEC-FDA modeling. Table 5-7 presents the results of the calculations to determine the 90 percent exceedence incidental flood damage reduction for each of the alternative plans evaluated.

Table 5-7. Summary of Estimated Flood Damage Reduction Benefits of Alternative Plans

Alternative Plan	1	2	3	4
Flood Damage Reduction				
Increase in 90% exceedence flood space (TAF) [1]	361	360	343	236
Average Annual Benefit ($ millions) [2]	**$5.0**	**$5.0**	**$4.9**	**$4.0**

Notes:
[1] November – January minimum 90% exceedence storage less 170 TAF for Millerton Lake and Mammoth Pool flood storage. The existing flood control space for Friant Dam is assumed to be shared between Millerton Lake and Temperance Flat Reservoir in the alternative plans.
[2] Dollar values are expressed in January 2013 price levels. The flood damage reduction benefits are not based on dedicating additional space in the alternative plans, but on the available incidental storage.

NED Cost Summary

Table 5-8 summarizes estimated NED construction, investment, and annual costs for each of the alternative plans. Total investment cost is the sum of total construction costs and IDC cost. Construction cost is the sum of the feature field costs plus non-contract costs. Field costs are an estimate of capital costs for a feature or project from award to construction closeout. Non-contract costs are costs of work or service provided in support of the feature construction, and other work that can be attributed to the feature as a whole; and are also known as distributed costs. The IDC cost is based on the construction period for all plans of approximately 8 years, and the Federal discount rate of 3.75 percent. Total investment cost is annualized over the project's assumed 100-year lifespan at the Federal interest rate of 3.75 percent to compute interest and amortization. Total annual cost is the sum of interest and amortization, estimated annual O&M costs, and additional hydropower mitigation and CVP/SWP pumping costs.

Key differences in costs for alternative plans are attributed to variations in the intake structure and additional hydropower mitigation. Additional detail on the development of investment and annual costs can be found in the Engineering Summary Appendix. The cost estimates have been developed primarily to a feasibility level and the alternatives are projected to be technically feasible, constructible, and can be operated and maintained.

Cost Estimate Terminology:

Construction Cost is the sum of the feature field costs plus non-contract costs.

Investment Cost is the sum of the construction costs and interest during construction.

Annual Cost is the sum of interest and amortization of the investment cost, and other annual costs, such as O&M.

Table 5-8. Estimated NED Investment and Annual Costs of Alternative Plans ($ million)

Alternative Plan	1	2	3	4
Construction Cost				
Field Costs	$1,710	$1,710	$1,710	$1,779
Non-Contract Costs	$430	$430	$430	$437
Total Construction Cost[1]	$2,140	$2,140	$2,140	$2,216
Investment Cost				
Interest During Construction	$349	$349	$349	$361
Total Investment Cost[1]	$2,488	$2,488	$2,488	$2,578
Annual Cost				
Interest and Amortization[2]	$95.7	$95.7	$95.7	$99.2
Operations and Maintenance	$8.4	$8.4	$8.4	$8.4
Additional Hydropower Mitigation[3]	$9.1	$9.1	$9.1	$4.2
CVP/SWP Additional Pumping[4]	$7.6	$4.1	$4.3	$4.1
Total Annual Cost[1]	**$120.8**	**$117.3**	**$117.5**	**$115.9**

Notes:
Costs are reported in January 2013 price levels.
[1] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[2] 100-year period of analysis, and 3.75 percent interest rate (federal discount rate).
[3] Additional hydropower mitigation is the estimated value of the impacted Kerckhoff Hydroelectric Project energy and ancillary services minus the Temperance Flat Reservoir powerhouse energy and ancillary services value.
[4] The additional CVP/CWP pumping costs do not include water conveyance costs beyond the net power requirement for delivering the new water supply, and additional costs may be incurred to achieve the intended benefits
Key:
CVP = Central Valley Project
NED = National economic development
SWP = State Water Project

Net National Economic Development Benefits

Net NED benefits are calculated by subtracting NED costs from NED benefits. The alternative plan that generates the greatest net NED benefits is Alternative Plan 4 (Table 5-9) with California- and U.S.-level ecosystem benefits.

Though U.S.-level ecosystem benefits may be more appropriate for the NED account, ecosystem benefits are presented for three geographic zones that could be affected by alternative plans and illustrate the range of potential ecosystem benefits. California-level ecosystem benefits represent the middle of the range of estimated ecosystem benefits and, given potential State bond funding and uncertainty in estimating ecosystem benefits, may be most appropriate for discussion and funding purposes.

Alternative Plan 4 would generate net benefits ranging from $24.9 to $41.0 million annually, with California-level ecosystem benefits valuation. Additional benefits of the alternative plans, that have not been monetized, are discussed in the EQ, OSE, and other unquantified benefits sections below. The alternative plans are projected to be economically feasible, since they would provide net benefits in excess of their costs, as summarized in Table 5-9.

Table 5-9. Summary of Estimated NED Annual Costs, Annual Benefits, and Net Benefits for Alternative Plans[1]

Alternative Plan	1		2		3		4	
Potential Annual Benefits[1] ($ million)								
Agricultural Water Supply Reliability	$18.6		$20.8		$20.8		$18.9	
M&I Water Supply Reliability	$43.2		$24.0		$25.7		$22.3	
Emergency Water Supply	$25.9		$26.0		$25.8		$27.1	
M&I Water Quality	$0.0		$0.0		$2.0		$0.0	
Net Hydropower Energy Generation at Friant Dam	$1.6		$1.6		$1.6		$1.6	
Recreation	$6.6		$6.6		$6.4		$7.4	
Flood Damage Reduction	$5.0		$5.0		$4.9		$4.0	
Total Potential Annual Monetary Benefits ($ million) (Without ecosystem benefits)	**$100.9**		**$84.0**		**$87.2**		**$81.3**	
With Ecosystem Benefits[2]	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**
Ecosystem (Six-County[3] Level)	$3.9	$2.2	$2.5	$2.2	$2.7	$0.5	$4.9	$3.9
Total Potential Annual Monetary Benefits ($ million) (Six-County[3] ecosystem benefits)	**$104.8**	**$103.1**	**$86.5**	**$86.2**	**$89.9**	**$87.7**	**$86.2**	**$85.2**
Ecosystem (CA Level)	$59.6	$34.1	$38.8	$33.9	$40.9	$7.6	$75.6	$59.5
Total Potential Annual Monetary Benefits ($ million) (CA-level ecosystem benefits)	**$160.5**	**$135.0**	**$122.8**	**$117.9**	**$128.1**	**$94.8**	**$156.9**	**$140.8**
Ecosystem (U.S. Level)	$391.7	$224.2	$255.2	$222.9	$269.2	$49.7	$496.9	$391.3
Total Potential Annual Monetary Benefits ($ million) (U.S.-level ecosystem benefits)	**$492.6**	**$325.1**	**$339.2**	**$306.9**	**$356.4**	**$136.9**	**$578.2**	**$472.6**
Total Estimated Investment Cost ($ million)	$2,488		$2,488		$2,488		$2,578	
Interest and Ammortization[4] ($ million)	$95.7		$95.7		$95.7		$99.2	
Operations and Maintenance ($ million)	$8.4		$8.4		$8.4		$8.4	
Additional Hydropower Mitigation[5] and CVP/SWP Pumping Costs ($ million)[6]	$16.7		$13.2		$13.4		$8.3	
Total Annual Cost ($ million)	**$120.8**		**$117.3**		**$117.5**		**$115.9**	

Table 5-9. Summary of NED Estimated Annual Costs, Annual Benefits, and Net Benefits for Alternative Plans[1] (contd.)

Alternative Plan	1		2		3		4	
Potential Net Benefits ($million) (Without ecosystem benefits)	-$19.9		-$33.3		-$30.3		-$34.6	
Preliminary Benefit-Cost Ratio (Without ecosystem benefits)	0.83		0.72		0.74		0.70	
***With Ecosystem Benefits*[2]**	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**	**Low SAR**	**High SAR**
Potential Net Benefits ($ million) (Six-County[3] ecosystem benefits)	-$16.0	-$17.7	-$30.8	-$31.1	-$27.6	-$29.8	-$29.7	-$30.7
Preliminary Benefit-Cost Ratio (Six-County[3] ecosystem benefits)	**0.87**	**0.85**	**0.74**	**0.73**	**0.77**	**0.75**	**0.74**	**0.74**
Potential Net Benefits ($ million) (CA-level ecosystem benefits)	$39.7	$14.2	$5.5	$0.6	$10.6	-$22.7	$41.0	$24.9
Preliminary Benefit-Cost Ratio (CA-level ecosystem benefits)	**1.33**	**1.12**	**1.05**	**1.01**	**1.09**	**0.81**	**1.35**	**1.21**
Potential Net Benefits ($ million) (U.S.-level ecosystem benefits)	$371.8	$204.3	$221.9	$189.6	$238.9	$19.4	$462.3	$356.7
Preliminary Benefit-Cost Ratio (U.S.-level ecosystem benefits)	**4.08**	**2.69**	**2.89**	**2.62**	**3.03**	**1.17**	**4.99**	**4.08**

Notes: All benefits and costs are reported in January 2013 dollars. All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[1] All benefits are reported as changes compared to the respective future No-Action Alternative conditions.
[2] The monetary valuation of ecosystem benefits is uncertain, so ranges are presented to capture varying anadromous fish return rates and geographic extent of the ecosystem benefits.
[3] Six-county region encompassing the San Joaquin River and adjacent areas includes Fresno, Kern, Kings, Madera, Merced, and Tulare counties.
[4] 100-year period of analysis, and 3.75 percent interest rate (Federal discount rate).
[5] Additional hydropower mitigation is the estimated value of the impacted Kerckhoff Hydroelectric Project energy and ancillary services minus the Temperance Flat Reservoir powerhouse energy and ancillary services value.
[6] The additional CVP/CWP pumping costs do not include water conveyance costs beyond the net power requirement for delivering the new water supply, and additional costs may be incurred to achieve the intended benefits.
Key:
$ million = million dollars
CA = California
CVP = Central Valley Project
M&I = municipal and industrial
NED = national economic development
SAR = Smolt-to-Adult-Return Rate
SWP = State Water Project

Environmental Quality

The EQ account is used to identify and display the significant non-monetary beneficial and adverse effects each alternative plan has on significant EQ resources when compared to the No-Action Alternative. These include ecological, cultural, and aesthetic properties of natural and cultural resources that sustain and enrich human life. Table 5-10 provides a summary of the effects of alternative plans on EQ resources that occur in the primary and extended study areas. For each EQ resource, one or more indicators were selected to directly or indirectly measure or otherwise describe changes that would be expected to occur with implementation of each alternative plan. A detailed assessment of the potential effects of each alternative plan on the selected resource indicators will be presented in the EIS/EIR and its accompanying appendices and referenced studies.

Millerton Lake/San Joaquin River near Big Bend

All alternative plans are similar in the types of potential environmental effects, although the level of some effects would vary in the primary study area and across different portions of the extended study area depending on water operations for alternative plans. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures (PRC Section 21002). Some adverse effects for action alternative plans would remain unavoidable despite practicable measures identified to mitigate effects. The EIS/EIR will contain more detailed information and a display of unavoidable impacts, if any are identified. Based on environmental resources studies to date, ecosystem enhancement accomplishments, and information presented in Table 5-10, it is anticipated that the alternative plans would be environmentally feasible.

Table 5-10. Summary of Potential Environmental Effects of Alternative Plans in Environmental Quality Account

Resource Area / Alternative Plan	Primary Study Area	Extended Study Area				Key Considerations
	Temperance Flat RM 274 Reservoir and Vicinity	San Joaquin River, Friant Dam to Merced River	San Joaquin River, Merced River to Delta	Delta	CVP/SWP Facilities and Water Service Areas	
Air Quality	🟧	🟩	🟩	🟩	🟩	Short-term unavoidable adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Long-term beneficial effects for all action alternatives could be realized through reduction in groundwater pumping within CVP service areas, leading to a reduction in emissions from diesel pump use were not quantified.
Biological Resources – Fisheries and Aquatic Ecosystems	🟧	🟪🟦	🟩	🟩	🟩	Adverse effects to riverine habitat within primary study area similar across all action alternatives and unavoidable due to conversion of riverine habitat to lacustrine habitat within San Joaquin River portion of primary study area. Long-term beneficial effects on anadromous fisheries associated with improved water temperature conditions and changes to flow conditions included in NED account for all action alternatives, and greatest for Alternative 4. Long-term beneficial effects on cold-water fisheries habitat in San Joaquin River between Friant Dam and Mendota Pool for all action alternatives were not quantified, but greatest for Alternative 4.
Biological Resources – Botanical and Wetlands	🟧	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction and long-term unavoidable adverse effects due to inundation of habitat in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.
Biological Resources – Wildlife	🟧	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction and long-term unavoidable adverse effects due to inundation of habitat in Primary Study Area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Potential long-term benefits related to improving delivered water quality to CVP refuges were not quantified, but Alternative 2 is likely to have the greatest benefits.
Climate Change and Greenhouse Gas Emissions	🟧	🟩	🟩	🟩	🟩	Short-term unavoidable adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Long-term beneficial effects, similar for all action alternatives, could be realized through reduction in groundwater pumping, leading to a reduction in diesel pump emissions.
Cultural Resources	🟧	🟩	🟩	🟩	🟩	Potential adverse and unavoidable effects due to construction and inundation of lands in primary study area similar across all action alternatives; adverse effects likely reduced through mitigation.
Environmental Justice	🟩	🟩	🟩	🟩	🟩	No disproportionately high and adverse effects to minority and low-income populations anticipated for all action alternatives.
Geology and Soils	🟩	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.
Hydrology – Flood Management	🟩	🟪🟦	🟩🟩	🟩	🟩	Beneficial impacts on San Joaquin River realized as a result of decreased flood risk with improved management of flood flows included in NED account for all action alternatives, and greatest for Alternative 1 and Alternative 2. Protection of in-stream channel improvements associated with the SJRRP from flood damages was not quantified.

Table 5-10. Summary of Potential Environmental Effects of Alternative Plans in Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area	Extended Study Area				Key Considerations
	Temperance Flat RM 274 Reservoir and Vicinity	San Joaquin River, Friant Dam to Merced River	San Joaquin River, Merced River to Delta	Delta	CVP/SWP Facilities and Water Service Areas	
Hydrology – Groundwater						Beneficial effects to groundwater levels in CVP/SWP water service areas due to increased surface water availability resulting in less groundwater pumping and potential increase in groundwater recharge are anticipated to be similar across all action alternatives; reduced groundwater pumping included in NED account.
Hydrology – Surface Water Supplies and Facilities Operations						Long-term beneficial effects related to water supply reliability included in NED account for all action alternatives, and greatest for Alternative 4; financial debt service benefits from more reliable water supply were not quantified.
Hydrology – Surface Water Quality						Short-term adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Long-term beneficial effects on water temperature conditions in San Joaquin River included in NED account for all action alternatives, and greatest for Alternative 4. Long-term beneficial effects on delivered M&I water quality in CVP and SWP water service areas included in NED account for Alternative 3; alternatives 1, 2 and 4 are not anticipated to have M&I water quality benefits. Potential long-term benefits related to meeting San Joaquin River salinity objectives at Vernalis (reduction in Reclamation actions to meet TMDL requirements) were not quantified, but Alternative 2 is likely to have the greatest benefits. Potential long-term water quality improvements for agricultural use and associated improvements in sustainability and agricultural productivity were not quantified, but are anticipated to be similar across all action alternatives.
Indian Trust Assets						Potential adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.
Land Use Planning and Agricultural Resources						Long-term unavoidable adverse effects to land use in primary study area anticipated to be similar across all action alternatives; adverse effects reduced through mitigation. Long-term beneficial effects on agricultural resources related to agricultural water supply reliability included in NED account for all action alternatives, and greatest for Alternatives 2 and 3. Potential long-term water quality improvements for agricultural use and associated improvements in sustainability and agricultural productivity were not quantified, but are anticipated greatest for CVP Friant Division under Alternative 1, and greatest for CVP South-of-Delta for Alternatives 3 and 4.
Noise and Vibration						Short-term unavoidable adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.
Paleontological Resources						There are no previously recorded fossil localities within or adjacent to the primary study area.

Table 5-10. Summary of Potential Environmental Effects of Alternative Plans in Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area	Extended Study Area				Key Considerations
	Temperance Flat RM 274 Reservoir and Vicinity	San Joaquin River, Friant Dam to Merced River	San Joaquin River, Merced River to Delta	Delta	CVP/SWP Facilities and Water Service Areas	
Power and Energy	🟩	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area anticipated to be similar across all action alternatives. Long-term adverse effects related to pumping operations and power demands of water conveyance facilities are anticipated for all action alternatives, and greatest for Alternative 1. Long-term adverse effects related to decommissioning of power generation infrastructure anticipated to be similar across all action alternatives. Adverse effects likely reduced through replacement power generation infrastructure and mitigation.
Public Health and Hazardous Materials	🟩	🟩	🟩	🟩	🟩	Potential short-term adverse effects due to construction in primary study area and decommissioning of power infrastructure anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Potential long-term benefits associated with dam safety were not quantified, but anticipated to be similar across all action alternatives.
Recreation	🟪🟦	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area; long-term beneficial effects on recreation in the primary study area included in NED account for all action alternatives, and greatest for Alternative 4. Potential long-term recreation benefits related to increased flow in San Joaquin River were not quantified, but Alternative 2 is likely to have the greatest benefits.
Socioeconomics, Population, and Housing	🟩	🟩	🟩	🟩	🟪🟦	Short-term beneficial effects associated with increased employment during project construction are included in RED Account for all action alternatives, and greatest for Alternative 4. Long-term beneficial effects associated with increased employment through improved water supply reliability are included in RED account for all action alternatives, and greatest for Alternative 1. Long-term beneficial effects associated with increased employment through improved recreation visitation in the study area are included in RED account for all action alternatives, and greatest for Alternative 4. Long-term beneficial effects associated with increased employment from O&M of project features are anticipated to be similar across all action alternatives and included in RED account.
Transportation, Circulation and Infrastructure	🟩	🟩	🟩	🟩	🟪	Short-term unavoidable adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.
Utilities and Service Systems	🟩	🟩	🟩	🟩	🟪	Short-term adverse effects due to construction in primary study area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation. Long-term beneficial effects due to replacing and modernizing utilities were not quantified, but anticipated to be similar across all action alternatives.

Table 5-10. Summary of Potential Environmental Effects of Alternative Plans in Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area	Extended Study Area				Key Considerations
	Temperance Flat RM 274 Reservoir and Vicinity	San Joaquin River, Friant Dam to Merced River	San Joaquin River, Merced River to Delta	Delta	CVP/SWP Facilities and Water Service Areas	
Visual Resources	Orange	Green	Green	Green	Green	Long-term unavoidable adverse effects to aesthetics in reservoir area anticipated to be similar across all action alternatives; adverse effects likely reduced through mitigation.

Key:
Green: No effect, minimal effect, not disproportionately high and adverse (environmental justice), and/or minimal effect after mitigation.
Orange: Unavoidable and/or disproportionately high and adverse (environmental justice).
Purple: Beneficial effect.
Blue: Beneficial effects associated with anadromous fish survival, water supply reliability, flood damage reduction, hydropower, and recreation accounted for in NED. Beneficial effects to regional economics (including jobs and income) included in RED accounts.
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
M&I = municipal and industrial
NED = National Economic Development
O&M = operations and maintenance
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RED = Regional Economic Development
SJRRP = San Joaquin River Restoration Program
SWP = State Water Project

Regional Economic Development

The RED account displays changes in the distribution of regional economic activity that result from each alternative plan considered in a feasibility study. According to the P&G, two measures of regional effects are considered: regional income and regional employment. A region is generally defined as an area that encounters “significant” income and employment effects. Income and employment effects are further divided into “positive” and “negative” effects. Each of the four categories (positive income, positive employment, negative income, and negative employment) is equal to the sum of the NED effects that accrue in a region, plus transfers between the region and outside the region (i.e., positive income effects equal the NED benefits in the region plus the transfers of income to the region from outside the region). Transfers can come from implementation outlays, transfers of basic economic activity, indirect effects, and induced effects. The positive (and negative) effects on regional employment are directly parallel to effects on income; therefore, typically the analysis of regional employment effects is organized in the same categories as regional income effects.

The alternative plans are likely to affect the regional economy as a result of the following three factors:

1. Development of Temperance Flat 274 Dam and Reservoir would introduce short-term construction expenditure.

2. Improved long-term water supply reliability would alter, and in some cases increase, agricultural production and output.

3. Improvements to water levels in Millerton Lake and creation of a new Temperance Flat 274 Reservoir would introduce new long-term recreational visitation and spending.

The regional economic impact analysis estimates the economic effects of the three factors described above for the alternative plans. Employment and income effects of the alternative plans were determined through the use of IMPLAN (IMpact analysis for PLANning), an input/output (I/O) model. I/O models are essentially accounting tables that trace the linkages of inter-industry purchases and sales within a given region and year. The IMPLAN model yields “multipliers” that are used to calculate the total direct, indirect, and induced effects on employment and income, among other factors. For further description of the regional economic impact analysis and specific assumptions used, see Chapter 12 of the Economic Analysis Appendix.

Two IMPLAN regional economics models were developed for regional economic impact analyses specific to the Investigation. The first incorporated economic activity in the six-county region (Fresno, Kern, Kings, Madera, Merced, and Tulare counties) surrounding the Friant and West San Joaquin southern CVP Divisions. The six-county regional model estimates the economic impacts to the local economy where the project would be constructed and primary economic effects would be experienced. A second regional economic impact model was developed to address effects at the California statewide level and that may accrue beyond the six-county region. The two models are referred to as the “Southern San Joaquin Valley” and “Statewide” models.

The Southern San Joaquin Valley model estimates the regional economic impact of the project construction expenditure, changes in agricultural production, and increases in recreational visitation to the local six-county region. The Statewide model is intended to capture effects of the alternative plans that transcend beyond the six-county region. The Statewide model estimates regional economic effects of changes in agricultural production that may affect residents and businesses throughout the State. Annual employment and personal income effects of the alternative plans are provided in Tables 5-11 and 5-12, respectively.

Short-term project construction would support 450 direct jobs per year for Alternative Plans 1, 2, and 3, and 460 direct jobs per year for Alternative Plan 4 over the 8 year construction period in the Southern San Joaquin Valley model impact region. Indirect and induced jobs supported by the construction activities would be 1,155 for Alternative Plans 1, 2, and 3, and 1,196 for Alternative Plan 4. The combined total of direct, indirect, and induced impacts would result in 1,605 total annual jobs supported in the Southern San Joaquin Valley model impact region for Alternative Plans 1, 2, and 3, and 1,656 for Alternative Plan 4.

Long-term increases in agricultural production due to alternative plans would support from 177 to 207 direct jobs per year in the Southern San Joaquin Valley model impact region over the project's lifetime (100 years). Indirect and induced jobs supported by increased agricultural production range from 162 to 194. The combined total of direct, indirect, and induced jobs supported in the Southern San Joaquin Valley model impact region by increased agricultural production ranges from 339 to 401 per year.

Long-term increases in recreational visitation due to alternative plans would support direct jobs to the Southern San Joaquin Valley model impact region, from 26 per year to 30 per year over the project's lifetime (100 years). There would be six indirect and induced jobs supported by recreation activities for Alternative Plans 1, 2, and 3, and seven jobs for Alternative Plan 4. The combined total of direct, indirect, and induced jobs supported by recreation activities would range from 33 jobs per year to 37 jobs per year in the Southern San Joaquin Valley model impact region.

Table 5-11. Summary of Annual Employment Benefits for RED Account

Model Impact Region/Duration of Effects/ Activity Type	Employment Effects (Jobs[1] per Year)	Alternative Plan			
		1	2	3	4
Southern San Joaquin Valley *Short-Term Impacts (average annual over 8-year construction period)*					
Construction Expenditure[3]	Direct	450	450	450	460
	Indirect & Induced	1,155	1,155	1,155	1,196
	Total[2]	1,605	1,605	1,605	1,656
Southern San Joaquin Valley *Long-Term Impacts (average annual over project life)*					
Agricultural Production	Direct	207	200	200	177
	Indirect & Induced	194	186	186	162
	Total[2]	401	386	386	339
Recreational Visitation	Direct	27	27	26	30
	Indirect & Induced	6	6	6	7
	Total[2]	33	34	33	37
Project Operations and Maintenance[4]	Direct	28	28	28	28
	Indirect & Induced	10	10	10	10
	Total[2]	38	38	38	38
TOTAL[2]	Direct	262	255	254	235
	Indirect & Induced	210	202	202	179
	Total[2]	472	457	456	415
Statewide *Long-Term Impacts (average annual over project life)*					
Agricultural Production	Direct	169	155	155	145
	Indirect & Induced	134	129	129	111
	Total[2]	303	284	284	256

Notes:
General: The Southern San Joaquin Valley model impact region includes Fresno, Kern, Kings, Madera, Merced, and Tulare counties.
General: The Statewide model impact region includes the entire State of California.
[1] Jobs per year represent full-time, part-time, and temporary positions.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[3] Direct jobs were estimated by the study team.
[4] Direct project operations and maintenance jobs were estimated by the study team for powerhouse, dam, and recreational operations.
Key:
RED = Regional Economic Development

Table 5-12. Summary of Annual Personal Income Effects for RED Account

Model Impact Region/Duration of Effects/ Activity Type	Personal Income per Year ($[1] million)	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4
Southern San Joaquin Valley ***Short-Term Impacts (average annual over 8-year construction period)***					
Construction Expenditure	**Direct**	$109.4	$109.4	$109.4	$113.2
	Indirect & Induced	$54.7	$54.7	$54.7	$56.6
	Total[2]	$164.0	$164.0	$164.0	$169.8
Southern San Joaquin Valley ***Long-Term Impacts (average annual over project life)***					
Agricultural Production	**Direct**	$5.4	$5.2	$5.2	$4.6
	Indirect & Induced	$7.5	$7.2	$7.2	$6.2
	Total[2]	$12.9	$12.4	$12.4	$10.8
Recreational Visitation	**Direct**	$0.8	$0.8	$0.8	$0.9
	Indirect & Induced	$0.3	$0.3	$0.3	$0.3
	Total[2]	$1.1	$1.1	$1.1	$1.3
Project Operations and Maintenance	**Direct**	$1.9	$1.9	$1.9	$1.9
	Indirect & Induced	$0.4	$0.4	$0.4	$0.4
	Total[2]	$2.4	$2.4	$2.4	$2.4
TOTAL[2]	**Direct**	$8.1	$7.9	$7.9	$7.4
	Indirect & Induced	$8.2	$7.9	$7.9	$6.9
	Total[2]	$16.3	$15.8	$15.8	$14.5
Statewide ***Long-Term Impacts (average annual over project life)***					
Agricultural Production	**Direct**	$3.3	$3.1	$3.1	$2.9
	Indirect & Induced	$6.5	$6.3	$6.3	$5.4
	Total[2]	$9.9	$9.4	$9.4	$8.3

Notes:

General: The Southern San Joaquin Valley model impact region includes Fresno, Kern, Kings, Madera, Merced, and Tulare counties.

General: The Statewide impact region includes the entire State of California.

[1] Results related to personal income per year are presented at January 2013 price levels.

[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
RED = Regional Economic Development

Long-term project O&M impacts of alternative plans would provide additional direct employment benefits to the Southern San Joaquin Valley model impact region. Direct jobs supported by operations and maintenance activities would be 28 jobs per year for all alternative plans over the project lifetime (100 years). Indirect and induced jobs supported by O&M activities would be 10 per year for all alternative plans. The combined total of direct, indirect, and induced jobs supported by O&M would be 38 jobs per year for all alternative plans.

Total long-term regional economic impacts to employment for the Southern San Joaquin Valley model impact region would range from 415 to 472 jobs per year for Alternative Plan 1.

Long-term increases in agricultural production of alternative plans would support direct jobs in the Statewide model impact region from 145 to 169 jobs per year over the project lifetime (100 years). Indirect and induced jobs supported by increased agricultural production range from 111 to 134 jobs per year. The combined total of direct, indirect, and induced jobs supported by increased agricultural production to the Statewide model impact region would range from 256 to 303 jobs per year.

Short-term project construction expenditures of Alternative Plans 1, 2, and 3 would lead to direct impacts on personal income of $109.4 million per year, and $113.2 million per year for Alternative Plan 4 in the Southern San Joaquin Valley model impact region over the 8 year construction period. Indirect and induced impacts would be $54.7 million for Alternative Plans 1, 2, and 3, and $56.6 million for Alternative Plan 4. The combined total of direct, indirect, and induced impacts would result in a total annual economic impact on personal income to the Southern San Joaquin Valley model impact region of $164.0 million for Alternative Plans 1, 2, and 3, and $169.8 million for Alternative Plan 4.

Long-term agricultural production impacts of alternative plans would provide a direct personal income benefit to agricultural proprietors and employees in the Southern San Joaquin Valley model impact region that range from $4.6 to $5.4 million per year over the project lifetime (100 years). Indirect and induced impacts on personal income would range from $6.2 to $7.5 million. The combined total of direct, indirect, and induced impacts related to long-term agricultural production would result in a total annual economic impact on personal income in the Southern San Joaquin Valley model impact region between $10.8 to $12.9 million per year.

Long-term recreational visitation impacts of alternative plans would lead to a direct personal income benefit to recreation support industry proprietors and employees in the Southern San Joaquin Valley model impact region that range from $0.8 to

$0.9 million per year over the project's lifetime (100 years). Direct impacts to personal income would lead to indirect and induced impacts of $0.3 million for all alternative plans. The combined total of direct, indirect, and induced impacts related to long-term recreational visitation would result in a total annual economic impact to personal income in the Southern San Joaquin Valley model impact region, ranging from $1.1 to $1.3 million per year.

Long-term project operations and maintenance impacts of alternative plans would provide direct additional personal income to Southern San Joaquin Valley impact region. Direct personal income related to operations and maintenance would be $1.9 million per year for all alternative plans over the project lifetime (100 years). These direct impacts would lead to indirect and induced impacts are $0.4 million per year for all alternative plans. The combined total of direct, indirect, and induced impacts would result in a total annual economic impact of $2.4 million per year for all alternative plans.

The total long-term regional economic impacts to personal income for the Southern San Joaquin Valley impact region would range from $14.5 to $16.3 million per year.

Long-term agricultural production impacts of alternative plans would provide a direct personal income benefit to the Statewide model impact region ranging from $2.9 to $3.3 million per year over the project lifetime (100 years). Direct impacts to personal income would lead to indirect and induced impacts from $5.4 to $6.5 million. The combined total of direct, indirect, and induced impacts would result in a total annual economic impact to personal income from $8.3 to $9.9 million per year.

Other Social Effects

The OSE account is a means of displaying, and integrating information on alternative plan effects from perspectives that are not reflected in the other three accounts into water resources planning. Categories of effects in the OSE account include the following: urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation. Both the beneficial and adverse effects in the OSE account are expected to be similar across all alternative plans.

In general, the project action alternatives would result in increased agricultural output (sales), net farm income, and personal income. Alternative plans would also provide limited opportunities for increased employment in agricultural, recreation-affected, and other sectors of the economy. Increases in employment would accrue largely to agricultural workers.

The affected counties in the southern San Joaquin Valley region include several large cities and suburbs, plus many small, agriculturally based towns and unincorporated areas. The prominence of agriculture in the economic base of the region, combined with the direct effect of the alternative plans on agricultural production, is likely to result in demonstrable community benefits.

The extended study area is also a region of considerable ethnic and cultural diversity, high population growth, and an increasing proportion of minority representation. The alternative plans may affect these population groups. Urban areas in the SOD service area could see a reduction in water costs stemming from reduced water treatment costs. The effects are likely to be widespread and positive, while having little, if any, disproportionate effect on a particular population or socioeconomic group.

Finally, there could be some short-term effects associated with all the alternative plans, including:

1. Temporary construction-related benefits flowing to local communities in the areas of the alternative plan features.

2. Potential short-term adverse effects that could occur to those directly affected by construction activities, related to pressures on housing, public services, transportation, and schools.

The alternative plans each result in essentially the same infrastructure requirements, the effects are expected to be nearly uniform across the alternatives.

Other Unquantified Benefits

The alternative plans would provide benefits that would accrue to the general public but that could be difficult to quantify on a monetary scale. For the alternative plans, these “unquantified benefits” not discussed specifically in the EQ or OSE accounts could include water management system operational flexibility and climate change adaptation. These other public benefits are recognized as positive in value and essentially additive to the monetized annual benefits for the alternative plans.

Additional surface storage provided by the alternative plans could provide flexibility to the State’s constrained water management system for real-time operational benefits that cannot be provided by other management actions. Surface water storage could also be useful in mitigating lost snowpack storage due to climate change, and in responding to other unforeseen circumstances.

Additional benefits associated with enhancement of the San Joaquin ecosystem are also expected. There could be advancement in research and scientific knowledge that could identify greater benefits to the San Joaquin spring-run chinook and other anadromous fish. There are also likely to be greater opportunities for educational enhancement, as an improved upper San Joaquin River habitat could serve as a field laboratory for students interested in biology and the environment.

Several other potential unquantified benefits of the alternative plans on the SJRRP related to reduction in San Joaquin River flood releases and improved operational flexibility could include:

- Increase in volume of Restoration Flows eligible for recapture at locations downstream of the Restoration Area, pursuant to Paragraph 16(a) of the Settlement.

- Reduction in losses of gravel from Reach 1 of the San Joaquin River during high flood flow, which would reduce maintenance costs for gravel replenishment requirements.

- Reduction in sediment accumulation downstream of Reach 1 due to sand mobilization, which would reduce operation and maintenance costs by the SJRRP to preserve the function of the San Joaquin River Flood Control Project.

- Decrease in the frequency and duration of river connectivity with gravel pits in Reach 1 that causes stranding of salmon and other fish, which could reduce the extent of gravel pit isolation to be implemented as a Phase 2 action of the Settlement.

- Reduction/elimination of late season flood flows damaging newly established riparian habitat.

Alternative Plan Comparison

The Federal planning process in the P&G also includes four specific criteria for consideration in formulating and evaluating alternative plans: completeness, effectiveness, efficiency, and acceptability (WRC 1983). In this section the No-Action Alternative and four alternative plans are ranked for a comparison of their effectiveness, efficiency, acceptability, and completeness.

Effectiveness

Effectiveness is the extent to which an alternative plan alleviates specified problems and achieves planning objectives. For the primary planning objective of increasing water supply reliability and system operational flexibility, ranking was based on the relative amount of long-term annual average water supply and the quantity of emergency water supply that could be derived from each alternative plan. For the primary planning objective of enhancing water temperature and flow conditions in the San Joaquin River, ranking was based on improving habitat conditions for salmon, as demonstrated by increased salmon abundance.

For the secondary planning objectives, four relative ranking factors were considered: (1) reduced frequency and magnitude of flood releases from Friant Dam., (2) maintained value of hydropower attributes, (3) maintained and increased recreation opportunities in the primary study area, and (4) improved quality of water supplies delivered to urban areas.

For increasing water supply reliability and system operational flexibility, Alternative Plan 2 is ranked highest because it has the highest combined ranking for long-term average annual increases in water supply for the CVP/SWP system and emergency water supply.

For enhancing water temperature and flow conditions in the San Joaquin River in support of anadromous fish, Alternative Plan 4 is ranked highest because the combination of high carryover storage and larger cold water pool, reservoir operations and water supply routing, and SLIS operations created the greatest river temperature and flow improvements for salmon out of the four alternative plans.

For potential reduction in flood damage, Alternative Plans 1 achieved the greatest new flood space at 90 percent exceedence and therefore received the highest ranking. For maintaining and increasing energy generation and improve energy management, the Alternative Plan 4, with the greatest amount of carryover storage in Temperance Flat RM 274 Reservoir, achieved the greatest increase in energy generation at Friant Dam, and is ranked the highest. To maintain and increase recreation opportunities in the study area, Alternative Plan 4 ranked highest, achieving about 170,000 new recreation visitor-days. Improving quality of water supplies delivered to urban areas was only achieved by Alternative Plan 3, which therefore ranked highest.

In developing a combined ranking, primary objectives were weighted twice as high as secondary objectives. The effectiveness relative rankings are shown in Table 5-13. A lower level of effectiveness does not mean an alternative plan would be infeasible or incapable of alleviating problems or achieving planning objectives and opportunities; it simply means it would be less preferred.

Table 5-13. Effectiveness Relative Rankings by Alternative Plan

Criterion	Basis for Ranking [1,2]	Alternative Plan				
		No-Action [3]	1	2	3	4
Primary Planning Objective						
Increase Water Supply Reliability and System Operational Flexibility	Long-term average annual increase in water supply; increase in SOD emergency water supply	Lowest	Moderate-Low	Highest	Moderate-High	**Moderate-High**
Enhance water temperature and flow conditions in the San Joaquin River in support of anadromous fish	Long-term average annual improvement in spring-run Chinook salmon abundance due to temperature and flow enhancement in the San Joaquin River between Friant Dam and the Merced River	Moderate-Low	Moderate-High	Moderate	Lowest	**Highest**

Table 5-13. Effectiveness Relative Rankings by Alternative Plan (contd.)

Criterion	Basis for Ranking [1,2]	Alternative Plan				
		No-Action [3]	1	2	3	4
Secondary Planning Objective						
Reduce frequency and magnitude of flood releases from Friant Dam.	Increase in flood space at 90 percent exceedence between Millerton Lake and Temperance Flat Reservoir	Lowest	Highest	Moderate -High	Moderate	**Moderate -Low**
Maintain the value of hydropower attributes.	Increase in local hydropower generation at Friant Dam and ability to mitigate onsite hydropower generation from the Kerckhoff Hydropower Project	Moderate	Moderate	Lowest	Moderate -High	**Highest**
Maintain and increase recreational opportunities in the primary study area	Increase in recreation visitor-days at Millerton Lake and Temperance Flat Reservoir.	Lowest	Moderate	Moderate -High	Moderate -Low	**Highest**
Improve quality of water supplies delivered to urban areas	Decrease in salinity of California Aqueduct water supply to SWP M&I at Edmonston Pumping Plant.	Moderate-High	Moderate-High	Moderate -High	Highest	**Moderate -High**
Combined Ranking	Primary planning objectives worth twice as much as secondary planning objectives	Lowest	Moderate	Moderate -High	Moderate -Low	**Highest**

Notes:

[1] Standard competitive ranking methodology was used to rank alternative plans against each other, including No-Action. An alternative plan was assigned its relative rank. For example, the fifth alternative plan would be ranked lowest, even if the first four alternative plans tie and are each ranked highest.

[2] The rankings do not represent magnitude of accomplishment or impact, or whether they are beneficial or adverse. For example, if all alternative plans, including the No-Action Alternative, have the same value for a criterion, they would all have a rank of highest, even if that value is zero or negative.

[3] The No-Action Alternative typically ranks lowest because it represents baseline conditions and has no accomplishment or impact for a specific criterion. Alternative plans that rank lower than the No-Action Alternative have values lower than the baseline condition.

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

Efficiency

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating specified problems and realizing specified opportunities, consistent with protecting the Nation's environment. The most efficient measures would best address the objectives with the least cost and adverse environmental effects. Factors pertinent to this criterion include (1) cost effectiveness, (2) preliminary monetary and environmental benefits (3) potential biological resource impacts, and (4) potential cultural resources impacts. A lower ranking does not mean that an alternative plan would be infeasible or inefficient; it simply means it would be less preferred. Table 5-14 presents the ranking for efficiency. Potential impacts to biological and cultural resources are currently under development for the EIS/EIR.

Table 5-14. Efficiency Relative Rankings by Alternative Plan[1]

Criterion	Basis for Ranking [2,3]	No-Action Alternative [4]	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4
Cost effectiveness	Alternative plans ranked by Benefit-Cost ratio	N/A	Moderate-High	Moderate-Low	Moderate	Highest
Preliminary monetary and environmental benefits	Alternative plans ranked by net NED benefits	Lowest	Moderate-High	Moderate-Low	Moderate	Highest
Combined Ranking		**Lowest**	**Moderate-High**	**Moderate-Low**	**Moderate**	**Highest**

Notes:

[1] Efficiency criteria and rankings for potential environmental impacts to biological and cultural resources are under development.

[2] Standard competitive ranking methodology was used to rank alternative plans against each other, including the No-Action Alternative. An alternative plan was assigned its relative rank. For example, the fifth alternative plan would be ranked lowest, even if the first four alternative plans tie and are each ranked highest.

[3] The rankings do not represent magnitude of accomplishment or impact, or whether they are beneficial or adverse. For example, if all alternative plans, including the No-Action Action Alternative, have the same value for a criterion, they would all have a rank of highest, even if that value is zero or negative.

[4] The No-Action Alternative typically ranks lowest because it represents baseline conditions and has no accomplishment or impact for a specific criterion. Alternative plans that rank lower than the No-Action Alternative have values lower than the baseline condition.

Key:

N/A = not applicable

NED = national economic development

Cost-Effectiveness

The alternative plans have the same relative ranking considering either benefit-cost ratio or net NED benefits (Table 5-15). The No-Action Alternative would have no costs and no benefits; therefore, the benefit-cost ratio is not applicable, and the net NED benefits are $0.0.

Table 5-15. Alternative Plans Ranked by Estimated NED Benefit-Cost Ratio and Net Benefits

Ranking	Alternative Plan	Benefit-Cost Ratio[1]	Net Benefits ($million)[1]
Highest	4	1.35	$41.0
Moderate-High	1	1.33	$39.7
Moderate	3	1.09	$10.6
Moderate-Low	2	1.05	$5.5
Lowest	NAA	Not Applicable	$0.0

Notes:
[1] Based on California level and low smolt-to-adult return rate ecosystem benefits valuation.

Key:
NAA = No-Action Alternative
NED = National Economic Development

Least Adverse Environmental Effects (Not Evaluated at This Time)

All alternative plans are anticipated to have similar potential environmental impacts within the primary study area. The level of some potential environmental impacts across the extended study area would vary depending on water operations for alternative plans. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures (PRC Section 21002). Some adverse effects for action alternative plans would remain unavoidable despite practicable measures identified to mitigate effects. Potential environmental impacts of alternative plans and proposed mitigation measures will be documented in the pending Draft EIS/EIR. The preferred alternative will be identified in the Final EIS/EIR. The environmentally preferred alternative will be identified in the ROD.

Alternative Plan 4 has the greatest ability to provide ecosystem benefits. These benefits would be associated with long term average annual improvement in spring-run Chinook salmon abundance due to temperature and flow enhancement in the San Joaquin River between Friant Dam and the Merced River.

Acceptability

Acceptability is the workability and viability of an alternative plan with respect to acceptance by Federal, State, local entities, public interest groups, and individuals, as well as compatibility with existing laws, regulations, and public policies. A measure with less support is not infeasible or unacceptable; rather, it is simply less preferred. All alternatives plans are compatible with existing laws, regulations, and public policies. This evaluation criterion will be very important following completion of the Final Feasibility Report and endorsement by a non-Federal partner of the comprehensive plan recommended for implementation. It appears that all of the alternative plans would be similarly ranked for this criterion. Each of the alternative plans need to be coordinated with other agencies and the diverse set of public and stakeholder interests.

Completeness

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Factors that are important in measuring this criterion include (1) authorization, (2) spectrum of objectives being addressed, (3) reliability (degree of uncertainty in achieving objectives), (4) implementability (includes constructability), and (5) environmental effects and mitigation.

Authorization

The Investigation was authorized by Public Law 108-7 in 2003 and again by Public Law 108-361 in 2004. Following development and selection of a feasible alternative and completion of associated environmental compliance, the recommended alternative will be presented to Congress for authorization.

Spectrum of Objectives Being Addressed

All alternative plans address both primary objectives of water supply reliability and ecosystem enhancement. Alternative plans address opportunities of flood damage reduction, recreation, and urban water quality to varying degrees. None of the alternative plans create opportunities for additional energy generation and management, and improvements to San Joaquin River water quality have not been quantified.

Reliability

All alternative plans currently stand alone and are feasible, but water supply and other benefits would increase in the event of broader operational integration with the CVP and SWP, and/or new Delta conveyance. All alternative plans include implementation of the SJRRP, and although the uncertainty in the magnitude of ecosystem enhancement benefits related to improvements in anadromous fish habitat are recognized, the lower end of the range of ecosystem benefits are defensible and sufficient to demonstrate economic feasibility.

Implementability

All alternative plans generally consist of the same physical implementation; construction of the dam and appurtenant structures was determined to be feasible; however, there is risk in the construction schedule related to cofferdam and diversion structures that could potentially increase project costs. Hydropower mitigation options may be refined based on PG&E interest. Implementation may also require changes to Reclamation's water right on the San Joaquin River, to the place of use, as well as other changes to potentially provide SWP M&I contractors the ability to receive water from Temperance Flat RM 274 Reservoir.

Environmental Effects and Mitigation

Environmental effects and mitigation have not been defined at a feasibility-level for any of the alternative plans. As described above, all alternative plans are anticipated to have similar potential environmental impacts within the primary study area; impacts across the extended study area would vary depending on water operations for alternative plans. The assessment of potential impacts of alternative plans on environmental resources, along with proposed mitigation measures, will be documented in the pending Draft EIS/EIR. Potential mitigation lands containing habitat comparable to habitat that would be affected by constructing Temperance Flat RM 274 Dam and Reservoir have been identified near the study area.

Summary of Comparisons

The evaluation criteria are applied to the alternative plans, as summarized in Table 5-16. The No-Action and four alternative plans were ranked for each of the P&G comparison criteria (none, low, low to moderate, moderate, moderate to high, high). A combined ranking was then developed as the composite of the individual criterion rankings for each alternative plan.

Table 5-16. Summary of Alternative Plan Comparison Related to Planning Criteria

Criterion [1,2]	No-Action Alternative [3]	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4
Effectiveness	Lowest	Moderate	Moderate-High	Moderate-Low	Highest
Efficiency	Lowest	Moderate-High	Moderate-Low	Moderate	Highest
Acceptability	Moderate-Low	Moderate-Low	Highest	Highest	Highest
Completeness	Lowest	Highest	Highest	Highest	Highest
COMBINED RANKING	**Lowest**	**Moderate-Low**	**Moderate-High**	**Moderate**	**Highest**

Notes:

[1] Standard competitive ranking methodology was used to rank alternative plans against each other, including the No-Action Alternative . An alternative plan was assigned its relative rank. For example, the fifth alternative plan would be ranked lowest, even if the first four alternative plans tie and are each ranked highest.

[2] The rankings do not represent magnitude of accomplishment or impact, or whether they are beneficial or adverse. For example, if all alternative plans, including the No-Action Alternative, have the same value for a criterion, they would all have a rank of highest, even if that value is zero or negative.

[3] The No-Action Alternative typically ranks lowest because it represents baseline conditions and has no accomplishment or impact for a specific criterion. Alternative plans that rank lower than the No-Action Alternative have values lower than the baseline condition.

Rationale for Plan Selection

A plan recommending Federal action is to be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. The basis for selecting the recommended plan is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government. When the Feasibility Report and EIS/EIR are finalized, the Secretary of the Interior will use both documents and supporting information to provide a recommendation to Congress. This recommendation will be documented in a ROD and used by the U.S. Congress, along with the Final Feasibility Report and Final EIS/EIR, to determine interest in, and the form of, project authorization if a plan is recommended for implementation. It is recognized that most of the activities pursued by the Federal Government require assessing trade-offs and that in many cases, the final decision will require judgment regarding the appropriate extent of monetized and non-monetized effects.

The needed rationale to support Federal investment in water resources projects is well described by the P&G (WRC 1983):

> *(a) The alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan) is to be selected unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reason for selecting another plan, based upon other Federal, State, local, and international concerns. (b) The alternative of taking no action, i.e., selecting none of the alternative plans, should be fully considered. (c) Plan selection is made by the agency - decisionmaker for Federal and Federally-assisted plans. Agency officials and State and local sponsors may recommend selection of a plan other than the NED plan. The agency decisionmaker (the Secretary of a department or the head of an independent agency) will determine whether the reasons for selecting a plan other than the NED plan merit the granting of an exception. (d) The basis for selection of the recommended plan should be fully reported, including considerations used in the selection process. (e) Plans should not be recommended for Federal development if they would physically or economically preclude non-Federal plans that would likely be undertaken in the absence of the Federal plan and that would more effectively contribute to the Federal objective when comparably evaluated.*

In addition, the 2013 P&R (Council on Environmental Quality [CEQ]) states:

> *The rationale supporting Federal investment in water resources at the programmatic or project levels should summarize and explain the decision rationale leading from the identification of need through to the recommendation of a specific action. This should include the steps, basic assumptions, methods and results of analysis, criteria and results of various screenings and selections of alternatives, peer review proceedings and*

> *results, and the supporting reasons for other decisions necessary to execute the planning process. The information should enable the public to understand the decision rationale, confirm the supporting analyses and findings, and develop their own fully-informed opinions and/or decisions regarding the validity of the analysis and any associated recommendations. This information should be presented in a decision document or documents, and made available to the public in draft and final forms. The document(s) must demonstrate compliance with the National Environmental Policy Act (NEPA) and other pertinent Federal statutes and authorities.*

At this stage of the Federal planning and NEPA processes, the potential physical accomplishments and the benefits and costs of the alternative plans have been evaluated and compared based on established criteria. Beneficial and adverse environmental effects analysis has not been completed; therefore, a recommended or preferred alternative plan has not been identified to date. Analyses and evaluations presented in this chapter, and that would be applicable to a recommended or preferred alternative plan, are completed for a representative alternative plan, Alternative Plan 4, because it has the greatest net NED benefits of the alternative plans evaluated in this Draft Feasibility Report.

Operations of the existing CVP and SWP may change as a result of reinitiated CVP and SWP long-term operations consultation. Operations of the representative alternative plan, or other alternative plans, may be refined based on updates to modeling studies, changes in CVP and SWP operations, and input from agencies, stakeholders, and the public.

It is recognized that changes in statewide water operations, other relevant water resources projects and programs, including BDCP efforts, could result in changes to the alternative plans. Ultimately the alternative plan that best meets the Investigation planning objectives, maximizes net public benefits, and is determined to be technically, environmentally, economically, and financially feasible, will be identified in the Final Feasibility Report and Final EIS/EIR with supporting rationale and documentation.

Consistency of Alternative Plans with Other Programs

Alternative plans were evaluated on their consistency with the CVPIA and overall goals and objectives of the CALFED ROD. Potential contributions of the Investigation toward the CVPIA and CALFED goals and objectives are described in this section and summarized in Table 5-17.

Table 5-17. Summary of Contributions of Alternative Plans to CVPIA and CALFED Goals

Program	Potential Contributions of Alternative Plans Toward Program Goals
CVPIA	
Anadromous Fish	• Would increase the ability of Friant Dam to make cold-water releases and regulate water temperature in the San Joaquin River • Could provide for additional flows and increased habitat between Friant Dam and Mendota Pool
Wildlife Habitat	• Could provide diversification of Level 2 water supplies to wildlife refuges with access to Mendota Pool
Water Supply Reliability	• Could increase reliability of firm water supplies by up to 76 TAF per year on an annual average basis, and up to 62 TAF in dry years • Could contribute to replacement of supplies redirected to other purposes in the CVPIA
CALFED	
Water Supply Reliability	• Could increase the reliability of firm water supplies by up to 76 TAF per year on an annual average basis, and up to 62 TAF in dry years
Ecosystem Quality	• Would increase the ability of Friant Dam to make cold-water releases and regulate water temperature in the San Joaquin River • Could provide for additional flows and increased habitat between Friant Dam and Mendota Pool • Could provide diversification of Level 2 water supplies to wildlife refuges with access to Mendota Pool
Delta Levee Integrity	• Could provide greater flexibility in flood control releases and reduce potential flood damage thereby reducing stress on Delta levees

Key:
CALFED = CALFED Bay-Delta Program
CVPIA = Central Valley Project Improvement Act
Delta = Sacramento-San Joaquin Delta
TAF = thousand acre-feet

Central Valley Project Improvement Act

The CVPIA is a Federal statute passed in 1992 with the following purposes:

To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California; to address impacts of the CVP on fish, wildlife, and associated habitats; to improve the operational flexibility of the CVP; to increase water-related benefits provided by the CVP to the State through expanded use of voluntary water transfers and improved water conservation; to contribute to the State's interim and long-term efforts to protect the Bay-Delta; and to achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agricultural, M&I, and power contractors.

Anadromous Fish

As part of the fish and wildlife restoration activities outlined by the CVPIA, a goal was to develop and implement a program that makes reasonable efforts to ensure that natural productions of anadromous fish in Central Valley rivers and streams will be sustainable on a long-term basis. Water temperature is an important factor in increasing the probability of success in achieving the Restoration Goal of the SJRRP. All alternative plans improve the capability, reliability, and flexibility to release water at suitable temperatures for anadromous fish downstream from Friant Dam. All the alternative plans increase the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in alternative plans with higher carryover storage.

Water Supply Replacement

Since the CVPIA was enacted, 1.2 million acre-feet of CVP yield have been dedicated and managed annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA. All alternative plans would increase water supply reliability through increasing firm water supplies for agricultural and M&I purposes. This action would contribute to the replacement of CVP SOD supplies redirected to other purposes in the CVPIA diversification of CVPIA Level 2 refuge water supplies.

CALFED Bay-Delta Program

CALFED, a coordinated Federal and State program, was established after the Bay-Delta Accord to address water supply reliability, water quality, ecosystem quality, and Delta levee system integrity. CALFED provides a programmatic framework to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The CALFED Bay-Delta Program developed the following program goals:

- **Water Supply Reliability** – Reduce the mismatch between Bay-Delta water supplies and the current and projected beneficial uses dependent on the Bay-Delta system.

- **Water Quality –** Provide good water quality for all beneficial uses.

- **Ecosystem Quality –** Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.

- **Delta Levee Integrity –** Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

Table 5-17 summarizes potential contributions of the alternative plans toward CALFED goals.

Expanding water storage capacity is critical to the successful implementation of all aspects of CALFED. Not only is additional storage needed to meet the needs of a growing population but, if strategically located, such storage would provide much needed flexibility in the system to support fish restoration efforts and improve water quality. Table 5-18 qualitatively compares anticipated contributions of the individual alternative plans relative to CALFED goals and CALFED Storage Program objectives.

Table 5-18. Comparison of Alternative Plans Relative to CALFED Goals and CALFED Storage Program Objectives

Alternative Plan	1	2	3	4
CALFED Bay-Delta Program Goals[1]				
Water Supply Reliability: Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses that depend on the Bay-Delta system	++	++	+++	+
Water Quality: Provide good water quality for all beneficial uses	++	++	++	+++
Ecosystem Quality: Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species	0	0	0	0
Delta Levee Integrity: Reduce the risk to land use and associated economic activities, water supply, infrastructure and the ecosystem from catastrophic breaching of Delta levees	+	+	+	+
CALFED Storage Program Element Objectives[2]				
Pursue specific opportunities for new off-stream storage sites and expansion of existing on-stream storage sites as identified in the Record of Decision	+	+	+	+
Provide financial and technical assistance to implement 1/2 million to 1 million acre-feet of new, locally managed groundwater storage	0[3]	0[3]	0[3]	0[3]

Notes:
[1] Source: CALFED Bay-Delta Program Record of Decision (CALFED 2000a)
[2] Source: CALFED Program Elements (CALFED and DWR 2005)
[3] Although the Investigation alternative plans do not include specific features to fund or assist groundwater storage, Temperance Flat River Mile 274 could allow for additional system flexibility for surface water deliveries, decreasing reliance on groundwater pumping. This could reduce groundwater overdraft conditions in CVP and SWP service areas.

Key:
+ = net positive effect (benefit)
0 = no anticipated effect
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
SWP = State Water Project

Water Supply Reliability

One of the primary goals of CALFED is to improve the reliability of California's water supply within the context of unpredictable hydrology and the competing needs of fish and wildlife and water users. In addition to hydrology, the CALFED ROD assumes that water supply reliability is predicated partially on investment in infrastructure to improve storage and conveyance capacity. Included in the CALFED Storage Program Preferred Program Alternative is development of additional storage in the upper San Joaquin River Basin. Water supply reliability depends on capturing water during peak flows and during wet years, as well as on more efficient water use through conservation and recycling. All alternative plans identified in this Draft Feasibility Report would increase water supply reliability for agricultural and M&I purposes, as well as further implementing demand reduction practices identified by the Common Assumptions for Water Storage Projects Work Group.

Water Quality

Additional storage in the Upper San Joaquin River basin would improve operational flexibility, which could contribute to improved Delta water quality conditions and Delta emergency response. Temperance Flat Reservoir would have the ability to provide increased releases to SOD population centers in the event of a Delta emergency. Water supplies delivered via the San Joaquin River could also improve water quality through reducing salt loading and facilitate exchanges and source diversification for users with access to Mendota Pool.

Ecosystem Quality

Temperance Flat RM 274 Reservoir could contribute to ecosystem enhancement along the San Joaquin River and potentially within the Delta. All alternative plans improve the capability, reliability, and flexibility to release water at suitable temperatures for anadromous fish downstream from Friant Dam. All the alternative plans increase the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in alternative plans with higher carryover storage.

Temperance Flat RM 274 Reservoir could also contribute to Delta species restoration through increased operational flexibility. Increased storage could allow CVP/SWP pumping operations to be shifted to times when fish are less vulnerable to the effects of these pumping operations.

Delta Levee Integrity

Temperance Flat RM 274 Reservoir could provide greater flexibility in flood control releases because of the potential for additional incidental flood control space. Improved operational flexibility in the timing of flood control releases could reduce stress on San Joaquin River and Delta levees, and could contribute to maintaining their stability.

CALFED "Beneficiary Pays" Principle

Federal cost allocation procedures and applicable cost-sharing laws/regulations govern how the costs of a project are allocated among project purposes, and apportioned to Federal and non-Federal project partners. Federal laws and regulations also determine which Federal costs are reimbursable (paid back to the Federal Government by beneficiaries, typically over time) and nonreimbursable (the burden of the Federal taxpayer). Should the project be authorized by Congress, the Federal authorizing language would likely specify any cost-sharing or financing arrangements that deviate from previously established Federal laws. Non-Federal partners would be responsible for determining how their share of project costs are financed (i.e., how these costs may be passed on to beneficiaries). Federal cost allocation and cost-sharing practices are consistent with the CALFED "beneficiary pays" principle.

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Chapter 6
Representative Plan and Implementation Requirements

This chapter summarizes a representative alternative plan and project implementation requirements. It includes a description and determination of feasibility of a representative alternative plan, identification of areas of risk and uncertainty, unresolved issues, next steps for the Feasibility Report, implementation requirements, Federal and non-Federal responsibilities, project timeline, and status of the Investigation.

Description of Representative Plan

No specific alternative plan has been chosen or recommended for implementation at this stage of the Investigation, so this chapter describes and evaluates the feasibility of a “representative” plan to illustrate the topics that will be evaluated for a recommended plan that will be identified in the Final Feasibility Report. Based on analyses and evaluations to date in accordance with the Federal planning and NEPA processes, in comparison to the other alternative plans, Alternative Plan 4 best addresses the Investigation planning objectives (highest rank for effectiveness), has a high certainty of achieving the intended benefits (completeness), has a relatively high economic efficiency, and provides the greatest net benefits. Therefore, Alternative Plan 4 was selected as the representative plan for evaluation in this chapter.

Changes and refinements may occur to the alternative plans after this Draft Feasibility Report with input from agencies, stakeholders, and the public; changes in CVP and SWP operational constraints and studies; and other relevant water resources projects and programs, such as BDCP efforts. These potential changes and refinements would be addressed in the Final Feasibility Report and EIS/EIR.

The following sections summarize major components and potential benefits associated with the representative plan (Alternative Plan 4) evaluations.

Major Components

The major project construction features, or components, of the representative plan (Alternative Plan 4) include the following:

- **Temperance Flat RM 274 Dam and Reservoir –** Temperance Flat RM 274 Dam would be an RCC arch dam located 6.8 miles upstream from Friant Dam. At a top-of-active-storage elevation of 985, the new reservoir would provide about 1,260 TAF additional storage (1,331 TAF total storage, of which 75 TAF would overlap with Millerton Lake), and would have a surface area of about 5,700 acres.
- **Outlet Works –** A 30-foot-diameter, concrete-lined tunnel would be constructed 1.5 miles upstream from the main dam through the south river bank. A SLIS with four inlet elevations would manage reservoir release temperatures. Releases would be made through a 20,000 cfs valve house when not made through the powerhouse.
- **Powerhouse –** The powerhouse would be located approximately 750 feet southwest from the outlet works tunnel exit. The powerhouse would contain two 80 MW turbines, which in combination would pass up to 6,000 cfs. The powerhouse would connect to a new Temperance Flat transmission line that would traverse about 5 miles southeast to the existing Kerckhoff–Sanger transmission line.
- **Recreational Facilities –** Reclamation would protect recreation 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 (i.e., relocate facilities off site).
- **Kerckhoff Hydroelectric Project Facilities –** The existing Kerckhoff and Kerckhoff No. 2 powerhouses would be decommissioned. Gates and equipment at the top of Kerckhoff Dam would be modified to accommodate higher tailwater elevations. Existing transmission lines in the inundation area will be relocated or decommissioned.
- **Utilities and Roads –** Impacted utilities include potable water, power distribution, telecommunications, and wastewater facilities. Utilities would be demolished

and/or relocated. Most impacted local roads would be demolished as they are not required for access. Three permanent access roads would be constructed to the dam, intake structure, and valve house/powerhouse.

The representative plan and associated features would be operated to meet the primary objective of water supply reliability by delivering additional water supply to the Friant Division, CVP SOD, and SWP M&I contractors, and the primary objective of ecosystem enhancement by providing a larger cold-water pool and improving the suitability of release temperatures for anadromous fish with additional storage and an SLIS. The operations of Temperance Flat RM 274 Reservoir and Millerton Lake would be coordinated to balance minimum carryover storage-dependent and active storage-dependent benefits and balance the secondary objectives of flood management, recreation, hydropower, and water quality.

Major Benefits

The potential major benefits of the representative plan (Alternative Plan 4) include the following:

- **Water Supply Reliability –** The representative plan would improve the capacity to capture and store San Joaquin River flows, providing water supply reliability and operational flexibility to the Friant Division and the CVP/SWP SOD system. On average, the representative plan (Alternative Plan 4) would provide 61 TAF per year of additional CVP/SWP systemwide water deliveries. Additional San Joaquin water supply could be provided with less carryover storage (up to 113 TAF), which would decrease other carryover-dependent benefit categories. Alternate future conditions with increased flexibility for CVP and SWP Delta export operations would likely result in significantly greater estimates of water supply reliability from Temperance Flat RM 274 Reservoir with full SWP/CVP system integration.

  The representative plan would provide significant reliability to SOD M&I water users in the event of an emergency that would disrupt Delta exports (e.g., earthquake, levee breach). The representative plan would have an average emergency water supply available to SOD M&I water users of between 28 TAF and 534 TAF, depending on the length of the potential Delta export disruption.

- **Enhance water temperature and flow conditions in the San Joaquin River** – The representative plan would improve the capability, reliability, and flexibility to release water at suitable temperatures and increased flows for anadromous fish downstream from Friant Dam. Temperance Flat RM 274 Reservoir and SLIS would improve the cold water volume for management and release to the San Joaquin River. The representative plan would reduce Friant Dam release temperatures by about 5°F degrees during fall months and slightly extend the distance downstream from Friant Dam where average daily river temperatures stay below 55°F.

  Spring-run Chinook salmon habitat would increase in the San Joaquin River because of improved flow and water temperature for long-term average annual and dry year types. The abundance of spring-run Chinook salmon would improve by a long-term average of 2.8 to 4.9 percent and 11.1 to 13.1 percent in dry years, depending upon SAR condition.

- **Hydropower Generation** – The representative plan would normally operate Millerton Lake at a steady water surface at elevation 550 (minimum carryover storage target of 340 TAF). The fixed elevation and additional reservoir releases would allow Friant Dam powerhouses to generate on average about 15.8 GWh per year more energy. Impacts to the Kerckhoff Project powerhouses would be mitigated.

- **Recreation** – The representative plan would support up to 96,400 new visitor-days. Keeping Millerton Lake at a steady elevation would also improve early-and late-season boating opportunities, and would increase visitation at the lake by about 34,000 visitor-days. The total increase in recreation visitor-days for Alternative Plan 4 would be 130,400.

- **Flood Damage Reduction** – The representative plan would increase active storage available for flood control (at the 90 percent exceedence) by 236 TAF during the flood control period (November through March) compared to the No-Action Alternative.

Economics

The estimated costs and benefits of the representative plan (Alternative Plan 4) are summarized below:

- **Estimated Costs** – The estimated total investment cost of the representative plan is $2,578 million. The estimated total annual cost for investment and other annualized costs is $115.9 million.

- **Estimated Benefits** – The total estimated average annual monetary benefit of the representative plan is $81.3 million without ecosystem benefits and ranges from $140.8 to $156.9 million with ecosystem benefits (considering California-level valuation with low and high SAR). The resulting annual net economic benefits under the same conditions range from $24.9 to $41.0 million, including California-level ecosystem benefits.

Determination of Feasibility

This section summarizes the technical, environmental, economic, and financial feasibility of the representative plan (Alternative Plan 4). A project feasibility determination includes the following four elements:

- Technical feasibility consists of engineering, operations, and constructability analyses verifying that it is physically and technically possible to construct, operate, and maintain the project.
- Environmental feasibility consists of analyses verifying that constructing or operating the project will not result in unacceptable environmental consequences to endangered species, cultural, Indian trust, or other resources.
- Economic feasibility consists of analyses verifying that constructing the project is an economically sound investment of capital (i.e., that the project would result in positive net benefits or that the project's benefits would exceed the costs).
- Financial feasibility consists of examining and evaluating project beneficiaries' ability to pay for their share of project costs and/or repay their appropriate portion of the Federal investment in the project over a period of time, consistent with applicable law.

Technical Feasibility

The representative plan is projected to be technically feasible, constructible, and can be operated and maintained. Revisions to feature designs such as the dam type and diversion scheme have been incorporated into feature designs and cost estimates based on senior review by Reclamation through the 2007 *Design, Estimating, and Construction* (DEC) *Review* (Reclamation 2007b) and 2011 *Value Planning Study* (Reclamation 2011c). Designs and cost estimates of project features in this Draft Feasibility Report have been developed primarily to a feasibility-level, but will not be suitable for use for congressional authorization and appropriation until the Final Feasibility Report. Approximately 13 percent of the total field cost is at an appraisal-level with the most significant features being the LLIS, and river outlet works tunnel and portals (see the Engineering Summary Appendix for details).

Additional review, including a feasibility-level DEC review, will be completed once Draft Feasibility Report comments on engineering features from public agencies and stakeholders have been addressed. The feasibility-level DEC review could identify remaining significant items not listed in the cost estimate and needed refinements to construction methods and scheduling. Responses to feasibility-level DEC review comments will be incorporated in the Final Feasibility Report.

Operations of the representative plan are technically feasible under existing laws, infrastructure, and operating agreements. Potential refinements to the operations of the representative plan include further consideration of the balance between active storage and carryover storage, and formulating and evaluating additional scenarios that balance economic and financial and feasibility with stakeholder support. Additional coordination with water management stakeholders to gather their input on operations priorities and scenarios will also take place before completion of the Final Feasibility Report. The representative plan may be even more feasible under potential future conditions with BDCP, which have not been specifically evaluated to date. Potential additional analysis includes development and evaluation of scenarios that would include representation of a new Delta conveyance to facilitate integration of Temperance Flat 274 operations with the CVP and SWP SOD system. Water supply benefits are expected to increase significantly under these scenarios, although other benefit categories, such as M&I water quality and emergency water supply, may decrease with a change in Delta conveyance in the without-project conditions.

Environmental Feasibility

Environmental analyses conducted to date suggest that the representative alternative plan would be environmentally feasible. Environmental effects analysis conducted to date includes the following:

- Terrestrial biological resources analyses, including detailed habitat assessments and surveys for threatened and endangered species, for the Temperance Flat RM 274 Reservoir inundation area and areas associated with most project features

- Wetland delineations for the Temperance Flat RM 274 Reservoir inundation area and areas associated with most project features

- Aquatic biological resources analyses for Millerton Lake and the Temperance Flat RM 274 Reservoir inundation area, and the San Joaquin River below Friant Dam

- Cultural resources analyses for Millerton Lake and the Temperance Flat RM 274 Reservoir inundation area and areas associated with most project features

The alternative plans will be evaluated further in the Draft EIS/EIR, and are anticipated to further demonstrate environmental feasibility. Implementation of the alternative plans would affect environmental resources in the primary and extended study areas, with beneficial effects on some resources, and adverse effects on other resources. Potential environmental effects will be evaluated and mitigation measures for each alternative plan will be identified in the Draft EIS/EIR. An environmentally preferable alternative, consistent with NEPA, will be identified in the ROD. Based on studies to date, the representative plan appears to provide the greatest environmental benefits; however, it is recognized that further refinement and changes may occur to the alternative plans based on additional analyses and responses to comments by concerned agencies, stakeholders, and the public.

Implementation of the representative alternative plan would affect environmental resources in the primary and extended study areas, as summarized in Table 5-10. Beneficial effects of constructing Temperance Flat RM 274 Dam and Reservoir, along with operations of the dam and other related CVP and SWP facilities, correspond to the following resource areas:

- Fisheries and aquatic ecosystems (San Joaquin River, Friant Dam to Merced River)
- Flood management (San Joaquin River, Friant Dam to Merced River)
- Groundwater (CVP/SWP facilities and water service areas)
- Surface water supplies and facilities operations (CVP/SWP facilities and water service areas)
- Surface water quality (San Joaquin River, Friant Dam to Merced River, and CVP/SWP facilities and water service areas)
- Recreation (Temperance Flat RM 274 Reservoir and vicinity)
- Socioeconomics, population, and housing (CVP/SWP facilities and water service areas)

Some adverse effects anticipated for constructing the representative plan would be temporary, construction-related effects and would be less than significant or would be reduced to less-than-significant levels with mitigation. These effects correspond to surface water quality, geology and soils, public health and hazardous materials, recreational resources, transportation, circulation and infrastructure, and utilities and service systems.

Other adverse effects would be permanent, such as effects within the newly inundated area of Temperance Flat RM 274 Reservoir and vicinity on fisheries and aquatic ecosystems, botanical and wetlands, wildlife, cultural, land use planning and agricultural resources, power and energy, and visual resources. Long-term adverse effects on power and energy resources would be reduced through replacement power generation infrastructure and mitigation. Some adverse effects, like temporary, construction-generated emissions and noise that exceed local thresholds, would remain significant and unavoidable despite mitigation measures.

As part of the project planning and environmental assessment 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 and construction, and O&M phases of the project with applicable resource agencies. Specific actions to avoid, mitigate, and/or compensate for potential adverse environmental effects will be identified and addressed in the Draft and Final EIS/EIR to the greatest extent practicable.

Economic Feasibility

The representative plan is projected to be economically feasible, because the estimated benefits exceed the estimated costs, resulting in positive net benefits of $24.9 to $41.0 million annually, and benefit-cost ratio of 1.21 (high SAR) to 1.35 (low SAR) (considering California-level ecosystem benefits) or 4.08 (high SAR) to 4.99 (low SAR) (considering US-level ecosystem benefits). Alternative Plan 4 has the highest net benefits of the alternatives evaluated in this Draft Feasibility Report.

Additional monetary benefit categories could be analyzed for the Final Feasibility Report, if any are identified, and an appropriate valuation methodology is available. Potential supplemental refinements to alternative features, hydropower mitigation strategies, and their associated cost estimates for the Final Feasibility Report may also have an effect on the relative economic feasibility of the alternatives.

Financial Feasibility

Financial feasibility determination during the planning stage consists of (1) a preliminary allocation and assignment of estimated construction, IDC, and operations and maintenance (O&M) costs to project purposes, both reimbursable and nonreimbursable; (2) identification of potential project beneficiaries; and (3) determination of project beneficiaries' potential ability to pay the allocated and assigned costs. This process informs the Federal decision maker and other non-Federal partners of the appropriateness of the investment in the overall project.

On the basis of analysis completed to date, Alternative Plan 4 provides the highest net NED benefits. For this reason, Alternative Plan 4 is used as an example in the following subsections to characterize the potential financial feasibility of a representative alternative plan for this Draft Feasibility Report. The financial feasibility of the recommended plan will be documented in the Final Feasibility Report.

Preliminary Cost Allocation

Reclamation law and policy require an allocation of costs to components or projects purposes to (1) test financial feasibility of reimbursable components or purposes by comparing estimated project costs with anticipated revenues during the feasibility study process, and (2) establish and measure compliance with project financial requirements after construction and determine the final cost allocation. A preliminary cost allocation for the recommended plan will be included in the Final Feasibility Report. The final cost allocation would be performed when the project or significant portions of the project are completed.

Methodology

Cost allocations are made for Federal multipurpose water resources projects to derive an equitable distribution of project costs among authorized project purposes, or those purposes proposed for authorization. Once costs are allocated to project purposes, repayment of the costs is assigned to the project beneficiaries. Beneficiaries include agricultural and M&I water agencies, power agencies, as well as State and Federal taxpayers. The three basic steps associated with cost allocation and assignment are (1) identifying costs to be allocated, (2) allocating costs to project purposes, and (3) determining cost assignment for reimbursability and repayment.

The preferred method, as noted in the P&G, of cost allocation for Federal water projects is known as the Separable Cost−Remaining Benefits (SCRB) approach (WRC 1983). The SCRB approach includes the following steps:

- Separable costs (costs that have been added to a multi-purpose project to specifically serve a given function) are identified for each purpose. Separable costs include specific costs, or costs of individual facilities that serve only a single purpose.

- Separable costs are subtracted from the lesser of benefits or single-purpose alternative project costs (costs of the most economical alternative that would likely be built as a Federal-type project to provide equivalent benefits of for a single purpose) to derive remaining benefits, also known as the justifiable expenditure.

- Joint costs (costs of identifiable physical facilities that serve more than one, and often several, purposes) are allocated in proportion to the distribution of remaining benefits.

- The total cost allocated to a purpose is the sum of its separable and allocated joint costs.

At this stage of the Investigation, single-purpose alternative project costs have not been developed, a recommended plan has not been selected, and separable costs have not been determined. In the Draft Feasibility Report, the Alternative Justifiable Expenditure (AJE) approach is used for a preliminary cost allocation of a representative alternative plan (Alternative Plan 4). The AJE method is a modified SCRB method used when separable costs and single-purpose alternative costs have not been derived. AJE cost allocation follows the same process as the SCRB method, except that specific costs (costs of individual facilities that serve only a single purpose) are used in place of separable costs.

The AJE method may give similar results to the SCRB method if the majority of separable costs are specific to each purpose. In addition, it is likely that any single-purpose alternative costs would exceed each purpose’s benefits and not affect the justifiable expenditure calculation. Single purpose alternative costs would likely exceed the multi-purpose project benefits because one way to achieve many of the benefits provided by the multi-purpose project would be to construct a smaller dam in the upper San Joaquin River basin. The cost of a smaller dam in the upper San Joaquin River basin would likely be greater than the benefit of any single category. The full SCRB method will be used for the Final Feasibility Report.

Costs to be Allocated

Costs to be allocated include annualized construction costs (including field costs and non-contract costs), IDC, O&M costs, additional pumping costs, and annual hydropower mitigation costs. It should be noted that cost allocation is a financial analysis rather than an economic evaluation. Consequently, project costs may be presented differently in a cost allocation than in the NED analysis.

Table 6-1 provides the estimated costs to be allocated for the representative plan. See the Engineering Summary Appendix for details on alternative plan features and cost estimates. Total estimated construction costs and IDC of the representative plan are $2,216 million and $361 million, respectively, and sum to a total investment cost of $2,578 million. Estimated annual costs total $115.9 million and include annualized investment costs and other annual costs (O&M, additional hydropower mitigation, and additional pumping).

Table 6-1. Representative Plan Costs to be Allocated ($ million)

Total Construction Cost[1]	**$2,216**
Interest During Construction	$361
Total Investment Cost[1]	**$2,578**
Annual Costs	
Interest and Amortization[2]	$99.2
Annual Operation and Maintenance	$8.4
Additional Hydropower Mitigation Cost[3]	$4.2
CVP/SWP Additional Pumping Cost[4]	$4.1
Total Annual Cost[1]	**$115.9**

Note:
[1] Project features and costs are described in detail in the Engineering Summary Appendix. Costs are presented in millions at a January 2013 price level. All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[2] 100-year period of analysis, and 3.75 percent interest rate (federal discount rate).
[3] Additional hydropower mitigation is the estimated value of the impacted Kerckhoff Hydroelectric Project energy and ancillary services minus the Temperance Flat Reservoir powerhouse energy and ancillary services value.
[4] The additional CVP/CWP pumping costs do not include water conveyance costs beyond the net power requirement for delivering the new water supply, and additional costs may be incurred.
Key:
CVP = Central Valley Project
SWP = State Water Project

Project Purposes for Preliminary Cost Allocation

For this preliminary cost allocation, the benefit categories are grouped into five purposes. The two primary project purposes for cost allocation are water supply and ecosystem/fish and wildlife enhancement. Benefit categories associated with the water supply purpose include agricultural water supply reliability, M&I water supply reliability, M&I water quality, and emergency water supply. The benefit category associated with the ecosystem/fish and wildlife enhancement purpose is improvements in habitat for anadromous fish. Benefit categories associated with project opportunities include flood damage reduction, recreation, and hydropower. Project purposes for which benefits have not been monetized are not included in this preliminary cost allocation analysis.

Cost Allocation Assumptions

The representative plan has several project features that can be identified as individual facilities that serve only a single purpose. The following assumptions apply to the identification of specific costs and joint costs:

- Specific costs have been identified for the SLIS associated with the ecosystem/fish and wildlife enhancement purpose.
- Specific costs have been identified for the boat ramp providing access associated with the recreational purpose.
- For hydropower generation, the power feature costs are not considered specific costs because the features are necessary for hydropower mitigation of the inundated Kerckhoff Project powerhouses associated with the multipurpose project. Therefore, hydropower feature costs are considered joint costs.
- Recreational feature costs associated with replacement of the existing recreational facilities that would be inundated by the alternative plan are not considered specific costs because those costs are necessary for the multipurpose project.

Cost Assignment

The cost allocation process is designed so that costs associated with project purposes are assigned for cost sharing and/or repayment. Once costs are allocated to project purposes, repayment of the costs is assigned to the project beneficiaries. Beneficiaries include agricultural and M&I water agencies, power agencies, as well as State and Federal taxpayers. Costs allocated to project purposes are assigned as reimbursable or nonreimbursable. Based on existing legislation, costs allocated to agricultural and M&I water supply and hydropower purposes are fully reimbursable to the Federal government by the beneficiaries.

Reimbursable costs are borne by beneficiaries via construction cost sharing, or repaid via rates or repayment contracts.

Nonreimbursable costs are borne by the Federal, state, or local government via tax or bond revenues because the benefits generally accrue to taxpayers.

Federal Authority

Repayment for Federal water resources projects is based on the principle that beneficiaries pay for benefits received. For the Investigation, the general principle for repayment of the Federal investment to construct a water resources project is established by the Reclamation Project Act of 1939, Section 7(b):

> *For any project, division of a project, development unit of a project, or supplemental works on a project, now under construction or for which appropriations have been made, and in connection with which the repayment contract has not been executed, allocations of costs may be made in accordance with the provisions of section 9 of the Act and a repayment contract may be negotiated,…*

Current authorities related to reimbursability of the Federal investment are summarized in Table 6-2 for each of the project purposes and benefit categories within those purposes. The preliminary cost assignment may be revised in the Final Feasibility Report, pending further developments with potential inclusion of other construction cost-share partners.

Table 6-2. Existing Authorities for Federal Financial Participation in Multipurpose Water Resources Projects

Purpose	Pertinent Federal Legislation	Description
Agricultural Water Supply	Reclamation Act of 1902, as amended	Reimbursable. This act provides for up-front Federal financing of agricultural water supply purposes, with 100% repayment of investment costs and O&M costs by the beneficiaries.
M&I Water Supply	Reclamation Act of 1939, as amended	Reimbursable. This act provides for up-front Federal financing of M&I water supply purposes, with 100% repayment of investment costs (including construction costs, IDC, and interest over the repayment period); 100% of O&M costs are paid by the beneficiaries.
Emergency Water Supply		
M&I Water Quality		
Hydropower	Reclamation Act of 1906, as amended	Reimbursable. Similar to M&I water supply.
Fish and Wildlife Enhancement	Federal Water Project Recreation Act of 1965 (Public Law 89-72), as amended	Public Law 89-72 provides Federal non-reimbursable share of up to 75% and non-Federal share of at least 25% for fish and wildlife enhancements.
Recreation	Federal Water Project Recreation Act of 1965, as amended by the Reclamation Recreation Management Act (Public Law 102-575)	Public Law 102-575 provides Federal nonreimbursable share of up to 50% for separable investment costs and non-Federal share of 100% for O&M.
Flood Damage Reduction	Reclamation Project Act of 1939, Section 9(c)	Nonreimbursable.

Key:
IDC = interest during construction
M&I = municipal and industrial
O&M = operations and maintenance

State Authority

California's comprehensive water legislation, SB 1, enacted in 2009, gave the Commission new responsibilities regarding the distribution of public funds set aside for the public benefits of water storage projects, and developing regulations for the quantification and management of those benefits. If passed by California voters, Chapter 8 of SBX7-2 would provide general obligation bond funds for water infrastructure and for various projects and programs to address ecosystem and water supply issues in California, including funds for statewide water system operational improvement.

Under the Safe, Clean and Reliable Drinking Water Act, the Commission is further tasked with selecting water storage projects for potential State bond funding toward project benefits "that improve the operation of the state water system, are cost effective, and provide a net improvement in ecosystem and water quality conditions." If this or another bond measure passes, funds may be eligible for public benefits resulting from construction and operation of Temperance Flat RM 274 Dam and Reservoir.

Projects that could be funded by the State under SBX7-2 would be selected by the Commission through a competitive public process ranking potential projects based on the expected return for public investment as measured by the magnitude of the public benefits provided. The public benefits categories defined by SBX7-2 include:

> *(1) Ecosystem improvements, including changing the timing of water diversions, improvement in flow conditions, temperature, or other benefits that contribute to restoration of aquatic ecosystems and native fish and wildlife, including those ecosystems and fish and wildlife in the Delta.*
>
> *(2) Water quality improvements in the Delta, or in other river systems, that provide significant public trust resources, or that clean up and restore groundwater resources.*
>
> *(3) Flood control benefits, including, but not limited to, increases in flood reservation space in existing reservoirs by exchange for existing or increased water storage capacity in response to the effects of changing hydrology and*

> *decreasing snow pack on California's water and flood management system.*
>
> *(4) Emergency response, including, but not limited to, securing emergency water supplies and flows for dilution and salinity repulsion following a natural disaster or act of terrorism.*
>
> *(5) Recreational purposes, including, but not limited to, those recreational pursuits generally associated with the outdoors.*

Section 79746 of Chapter 8 of SBX7-2 provides the formula to calculate the amount of potential State funding for a water storage project:

> *"79746 (a) The public benefit cost share of a project funded pursuant to this chapter, other than a project described in subdivision (c) of Section 79741, may not exceed 50 percent of the total costs of any project funded under this chapter.*
>
> *(b) No project may be funded unless it provides ecosystem improvements as described in paragraph (1) of subdivision (a) of Section 79743 that are at least 50 percent of total public benefits of the project funded under this chapter." (Emphasis added)*[1]

Subsection (a) limits the amount of public funding that may be expended for any project, other than a conjunctive use or reservoir reoperation project, under SBX7-2 to a maximum of 50 percent of the *total cost of the project* (Commission 2013). For example, if the total cost of a project funded is $1,000,000, the maximum public contribution would be $500,000. But it is important to note that because the 50 percent rule is a State funding cap, the public contribution percentage could also be less.

Subsection (b) clarifies that 50 percent of "the total public benefits of the project funded under this chapter" not "the project" overall must be attributable to ecosystem benefits to

[1] Section 79743 defines "ecosystem improvements" to include: "changing the timing of water diversions, improvement in flow conditions, temperature or other benefits that contribute to restoration of aquatic ecosystems and native fish and wildlife, including those ecosystems and fish and wildlife in the Delta."

maximize the State funding. If non-ecosystem public benefits exceed ecosystem public benefits, then the difference is not eligible for funding (Commission 2013). As such, whatever percentage is determined to be appropriate for public cost-share funded under subsection (a), *at least* half of that amount must be attributable to ecosystem benefit improvements.

Cost Assignment Assumptions

Table 6-3 shows potential cost assignment percentages used in this analysis for purposes of repayment. The assignment percentage assumptions are based on pertinent Federal and State legislation described above and assumptions about potential implementation agreements. As this is a preliminary cost allocation of a representative plan, assignment percentages may be updated for the preliminary cost allocation for the recommended plan in the Final Feasibility Report.

Table 6-3. Potential Cost Assignment Percentages

Purpose	Reimbursable		Federal Nonreimbursable		State/Local Nonreimbursable	
	Investment	O&M	Investment	O&M	Investment	O&M
Water Supply						
Agricultural Water Supply Reliability	100%	100%	–	–	–	–
M&I Water Supply Reliability	100%	100%	–	–	–	–
Emergency Water Supply	–	–	–	–	100%	100%
M&I Water Quality[1]	100%	100%	–	–	–	–
Fish and Wildlife Enhancement						
Ecosystem	–	–	50%	50%	50%	50%
Hydropower	100%	100%	–	–	–	–
Recreation	–	100%	50%	–	50%	–
Flood Damage Reduction	–	–	50%	50%	50%	50%

Note:
[1] Water quality improvements for specific beneficiaries are assumed to be reimbursable to Federal, state, or local governments. Delta water quality improvements may be a broad public benefit and nonreimbursable.
Key:
M&I = Municipal and Industrial
O&M = operations and maintenance

Results

Table 6-4 provides the results of the preliminary cost allocation procedure using the AJE approach and NED benefits and costs estimates for the representative plan. Total benefits including ecosystem enhancement benefits accruing to California residents are used for preliminary cost allocation. Ecosystem benefits accruing to California residents represent the middle of the range of estimated ecosystem benefits and were used for this preliminary cost allocation given potential State bond funding and uncertainty in ecosystem benefit results. See the Economic Analysis Appendix for benefit estimate methodologies and results for all Alternative Plans evaluated. See the Engineering Summary Appendix for details on all alternative plans' features and cost estimates.

The ecosystem/fish and wildlife enhancement and recreational purposes include specific costs that can be separated from the remaining costs. The remaining benefits, and the proportion by category, are shown in the table after removing specific costs. The allocated joint costs are calculated by apportioning the remaining costs. Finally, the allocated costs for each benefit category are the sum of specific costs and allocated joint costs. Based upon this procedure, the largest share of total annual costs of $115.9 million is allocated to ecosystem/fish and wildlife enhancement (spring-run Chinook salmon habitat), followed by emergency water supply.

Cost assignment of project costs between the Federal government and non-Federal beneficiaries is presented in Table 6-5 for the AJE approach. Costs are assigned by applying the preliminary assignment percentages shown in Table 6-3. As indicated in Table 6-5, $32.1 million, or 28 percent, of annual project costs is anticipated to be Federal nonreimbursable. The remaining 72 percent ($31.8 + $51.9 = $83.7 million) of annual project costs would be either reimbursable by the project beneficiaries or funded by State and/or local tax or bond revenues.

Table 6-4. Preliminary Annual Cost Allocation for Representative Plan ($ million)

Purpose	Annual Benefits[1,2]	Specific Costs[3]	Remaining Benefits (Justifiable Expenditure)[4]	% Distribution of Remaining Benefits	Allocated Joint Costs[5]	Total Allocated Costs[6]	Overall % Cost Allocation
Water Supply	**$68.3**	**$0.0**	**$68.3**	**45.0%**	**$49.8**	**$49.8**	**43.0%**
Agricultural Water Supply Reliability	$18.9	$0.0	$18.9	12.5%	$13.8	$13.8	11.9%
M&I Water Supply Reliability	$22.3	$0.0	$22.3	14.7%	$16.3	$16.3	14.0%
Emergency Water Supply	$27.1	$0.0	$27.1	17.9%	$19.8	$19.8	17.1%
M&I Water Quality	$0.0	$0.0	$0.0	0.0%	$0.0	$0.0	0.0%
Ecosystem/ Fish and Wildlife Enhancement (Spring-Run Chinook Salmon Habitat)	**$75.6**	**$4.8**	**$70.8**	**46.7%**	**$51.6**	**$56.4**	**48.7%**
Hydropower[7]	**$1.6**	**$0.0**	**$1.6**	**1.1%**	**$1.2**	**$1.2**	**1.0%**
Recreation	**$7.4**	**$0.4**	**$7.0**	**4.6%**	**$5.1**	**$5.5**	**4.8%**
Flood Damage Reduction	**$4.0**	**$0.0**	**$4.0**	**2.6%**	**$2.9**	**$2.9**	**2.5%**
TOTAL	**$156.9**	**$5.2**	**$151.7**	**100.0%**	**$110.6**	**$115.9**	**100.0%**

Notes:
[1] Annual benefits used for this preliminary cost allocation are displayed in Table 5-9 for Alternative Plan 4. California-level ecosystem benefits with low SAR are used for this preliminary cost allocation. See Table 5-3 for a more detailed summary of the range of ecosystem benefit estimates.[2] Annual benefits are the justifiable expenditure for each purpose because sing le-purpose alternative costs have not been estimated at this stage in the Investigation. It is likely that any single-purpose alternative costs will exceed each purpose's benefits and not affect the justifiable expenditure calculation.
[3] Specific costs are used instead of separable costs with the AJE approach. Including separable costs may change allocated joint cost percentages.
[4]Remaining benefits = Benefits less separable costs, but must be greater than $0. Remaining benefits are the remaining justifiable expenditure after specific costs have been removed from each project purpose.
[5] Total project costs less sum of separable costs, times share of remaining benefits.
[6] Sum of specific costs and allocated joint costs.
[7] Hydropower values represent only hydropower at Friant Dam.

Key:
% = percent
AJE = alternative justifiable expenditure
M&I = Municipal and Industrial
SAR = smolt-to-adult return rate

Table 6-5. Preliminary Annual Cost Assignment for Representative Plan ($ million)

Purpose	Total Allocated Costs	Reimbursable	Federal – Nonreimbursable	State/Local – Nonreimbursable
Water Supply	**$49.8**	**$30.1**	**$0.0**	**$19.8**
Agricultural Water Supply Reliability	$13.8	$13.8	$0.0	$0.0
M&I Water Supply Reliability	$16.3	$16.3	$0.0	$0.0
Emergency Water Supply	$19.8	$0.0	$0.0	$19.8
M&I Water Quality	$0.0	$0.0	$0.0	$0.0
Ecosystem/Fish and Wildlife Enhancement (Spring-Run Chinook Salmon Habitat)	**$56.4**	**$0.0**	**$28.2**	**$28.2**
Hydropower[1]	**$1.2**	**$1.2**	**$0.0**	**$0.0**
Recreation	**$5.5**	**$0.6**	**$2.5**	**$2.5.**
Flood Damage Reduction	**$2.9**	**$0.0**	**$1.5**	**$1.5**
TOTAL Assigned Cost	**$115.9**	**$31.8**	**$32.1**	**$51.9**

Notes: General. Cost and benefit information is based on annual values.
General. Line item values may not sum to total due to rounding.
[1] Hydropower values represent only hydropower at Friant Dam.
Key: M&I = municipal and industrial

Payment Capacity/Ability to Pay

Financial feasibility is ultimately based on the ability of project beneficiaries to pay the costs associated with a recommended plan. If beneficiaries have the financial resources to pay the costs allocated to them, then the project is considered financially feasible. In the context of this Investigation, ability to pay analysis is necessary to assess the financial capacity of non-Federal project beneficiaries to absorb additional costs associated with benefits they would receive under the recommended plan. For the Draft Feasibility Report, the preliminary ability to pay analysis for agricultural and M&I water supply beneficiaries is presented for illustrative purposes. Alternative Plan 4 is used as a representative alternative plan in the analysis. Further ability to pay analysis will be performed for the Final Feasibility Report with the recommended plan.

Ability to pay evaluations vary by the water supply purpose. Typically, agricultural water user ability to pay analyses include a crop budget analysis for a typical farm that is aggregated to the water district level. The most common measures for municipal water supply are the percent of median household income and other socioeconomic measures. Commercial and industrial water users' ability to pay can be estimated by comparing gross revenues to necessary non-water supply expenses.

Agricultural Water Supply Beneficiaries

For agricultural water supply beneficiaries, the ability to pay analysis is completed following a payment capacity study, which considers net incomes to representative farms within the irrigation district through a crop budget analysis. The ability to pay is defined as the farm-level payment capacity aggregated to the entire irrigation district, less existing district obligations, O&M costs, power costs, and reserve fund requirements. Non-farm related income to the district is also incorporated to assess the district's annual loan amortization capacity (Reclamation 2004c).

An initial ability to pay analysis for potential agricultural water supply beneficiaries was developed in 2011 for four regions of the CVP using four representative contractors. Table 6-6 displays the representative ability to pay per acre-foot results for agricultural water supply beneficiaries in each region (Reclamation, 2011d).

Table 6-6. Ability to Pay Results for Four Representative CVP Agricultural Contractors

	Friant/ San Joaquin River	Sacramento River	South of Delta	Northern Sacramento
Ability to Pay ($/acre-foot)	7.50	324.55	150.59	97.40

Source: Reclamation 2011d

Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta

Financial feasibility is determined by comparing the beneficiaries' ability to pay with the annualized repayment of construction costs, IDC, and OM&R costs. Table 6-7 summarizes the allocated agricultural water supply costs for the representative plan, which were estimated as follows:

- Construction costs allocated to the agricultural water supply purpose (shown in Table 6-7) are estimated to be $263.7 million by multiplying the agricultural water supply reliability overall cost allocation percentage (11.9 percent) displayed in Table 6-4 by the total construction cost ($2,216 million) displayed in Table 6-1. No IDC is allocated to agricultural water supply beneficiaries.

- Annual agricultural water supply repayment cost ($6.6 million) is then calculated over a 40-year repayment period with no interest.

- Annual agricultural water supply O&M and additional hydropower mitigation costs are calculated by multiplying the agricultural water supply reliability overall cost allocation percentage (11.9 percent) displayed in Table 6-4 by their respective costs displayed in Table 6-1.

- Additional CVP annual pumping costs are estimated to be $0.6 million based on LTGen power modeling documented in the Modeling Appendix.

- Total annual agricultural water supply costs over the 40-year repayment period ($8.7 million) are the sum of annual agricultural water supply repayment, O&M, additional hydropower mitigation, and additional CVP pumping costs.

Table 6-7. Representative Plan Allocated Agricultural Water Supply Costs ($ million)

Total Construction Cost[1]	**$263.7**
Annualized Costs	
Agricultural Water Supply Repayment Cost (40-year repayment with no interest)	$6.6
Operations and Maintenance	$1.0
Additional Hydropower Mitigation Cost	$0.5
Central Valley Project Additional Pumping Cost	$0.6
Total Annual Agricultural Water Supply Cost[1] (40-Year Repayment)	**$8.7**

Note:
[1] Project features and costs are described in detail in the Engineering Summary Appendix. Costs are presented in millions at a January 2013 price level.

Financial feasibility for agricultural water supply was evaluated by comparing the representative beneficiaries' ability to pay with potential agricultural water costs developed with two scenarios. Scenario 1 is based on the assumption that the increment of agricultural water supply from the representative plan is fully integrated into the CVP to meet existing contracts. The CVP Irrigation Ratesetting Policy (Reclamation 1988) would be used to recover O&M costs and provide repayment of construction costs through water service contracts. Scenario 2 assumes the increment of agricultural water supply from the representative plan would require new repayment contracts with existing CVP and SWP contractors who are willing and able to pay the incremental costs to receive the incremental benefits. For both scenarios, the fully integrated and incremental costs of the project would be repaid over a 40-year period.

An increase in the annual cost of agricultural water supply of $6.6 million would be allocated to CVP agricultural water supply contractors for repayment (Table 6-7). To derive the increase in the cost of water using Scenario 1, the total annual agricultural water supply cost $8.7 million is divided by the 5-year average of total annual CVP water deliveries, 2.2 million acre-feet (Reclamation 2011d). This results in a marginal increase of agricultural water of $3.95 per acre-foot ($3 for repayment and $0.95 for other annualized costs). This marginal increase would fall within the ability to pay for each of the four representative contractors.

For Scenario 2, financial feasibility was also determined by comparing the beneficiaries' ability to pay the annualized costs. At present, the specific agricultural contractors have not been identified beyond the general groupings of CVP Friant Division and CVP SOD. If new contracts were identified, the $8.7 million in allocated agricultural water supply costs would be spread over an average annual increase of 41,000 acre-feet, and the cost per acre-foot is estimated at $212 for CVP agricultural water supply contractors ($161 for repayment and $51 for other annualized costs). Specific analysis for any contractor would be conducted to provide a determination of financial feasibility.

Municipal and Industrial Beneficiaries

For municipal water supply beneficiaries, ability to pay and payment capacity of potential beneficiaries is estimated with an "affordability threshold" represented as a percent of median household income. This analysis applies the affordability threshold established by the EPA. In 1980, the EPA Office of Drinking Water completed a study to assess the costs of complying with new drinking water regulations. The study determined that costs of water service exceeding 2.5 percent of household income were not affordable (EPA 1980). For this analysis, the EPA affordability threshold of 2.5 percent of median income is applied to estimate payment capacity. A range of affordability thresholds from other analyses were also considered in this analysis but were not applied because they lacked regional relevance to the study area.

The alternative plans have the potential to provide water supply benefits to a range of SWP M&I water contractors. As a result, this preliminary payment capacity analysis is estimated based on a range of representative SWP M&I contractors that could receive project water supplies, and representative regional data was used rather than data specific to individual water agencies. Service area population data for a range of 10 potential SWP M&I water supply beneficiaries was obtained from 2010 urban water management plans, and the number of households was estimated with U.S. Census Bureau data (U.S. Census Bureau 2013) by dividing the population estimates by the median household size for the county that comprises the majority of each water agency's service area. Similarly, median household income levels were obtained from county-level data for the county that comprises the largest portion of each water service provider's service area.

In this analysis, the estimated number of households in 2030 within each water service area is used to estimate payment capacity. Table 6-8 provides the average payment capacity analysis results for the 10 representative SWP M&I contractors. As described above, payment capacity is estimated as 2.5 percent of median household income. To account for existing water payments, an estimate of current water rates for Southern California residential customers (obtained from Raftelis Financial Consultants, Inc. and American Water Works Association 2011) is subtracted from the estimate to arrive at the estimated additional payments that are available to support new water projects. As shown in Table 6-8, the annual average estimated total payment capacity of representative municipal and industrial contractors is approximately $690 million. Total estimated annual payment capacity of representative M&I beneficiaries is approximately $6.9 billion.

Table 6-8. Average Payment Capacity Results for Representative Municipal and Industrial Contractors

Average Estimated Households in 2030	Average Median Household Income ($[1]/hhld/yr)	Average Estimated Current Water Rates ($[1]/hhld/yr)	Average Household Payment Capacity ($[1]/hhld/yr)	Average Estimated Total Payment Capacity ($[1]/yr)
826,307	$61,642	$646	$895	$692,301,067

Note: [1] Dollars are presented at a January 2013 price level.
Key: hhld = household
yr = year

Financial feasibility is determined by comparing the beneficiaries' ability to pay with the annualized repayment of construction costs, IDC, and O&M costs. Table 6-9 summarizes the allocated M&I water supply costs for the representative plan, which were estimated as follows:

- Investment costs allocated to the M&I water supply purpose (shown in Table 6-9) are estimated to be $361.9 million by multiplying the M&I water supply reliability overall cost allocation percentage (14.0 percent) displayed in Table 6-4 by the total investment cost ($2,578 million) displayed in Table 6-1. IDC is allocated to M&I water supply beneficiaries.

- Annual M&I water supply repayment cost ($22.1 million) is then calculated over a 40-year repayment period with 5.357 percent annual interest rate (U.S. Department of Treasury 2013).

- Annual M&I water supply, O&M and additional hydropower mitigation costs are calculated by multiplying the M&I water supply reliability overall cost allocation percentage (14.0 percent) displayed in Table 6-4 by their respective costs displayed in Table 6-1.

- Additional SWP annual pumping costs are estimated to be $3.5 million based on SWP_Power modeling documented in the Modeling Appendix.

- Total annual M&I water supply costs over the 40-year repayment period ($27.4 million) are the sum of annual M&I water supply repayment, O&M, additional hydropower mitigation, and additional SWP pumping costs.

This analysis assumes the increment of M&I water supply from the representative plan would require repayment contracts with existing CVP and SWP contractors who are willing and able to pay the incremental costs to receive the incremental benefits. In addition to the M&I water supply repayment cost, the analysis assumed the M&I beneficiaries would need the payment capacity for other allocated annualized costs.

Table 6-9. Representative Plan Allocated Municipal and Industrial Water Supply Costs ($ million)

Total Investment Cost[1]	**$361.9**
Annualized Costs	
M&I Water Supply Repayment Cost (40-year repayment with interest[2])	$22.1
Operations and Maintenance	$1.2
Additional Hydropower Mitigation Cost	$0.6
SWP Additional Pumping Cost	$3.5
Total[3] Annual M&I Water Supply Cost[1] (40-Year Repayment)	**$27.4**

Notes:
[1] Project features and costs are described in detail in the Engineering Summary Appendix. Costs are presented in millions at a January 2013 price level.
[2] 5.357 percent annual interest rate (U.S. Department of Treasury 2013).
[3] All numbers are rounded for display purposes; therefore, line items may not sum to total.

Key:
M&I = municipal and industrial
SWP = State Water Project

Financial feasibility was determined by comparing the representative beneficiaries’ payment capacity with the annualized costs. At present, the specific M&I water supply beneficiaries have not been identified beyond SWP M&I contractors generally. If new contracts were identified, for the representative plan, the $27.4 million in allocated M&I water supply costs would be spread over an average annual increase of 21,000 acre-feet, and the cost per acre-foot is estimated at $1,305 for M&I water supply beneficiaries ($1,054 for repayment, and $251 for other annualized costs). The allocated cost to M&I beneficiaries would be significantly less than the average payment capacity for representative M&I contractors.

Risk and Uncertainty

Certain assumptions were made for aspects of this report based on engineering and scientific judgment. Careful consideration was given to methodologies and evaluations for hydrology and system operations, cost estimates, and economic analyses, as described in the Modeling Appendix, Engineering Summary Appendix, and Economic Analysis Appendix. Analyses were developed with advanced modeling and estimating tools using historical data and trends and projected future conditions. While this is effective in helping predict outcomes for alternative operations, costs, and economic values, many uncertainties could affect the findings of this Draft Feasibility Report. Various risks and uncertainties associated with the Investigation are discussed below.

Hydrology and Climate Change

Potential climate change could produce conditions different from those for which current water management infrastructure and operations were designed. The magnitude of climate change is widely debated. The State is investing significant resources to study how global climate changes could affect the way California receives and stores water. Results indicate that climate changes in the State could affect hydrology, water temperatures for fish, and future operations for both flood management and water supply deliveries.

California could experience changes in temperature, precipitation, and snow level (DWR 2013a). Any measurable change in these climate indicators could affect future water operations in California. According to the California Water Plan Update (DWR 2013a), more studies are needed before definitive answers can be given:

> *Uncertainties will never be eliminated, but better data collection and management and improved analytical tools will allow water and resource managers to better understand risks within the system. Many water agencies in California have begun incorporating climate change information into their operation and planning process to reduce uncertainty of how climate may affect California's water resources in the future. Additional efforts are needed to develop the accurate climate data needed to reduce uncertainty and risk in California water management in the future.*

Additional information on climate change is included in the Modeling Appendix Attachment C.

Water Supply Reliability and Demands

Water supplies and demands will continue to be subject to annual variability. Demands are expected to exceed supplies in the future. There are numerous variables considered in forecasting expected future water supply and/or shortages in California and, just as important, numerous opinions regarding these variables, depending on the growth scenarios anticipated. The California Water Plan (DWR 2013a) estimates demand for different growth scenarios, ranging from “slow and strategic growth,” that is slower than currently projected, to “expansive growth,” which assumes that population growth will be faster than currently projected, with nearly 70 million people living in California in 2050. Potential for an overall reduction in future demands for agricultural water supplies has been predicted. Reasons for this are conversion from agricultural to urban land uses and implementation of more efficient irrigation water applications.

Future Land Use

Population growth is a major factor in California’s future water picture. California’s population is expected to increase by just over 60 percent by 2050. Population growth could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. Certainly, some portion of increased population growth in the Central Valley would occur on lands currently used for irrigated agriculture. Therefore, water that would have been needed for these lands for irrigation would instead be used to serve replaced urban demands. However, this would only partially offset the required agricultural-to-urban water conversion, since much of the growth would occur on nonirrigated agricultural lands. If it was assumed that all of the urban growth in the Central Valley would occur on lands currently under irrigation, this would only account for up to about 40 percent of expected future conversion needs. The remainder of the agricultural-to-urban water conversion would be required to help sustain urban growth primarily in other areas of the State.

Efficiency in Water Use

While agricultural interests are ever improving in irrigation efficiencies, technology is also being used to be more efficient with all of the supplies that can be acquired. Challenges are greatest during dry years and droughts because in drier years, water dedicated to the environment is curtailed and less water is available for agriculture. Users who have already increased efficiency may find it more challenging to achieve additional water use reductions during droughts.

San Joaquin River Ecosystem Enhancement

Anadromous fish are highly affected by changes in their habitat conditions. Predicting anadromous fish survival is difficult because of many influencing factors; therefore, the models used to predict fish habitat for this Draft Feasibility Report contains assumptions with varying levels of uncertainty.

Limited data exists on the survival of San Joaquin River Chinook salmon as they migrate below the Merced River to the ocean, and then return to spawn (referred to as the SAR), and no SAR data exist that could be directly related to a potential spring-run Chinook population in the San Joaquin River. SAR is known to vary widely between years, largely controlled by ocean conditions or variation in other environmental conditions. These conditions make the SAR especially uncertain.

Without Chinook salmon in the San Joaquin River, an accurate SAR cannot be estimated and used in the modeling. Hypothetical spring-run life histories and a SAR value were developed based on expert advice from the SJRRP Fisheries Management Work Group and were consistent with observed rates for other anadromous fish in the Sacramento-San Joaquin River system (Barnett-Johnson et al. 2008, Buchanan et al. 2013). Results were developed to demonstrate a range of potential results for a low and high potential SAR to account for the uncertainty and limited data. The alternative plans are anticipated to have beneficial effects in support of the Restoration and Water Management goals of the Settlement, including enhancing San Joaquin River habitat for anadromous fish and increasing the volume of Restoration Flows eligible for recapture. There may be numerous other effects that could be the subject of future studies and coordination. The effects of the alternative plans on the SJRRP will continue to be evaluated.

Water System Operations Analysis

Water operations modeling performed for this Draft Feasibility Report was based primarily on operational constraints described in the 2008 OCAP BA (Reclamation 2008c), the 2008 USFWS BO (USFWS 2008a), and the 2009 NMFS BO (NMFS 2009) and associated RPAs. Ongoing consultation processes for the 2008 USFWS and 2009 NMFS BOs have resulted in some uncertainty in future CVP and SWP operational constraints. In response to lawsuits challenging the 2008 and 2009 BOs, the District Court remanded the BOs to USFWS and NMFS in 2010 and 2011, respectively, and subsequently ordered consultation to be reinitiated and preparation of new BOs. These legal challenges may result in changes to CVP and SWP operational constraints if the revised USFWS and NMFS BOs contain new or amended RPAs.

Federal planning policies were used to help estimate which future projects may or may not be implemented; projects were deliberately either included or excluded from water operations models and evaluations. Some projects included in the without-project condition, if not implemented, could influence the findings of this Draft Feasibility Report. Also, some projects not accounted for in the models could change the findings of this Draft Feasibility Report if they are implemented. Changes in Delta exports could also influence future water operations. In addition, changes in hydrology could produce conditions that are different than current water operations were designed for.

Modeling studies may be updated to reflect changes in water operations resulting from ongoing consultation of the Coordinated Long-Term Operation of the CVP and SWP, and other relevant water resources projects and programs, including BDCP efforts. Any updated studies will be incorporated into future Investigation documents.

Implementation of a BDCP alternative could affect the estimated benefits of Investigation alternative plans. The following discussion describes the nature of potential effects.

Analysis of Potential Bay Delta Conservation Plan Alternatives

The BDCP is being prepared collaboratively by Federal, State, and local agencies, environmental organizations, and other interested parties. The BDCP is intended as a comprehensive conservation strategy for the Delta, designed to advance the coequal planning goals of restoring ecological functions of the Delta and improving water supply reliability for large portions of the State of California.

A range of alternatives for providing Delta species/habitat protection and improving water supply reliability is being evaluated through development of an EIS/EIR. The current CEQA Preferred Alternative outlined in the BDCP Draft EIS/EIR and includes a dual-conveyance water delivery system that would consist of new isolated north Delta diversion facilities and the existing SWP/CVP export facilities in the south Delta (Reclamation, USFWS, NMFS, and DWR 2013). The north Delta diversion would be the primary diversion point and would be operated in conjunction with the existing south Delta diversion; the existing south Delta diversion would only operate on its own when the north Delta diversion is nonoperational during infrequent periods for maintenance or repair. Facilities associated with the new north Delta diversion described under the current CEQA Preferred Alternative, Conservation Measure 1 – Water Facilities and Operation, include the following (Reclamation, USFWS, NMFS, and DWR 2013):

- Three new intakes with pumping plants located along the Sacramento River, each with an intake capacity of 3,000 cfs
- An intermediate forebay located near the town of Hood
- A dual-bore 40-foot-inside-diameter tunnel with conveyance capacity of 9,000 cfs by gravity flow from the location of the new intermediate forebay to Clifton Court Forebay

The following discussion describes how implementation of the BDCP could affect the existing system, and how the estimated benefits of Investigation alternative plans could change if a BDCP alternative was implemented.

Water Supply Reliability

All Investigation alternative plans were formulated specifically to increase CVP and SWP water deliveries and water supply reliability. Isolated north Delta diversion facilities implemented as part of the BDCP could increase water deliveries to CVP and SWP SOD water users and improve water quality for urban and agricultural water users. Implementation of the Temperance Flat RM 274 Dam and Reservoir in combination with any BDCP alternative would likely provide greater water supply benefits than implementing either proposed project independently. Temperance Flat RM 274 could increase system flexibility and provide for even greater water supply reliability with implementation of BDCP through operations integration. However, the magnitude of the combined benefits would be dependent upon the BDCP alternative recommended for implementation.

Ecosystem Enhancement

All Investigation alternative plans were formulated specifically to benefit anadromous fish in the San Joaquin River, with a specific focus on improving San Joaquin River water temperature conditions downstream from Friant Dam. The BDCP is anticipated to improve habitat conditions in the Delta for anadromous fish species and increase the survival of out-migrating salmonids in the Delta. The potential effects of BDCP implementation on ecosystem enhancement benefits for the Investigation are unknown.

Planning Opportunities

Investigation benefits for hydropower generation, flood damage reduction, recreation, and urban water quality could also be affected for Investigation alternative plans if BDCP is implemented. Increases in water supply reliability due to system flexibility and potential use of new Delta conveyance facilities could change average water levels in Temperance Flat RM 274 Reservoir and Millerton Lake, affecting planning opportunities. However, the magnitude and timing of these affects are unknown.

Cost Estimates

Cost estimates developed for alternative plans included in this report are based on January 2013 price levels and a 100-year period of analysis. Varying uncertainties are associated with the material and unit costs used to develop the estimates. Unknowns include the future price of construction materials and labor costs. In particular, the construction market has experienced extreme price volatility in the last several years.

A significant market anomaly occurring from 2002 to 2009 skews the calculation of forward cost trends using short-term linear regression techniques.

Although the recent economic downturn has resulted in price decreases, it is expected that prices will continue to escalate over the long term. While future inflation trends are difficult to predict, new market forces (e.g., higher material commodity pricing, energy costs, lack of competition) will likely continue to have significant impacts on heavy civil infrastructure construction costs for the foreseeable future. Because of uncertainty and variability among the short-term regressions, a longer view of the market is preferred. Consequently, while forward cost trends are always difficult to predict, there is some basis to believe that cost escalation is normalizing back to historical levels at approximately 3 percent to 4 percent per year. An allowance for escalation from the January 2013 price level to the Notice to Proceed milestone was not included in the cost estimate. Future studies and coordination should be undertaken to determine an appropriate escalation factor to be used for budgetary approval.

Alternative Refinements

Alternative formulation is an iterative process with the intent to lead to identification of a recommended plan for Federal and/or non-Federal consideration. The alternative plans described in this report could evolve as the Draft Feasibility Report and pending Draft EIS/EIR are reviewed by the public and stakeholders. In addition to some of the other areas of uncertainty described herein, potential adjustments in potential mitigation, and consideration of system integration with other CVP and SWP water supplies and demands. This iterative process is important in refining alternatives to ensure that the plan ultimately chosen as the recommended plan best addresses the planning objectives and Federal and/or State criteria.

Unresolved Issues

As the Investigation progresses toward project implementation, issues will evolve that need to be addressed and resolved. Multiple subject areas need to be addressed during upcoming phases of the Investigation, as described below. In addition, the pending Draft EIS/EIR will contain additional discussion related to areas of controversy and unresolved issues. All reasonable efforts will be made to resolve such issues in the Final Feasibility Report and EIS/EIR.

Non-Federal Partner

To date, interest has been expressed in a potential project implementation to address the identified Investigation planning objectives. Support has been expressed by representatives of CVP contractors, DWR, and other water supply interests.

If authorized for construction, a recommended plan would likely require a portion of its costs to be reimbursed by a non-Federal partner(s). Reimbursable costs include agricultural water supply, M&I water supply and quality, and hydropower.

Native American and Cultural Resources

This Draft Feasibility Report and pending Draft EIS/EIR are consistent with the National Historic Preservation Act (NHPA), Section 106. The Draft and Final EIS/EIR will describe supporting analyses, studies, coordination, impacts, and mitigation, as necessary. Tribal groups will continue to have the opportunity to participate, and are anticipated to continue to provide input to the Investigation through the Section 106 process as an invited consulting party, as well as through the NEPA process.

Environmental Impacts and Mitigation Requirements

Many detailed environmental resources studies have been conducted for the Investigation in support of feasibility analyses and environmental impact assessments. Some of the results of these analyses are documented in this report. The assessment of potential impacts of alternative plans on environmental resources, along with proposed mitigation measures, will be documented in the pending Draft EIS/EIR.

Details about offsite opportunities to mitigate impacts on biological resources in the primary study area are not yet available. Potential mitigation lands containing wetland and special-status species habitat comparable to habitat that would be affected by constructing Temperance Flat RM 274 Dam and

Reservoir have been identified near the study area. How conservation and enhancement efforts on these lands may be applied for mitigation of loss of habitat will be discussed in more detail in future documents.

Special Designations

During development of the Draft Bakersfield RMP and EIS (2011 and 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 Interior determination of suitability or nonsuitability and submittal of reports to the president. The president would then report recommendations to the 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.

Water Rights

To facilitate implementation of the alternative plans and associated operations, Reclamation may need to amend its existing water right permits on the San Joaquin River for Friant Dam operations. Potential changes could include the location(s) and amounts for direct diversion for consumptive use and storage, season(s) of diversion and storage, purposes of use, and the place of use. Additional project measures such as transfers, exchanges, modifications to hydropower operation, dedicated in-stream flow releases, or emergency supply may need additional water right petitions. Other components of the alternative plans, such as transfers, exchanges, hydropower operations modifications, releases for ecosystem, and emergency supply, may require addition al water right petitions.

Reclamation would comply with the CWC to pursue a petition of change to its existing water rights for implementing the preferred plan. The EIS/EIR will contain the necessary information to support the State Water Board's discretionary action on deciding on a potential petition, including compliance with CEQA. Before approving any potential water right petitions, the State Water Board, under CWC Section 1707, would be required to find that (1) the proposed change would not increase the amount of water Reclamation is entitled to use, and (2) the proposed change would not unreasonably affect any legal user of water. As part of the petition, Reclamation may provide supplemental information, including overriding considerations, if any.

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.

Next Steps for Feasibility Study

This Draft Feasibility Report is a significant milestone in the Investigation. As the Investigation progresses, Reclamation will continue to evaluate and refine alternative plans and address unresolved issues and concerns. Based on the findings of the Investigation to date, the following items comprise the next steps.

Solicit Input on Draft Feasibility Report

Reclamation will solicit public input on this report.

Alternative Plan Refinement

As the Investigation progresses, Reclamation will continue to refine and evaluate alternative plans to respond to public comments and reflect potential changes to existing and likely future conditions. Additional refinement of alternative plans is expected based on public and stakeholder input on the Draft Feasibility Report and Draft EIS/EIR and updates to operations modeling and economic studies. Conditions in the San Joaquin River basin and Delta are also complex and subject to change.

Operations studies may be updated to reflect water operations resulting from ongoing consultation of the Coordinated Long-Term Operation of the CVP and SWP and other relevant water resources projects and programs, including, potentially, BDCP efforts. The results of these updated studies would be incorporated into future Investigation documents. Future studies based on updated water operations would require revising several models and related analyses to reflect potential changes for each of the project resource areas.

Environmental Compliance Documentation and Mitigation Requirements

Reclamation will prepare, release, and solicit input on the separate Draft EIS/EIR. The Draft and Final EIS/EIR will include an evaluation of environmental effects and mitigation measures for each alternative plan, consistent with NEPA. Compliance documents will also be prepared to address potential impacts to special-status species protected under the ESA. The environmentally preferable alternative will be identified in the ROD. Preliminary cost allowances for environmental mitigation were prepared for this report. Environmental mitigation costs will be updated to reflect detailed plans and cost estimates for specific activities to mitigate impacts on environmental resources, which will be identified in the Draft and Final EIS/EIR.

Update Economic and Financial Evaluations

Future economic and financial evaluations will focus on updating estimates of benefits of the alternative plans, and further refining the preliminary allocation of costs to project purposes using the SCRB method. If authorized for construction, the proposed plan would require a portion of its costs to be shared and/or reimbursed by a non-Federal partner(s). Reclamation also plans to refine analyses for the financial capability of project beneficiaries. Further efforts are also planned to identify and confirm specific non-Federal partner(s) and beneficiaries. In addition, if the SBX7-2 bond measure passes, Reclamation will investigate use of bond funding for the public benefits of Temperance Flat RM 274 Dam and Reservoir.

Refine Feature Designs and Update Cost Estimates

Upcoming activities to support continued feature designs include performing additional geologic investigations, and refining feature designs and cost estimates, including river outlet works and diversion plan, additional low-level outlet, reservoir clearing, and affected facilities. Facility cost estimates will be updated with current unit pricing and escalation. Estimates for non-contract costs will also be refined, including project area lands requirements, and environmental and cultural resources mitigation costs consistent with mitigation requirements identified in the Draft and Final EIS/EIR.

Selection of Recommended Plan/Preferred Alternative

At this stage of the Federal planning process, a representative plan is presented but a recommended plan has not been identified. Further refinement and changes may occur to the alternative plans after input from agencies, stakeholders, and the public.

Continued Coordination and Evaluations

As the Investigation progresses, Reclamation will continue to coordinate with stakeholders and other agencies to address and resolve issues related to water rights, Native American and cultural resources, biological investigations and mitigation, non-Federal partner(s), special designations, and hydropower mitigation. Reclamation will continue to coordinate activities with other relevant projects and programs, including BDCP, SJRRP, and the RPAs resulting from the consultation process for the Coordinated Long-Term Operation of the CVP and SWP.

Implementation Requirements

After the feasibility study is completed the following requirements would need to be addressed before the project could be implemented.

Feasibility Report Approval

The Final Feasibility Report would be submitted by the Commissioner of Reclamation to the Secretary of the Interior. The Secretary may accept or revise the Final Feasibility Report. After review by the Office of Management and Budget, in accordance with Executive Order 12322, the Secretary would transmit a Final Feasibility Report, Final EIS, and ROD to the U.S. Congress to determine the type and extent of Federal interest in the project. The Secretary may recommend any of the alternatives considered, including No-Action.

Federal Project Authorization and Funding

If Congress authorizes project construction, the authorized project would be included in either an appropriation act or the president's budget based on (1) national priorities, (2) magnitude of the Federal commitment, (3) level of local support, (4) willingness of the non-Federal partner(s) to fund its share of the project costs, and (5) budgetary constraints that may exist at the time of construction.

Non-Federal Project Authorization and Funding

Federal funding may be supplemented by State or local funding in various ways. If passed by voters, State or local bonds could provide funds to pay costs allocated to State or local taxpayers. For example, if passed by California voters, Chapter 8 of SBX7-2 would provide general obligation bond funds for various projects and programs to address ecosystem and water supply issues and these funds may be eligible for public benefits of a recommended plan.

Regulatory and Related Requirements for Environmental Compliance

Construction and operations of any recommended plan would be subject to applicable requirements of Federal, State, and local laws, policies, and environmental regulations. Reclamation would need to obtain various permits and regulatory authorizations before any project construction could begin.

In addition to NEPA requirements, major permits and approvals potentially required for project implementation are shown in Table 6-10. These would be in addition to compliance with a number of environmental regulatory requirements as part of the NEPA process.

Table 6-10. Summary of Potential Major Permits and Approvals for Project Implementation

Agency Permit/ Approval	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]	Anticipated Fees
Federal			
USACE Clean Water Act Section 404 Rivers and Harbors Act Section 10 Permit	• Application • ESA compliance document for submittal to USFWS/NMFS/CDFW • Section 401 Water Quality Certification permit or application • NEPA documentation (environmental compliance documents) • NHPA, Section 106 compliance documentation • Wetland delineation • CWA, Section 404 (b)(1) evaluation and identification of the Least Environmentally Damaging Practical Alternative • Mitigation and monitoring plan	24 months	$100 for Individual permit (may be waived for government permitees)
USFWS/NMFS Endangered Species Act Section 7 Consultation	• Regular formal and informal technical consultation • ESA compliance document • Draft Biological Assessment	18 months	None
NMFS **Essential Fish Habitat Assessment**	• Regular formal and informal technical consultation • Biological Assessment • Draft environmental compliance documents	18 months	None
USFWS Fish and Wildlife Coordination Act	• Service agreements among USFWS, NMFS, and CDFW • Regular Informal technical coordination • Draft environmental compliance documents	12 months	None
USFWS Bald and Golden Eagle Protection Act	• Application • EIS/EIR compliance document • Pre-construction survey report(s) • Eagle management Plan	TBD	TBD
SHPO[3]/ACHP National Historic Preservation Act, Section 106	• Historic Property Inventory Report • Native American consultation • Impacts to Indian trust resources and sacred sites • Environmental compliance documents	24 months	None
BLM Special-Use Permits (e.g., livestock grazing, forest products)	• Application	TBD	TBD

Table 6-10. Summary of Potential Major Permits and Approvals for Project Implementation (contd.)

Agency Permit/ Approval	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]	Anticipated Fees
State			
Central Valley Water Board Clean Water Act Section 401	• Application • Fish and Game Code Section 1602 application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation and monitoring plan (if needed)	6 months	$500+
CDFW California Endangered Species Act Section 2081—Incidental Take Permit or 2080.1 Consistency Determination	• Informal technical consultation • Application, if requesting a 2081 Incidental Take Permit • Biological opinion and incidental take statement, if requesting a consistency determination	9 months	None
CDFW **Fish and Game Code Section 1600 Streambed Alteration Agreement**	• Application • CWA Section 401 Water Quality Certification permit or application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation plan	9 months	$4,000
State Water Board Amended Water Right	• Application • Draft (possibly final) environmental compliance documents	12 months	$440,000
State Lands Commission Land Use Lease	• Application • Draft environmental compliance documents	9 months	$25
State of California Department of Transportation Encroachment Permit	• Application • Permit Engineering Evaluation Report	60 days	None
California Department of Conservation California Surface Mining and Reclamation Act Permit	• Application	TBD	TBD

Table 6-10. Summary of Potential Major Permits and Approvals for Project Implementation (contd.)

Agency Permit/ Approval	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]	Anticipated Fees
Local			
Fresno and Madera Counties Construction-Related Permits	• Demolition, grading, building, mechanical, and utility construction and encroachment permits; and easements	TBD	TBD
SJVAPCD Dust Control Plan	• Dust Control Plan • Dust Control Training Course • Preapplication meeting (encouraged)	2 months	TBD
SJVAPCD Authority to Construct and Permit to Operate	• Application • Preapplication meeting (encouraged) • Required conformity and inclusion in the State Implementation Plan	6 months	$75

Notes:
[1] All permit applications require detailed project description information.
[2] Anticipated processing time is estimated based on submittal of initial permit applications to permit issuance.
Key:
ACHP = Advisory Council on Historic Preservation
BLM = U.S. Department of the Interior, Bureau of Land Management
CDFW = California Department of Fish and Wildlife
Central Valley Water Board = Central Valley Water Quality Control Board
CWA = Clean Water Act
EIR = Environmental Impact Report
EIS = Environmental Impact Statement
ESA = Endangered Species Act
NEPA = National Environmental Policy Act
NHPA = National Historic Preservation Act
NMFS = National Marine Fisheries Service
PRC = Public Resources Code
SHPO = State Historic Preservation Officer
SJVAPCD = San Joaquin Valley Air Pollution Control District
State = State of California
State Water Board = State Water Resources Control Board
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

In addition to the major Federal, State, and local environmental requirements detailed in Table 6-10, the proposed plan considered may be subject to other applicable laws, policies, or plans. Table 6-11 summarizes other laws, policies, and plans that may potentially affect the development of any plan.

Table 6-11. Summary of Applicable Laws, Policies, Plans, and Permits Potentially Required

Level	Laws, Policies, Plans, and Permits
Federal	Federal Endangered Species Act
	Section 404 of the Clean Water Act
	Rivers and Harbors Act Section 10
	National Historic Preservation Act, Section 106 (1966)
	Migratory Bird Treaty Act
	Fish and Wildlife Coordination Act
	Executive Orders 11990 (Wetlands Policy), 11988 (Flood Hazard Policy), and 12898 (Environmental Justice Policy)
	Indian Trust Assets
	Americans with Disabilities Act
	Rehabilitation Act
	Farmland Protection Policy
	Federal Transit Administration Activities and Programs
	Architectural Barriers Act
	Federal Cave Resources Protection Act (1988)
	Executive Order 11312 (National Invasive Species Management Plan)
	Magnuson-Stevens Fishery Conservation and Management Act
	National Wild and Scenic Rivers System
	Federal Land Use Policies
	Federal Water Project Recreation Act
	Millerton Lake Resource Management Plan and General Plan
	San Joaquin River Gorge Recreation Area
	Federal Energy Regulatory Commission Permitting Requirements
	U.S. Army Corps of Engineers, Reservoir Regulation Manual for Flood Control Friant Dam and Reservoir
	Uniform Relocations Assistance and Real Properties Acquisition Act of 1970, as amended (Public Law 91-646 and Public Law 100-17)
State	California Public Resources Code
	Clean Water Act, Section 401
	California Endangered Species Act
	California Fish and Game Code, Fully Protected Species
	California Fish and Game Code, Section 1600 – Streambed Alteration
	Porter-Cologne Water Quality Control Act
	California Native Plant Society Species Designations
	Reclamation Board Encroachment Permit
	California Water Rights
	State Lands Commission Land Use Lease
	State of California General Plan Guidelines
	California Department of Transportation, Encroachment Permit and Activities, Programs
	California Land Conservation Act of 1965 (Williamson Act)
	California Native Plant Protection Act
	California Department of Boating Activities and Programs
	California Scenic Highway Program
	California Wild and Scenic Rivers Act
	Millerton Lake Resource Management Plan and General Plan
Local	San Joaquin Valley Air Pollution Control District Dust Control Plan
	San Joaquin Valley Air Pollution Control District Authority to Construct and Permit to Operate
	California Government Code General Plan Requirements (municipal general plans)
	Other Applicable Local Permits and Requirements

Advanced Planning and Design Activities

In addition to the environmental compliance efforts described above, other significant advanced planning and design activities would be required before implementation of an action alternative. Several key activities include the following:

- Develop a Definite Plan Report and associated advanced planning studies, including preparing detailed plans, specifications, and bid packages
- Establish agreements for reimbursable project purposes
- Develop and/or revise O&M and related plans
- Acquire required lands

Federal and Non-Federal Responsibilities

If Congress authorizes a project, Federal and non-Federal obligations and requirements would be contained in a Project Cooperation Agreement (PCA).

Federal Responsibilities

If recommended for implementation, Reclamation and/or future project partners or beneficiaries would perform preconstruction and design studies for the recommended plan, which may require updated economic and/or environmental analyses and documentation. After PCAs are signed and non-Federal partners have provided any required financial contributions and assurances, the Federal Government would acquire real estate and/or relocate displaced parties according to Public Law 91-646 and construct the project modifications and related mitigation requirements. Reclamation and other Federal agencies (e.g., BLM) would be responsible for various O&M activities, as shown in Table 6-12.

Table 6-12. Potential Federal and Non-Federal Responsibilities for Various Project Component O&M

Facility	Responsibility
Temperance Flat RM 274 Dam and Reservoir (including outlet works)	Reclamation
Temperance Flat RM 274 Powerhouse and Transmission Line	TBD
Transmission Line Relocations	PG&E
Recreational Facilities (BLM facilities)	BLM
Recreational Facilities (reservoir facilities)	State Parks
Utilities	Various Non-Federal

Key:
BLM = U.S. Bureau of Land Management
O&M = operation and maintenance
PG&E = Pacific Gas and Electric Company
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RM = river mile
State Parks = California Department of Parks and Recreation
TBD = to be determined

Non-Federal Responsibilities

Before implementation, the non-Federal partner(s) for both reimbursable and nonreimbursable costs would agree to perform items of local and state cooperation specific to the authorized purposes of the project. A non-Federal partner needs to be identified for each of the reimbursable project purposes. For most and possibly all of the reimbursable purposes, the non-Federal partner would need to share in the cost of the authorized project.

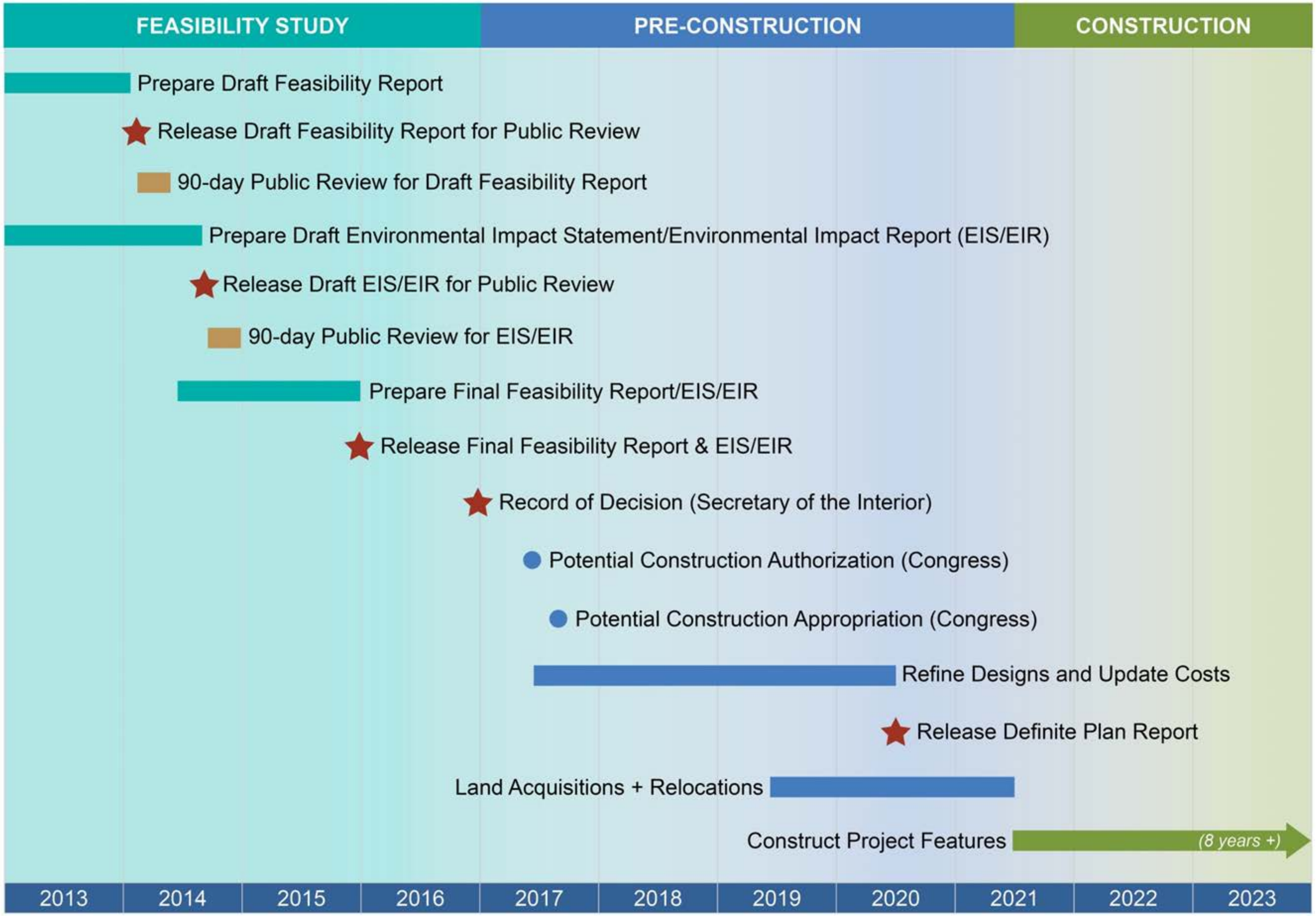
Timeline and Status of Feasibility Study

Table 6-13 summarizes major activities that have either occurred, or are planned to occur, as a part of the Investigation. A timeline of major actions to complete the Investigation and future milestones leading to project implementation is shown in Figure 6-1. If Congress authorizes a project and appropriates funds, then detailed project designs would be initiated, a Definite Plan Report would be prepared, and any necessary real estate acquisitions could be initiated before initiating project construction. The initial phase of construction-related activities would include acquiring any necessary real estate interests and/or relocating displaced parties according to Public Law 91-646, acquiring necessary permits, and relocating infrastructure within the reservoir area. Construction activities for project features would likely span 8 or more years.

Table 6-13. Summary and Status of Feasibility Study Activities

Activity	Description
Completed and Ongoing Activities	
Federal authorization	Federal authorization for the Investigation was initially provided in Public Law 108-7, Division D, Title II, Section 215, the omnibus appropriations legislation for fiscal year 2003, 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 (2000a), including the Investigation. Subsequent authorization for the Investigation and funding was provided in Public Law 108 361, Title I, Section 103, Subsection (d)(1)(A)(ii), the Water Supply, Reliability, and Environmental Improvement Act, signed October 25, 2004.
Phase 1 Investigation Report (report issued October 2003)	Evaluated 17 possible reservoir sites in the eastern San Joaquin Valley and selected 6 for continued study, as documented in the Phase 1 report.
Formal initiation of environmental compliance processes (NOI/NOP) (February 2004)	Formal initiation of environmental compliance processes began with the NOI/NOP, consistent with Federal and State regulations.
Public Scoping (report issued December 2004)	Results of the public scoping process were documented in the Scoping Report. This document reports the results of a series of public scoping meetings held throughout California for the Investigation.
Initial Alternatives Information Report (report issued June 2005)	The six reservoir sites retained from Phase 1 were evaluated, and other reservoir storage sites added in response to comments received during public scoping, and identified potential groundwater storage measures.
Plan Formulation Report (report issued October 2008)	This report outlines the formulation, comparison, and evaluation of comprehensive alternative plans that address Investigation planning objectives and opportunities.
Draft Feasibility Report (report issued January 2014)	The Draft Feasibility Report is a Federal decision document that describes the study process, major results, potential recommended plan, Federal/non-Federal responsibilities and sponsorship, and future actions.
Draft EIS/EIR and Related Documents (scheduled for 2014)	The Draft EIS/EIR will provide environmental compliance documentation consistent with NEPA and CEQA for the alternatives presented in the Draft Feasibility Report, which will be incorporated by reference.
Washington D.C.-level Review and Processing (scheduled for 2015)	The Final Feasibility Report, Final EIS/EIR, and ROD will be reviewed and processed within the Department of the Interior and the President’s Office of Management and Budget before public release.
Final Feasibility Report and Accompanying Final EIS/EIR (scheduled for 2015)	Following public and agency review, the Final Feasibility Report and Final EIS/EIR will incorporate responses to comments made on the draft report and include a plan recommended for implementation.
ROD (scheduled for 2016)	The Secretary of the Interior will issue a ROD for the Investigation, which will identify the Recommended Plan, identify alternatives considered, including the environmentally preferable alternative; and describe mitigation plans, including any enforcement and monitoring commitments.
Congressional Authorization (scheduled for 2017)	Congress will review and vote on whether to authorize the project. Legislation containing construction authorization would be sent to the president for approval.

Key:
CALFED = CALFED Bay-Delta Program
CEQA = California Environmental Quality Act
EIS/EIR = Environmental Impact Statement/Environmental Impact Report
Investigation = Upper San Joaquin River Basin Storage Investigation
NEPA = National Environmental Policy Act
NOI = Notice of Intent
NOP = Notice of Preparation
ROD = Record of Decision



Note: Subject to refinement/change during remainder of feasibility study.

Figure 6-1. Upper San Joaquin River Basin Storage Investigation Project Timeline

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Chapter 7
Coordination and Public Involvement

Efforts to engage the public, stakeholders, federally recognized tribes, Native American tribal groups, public agencies, and other interested parties continue to play an important role in the Investigation. In addition to ongoing public and stakeholder outreach, the Project Coordination Team (PCT) continues to facilitate participation by the Investigation's numerous cooperating agencies.

This chapter describes the outreach and coordination approach for the Investigation, and continuing activities for communicating with the public and coordinating with stakeholders, federally recognized tribes, Native American tribal groups, cooperating agencies, and other interested parties.

Public Involvement Plan

From the inception of the Investigation in late 2001, 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. Specifically, the public involvement plan is designed to address issues of interest and concern to the public, stakeholders, and other interested parties engaged in local and regional water resources planning. The plan supports Reclamation's efforts to work with interested parties to develop alternatives for increasing storage in the upper San Joaquin River Basin, and is consistent with Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). Elements of the plan have evolved throughout the Investigation, and its principles continue to guide outreach and engagement conducted in support of the feasibility study.

The plan describes a system and set of activities through which four objectives are met:

1. **Stakeholder Identification –** This effort is ongoing and consists of identifying 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.

2. **Project Transparency –** Providing information and study results to the public, stakeholders, and other interested parties is an important practice to facilitate stakeholder understanding of the process and project. Distributing study information occurs through the media, Web postings, public meetings, stakeholder meetings, public presentations, mailings, and other means.

3. **Issues and Concerns Resolution –** Equally important as project transparency is gaining awareness of the issues and concerns of the public, stakeholders, and other interested parties, and establishing a mechanism for the Investigation team to learn of problems early. Using various public involvement processes, the Investigation team has addressed, and will continue to address, issues and concerns in an effective and timely manner.

4. **Project Implementation –** Critical to developing an implementable project is ensuring that planning objectives are met, and, to the greatest extent possible, that opportunities are also met. In addition, the project would need to address other issues, and not harm the environment, people, or people’s property. Accordingly, one goal of the plan has been to build a communications network in which policymakers understand the objectives and benefits of the project, and can conclude for themselves that the project has met all requirements necessary to be implemented. Ensuring policymakers receive the necessary information to make this informed decision is an important component of the plan.

The public involvement plan maintains two primary themes, outreach and information, as discussed in the following sections. Associated with these themes are procedures that enable the overall Investigation to satisfy the public involvement requirements of NEPA and CEQA for development of an EIS/EIR.

Outreach

The interactive components of the public involvement plan facilitate participation of the public, stakeholders, and other interested parties and provide the opportunity for them to effectively participate in the development of the Investigation. Stakeholders in the study area bring a high level of experience and local knowledge to the process, and provide a variety of recommendations, responses, and reviews that likewise inform the plan formulation process. Outreach components are designed to provide information and materials to a broad group of interested parties.

Outreach elements include: stakeholder and public meetings and workshops, tribal coordination, Technical Working Group (TWG) coordination, and PCT and Study Management Team (SMT) activities.

- **Stakeholder/Public Meetings/Workshops –** Stakeholder and public meetings and workshops are important to enable the overall Investigation to satisfy the public involvement requirements of NEPA and CEQA, and also to afford the public, stakeholders, and other interested parties the opportunity to participate in development of the Investigation.

- **Tribal Coordination –** Specific outreach activities oriented toward communicating with federally recognized tribes and Native American tribal groups.

- **Technical Working Groups –** The TWGs provided critical support in defining and clarifying alternative plans and analyses for the prior phases of the Investigation. These TWGs were organized by key topics, including water operations and management, hydropower, economics, engineering, and environmental compliance. The participants and meeting frequency for each TWG vary, depending on needs identified by the SMT.

- **Project Coordination Team and Study Management Team Activities –** The PCT includes the Reclamation Project Manager and technical experts from various disciplines and organizations, while the SMT comprises key policy and decision makers with direct influence over policy guidance for the study. The SMT provides overall guidance, suggestions, and comments for the study.

Information Dissemination

To ensure project transparency and to keep the public, stakeholders, and other interested parties informed on study progress, study-related information is disseminated in a number of ways:

- **Investigation Updates** – Reclamation produces periodic informational brochures and distributes them to the study mailing list and on the Web. To date, the timing of these brochures have coincided with major Investigation milestones, provides “snapshots” about the feasibility study process, and highlights upcoming events related to the Investigation.

- **Web Site** – An Investigation Web site hosted by Reclamation contains presentations used at public workshops and meetings, Investigation updates, contact information for Reclamation’s Project Manager on the Investigation, and technical documents prepared to date, including the Phase 1 Investigation Report (Reclamation 2003), the IAIR (Reclamation 2005b), the PFR (Reclamation 2008a), and other Investigation-related documents. The Web site, which serves as a gateway for contacting the Investigation team, has been a key feature in outreach efforts and will continue to be used as the Investigation proceeds. The Investigation Web site address is: http://www.usbr.gov/mp/sccao/storage

- **Media Relations –** Media relations for the study have included news releases, media advisories, calendar activities, and editorial board visits. The media relations effort, which is led by Reclamation, is flexible to ensure prompt responses to comments, questions, or information regarding the Investigation.

- **Stakeholder and Agency Briefings –** The Investigation’s SMT has presented information on study topics of interest at the request of stakeholder groups and agencies. The stakeholder briefing program will continue to serve as an outreach mechanism for disseminating information, gathering comments, and providing responses.

Public Engagement

Substantial efforts have been made to date to communicate with the public, stakeholders, and other interested parties about the Investigation. The following sections describe public engagement activities conducted for the Investigation to date.

Meetings

Since Phase 1 began in 2001, the Investigation team has conducted public meetings to provide participants with updates on progress of the Investigation. Public meetings and workshops have had, and will continue to play, a major role in the overall study process. Future public meetings and workshops will be scheduled at important points in the Investigation.

Workshops

A series of workshops and meetings were held during Phase 1 of the Investigation. Participants had opportunities to hear presentations by the study team, take part in discussions regarding preliminary plan formulation, and provide input about the planning process, analyses, and project documents. This process included six general workshops and one topic-oriented working session. Workshop participants included representatives of water agencies, counties, Federal and State agencies, water districts, environmental interest groups, and others with an interest in the Investigation. The workshops, which were held in a variety of locations within the study area, and were announced via e-mail, mailed postcards, and the project Web site, were well attended.

Environmental Scoping

Reclamation and DWR initiated an environmental compliance process for the Investigation consistent with NEPA and CEQA in February 2004 when the agencies issued an NOI and an NOP, respectively. During the week of March 15, 2004, Reclamation and DWR convened a set of public scoping meetings in Sacramento, Modesto, Friant, and Visalia, California, to inform interested groups and individuals about the Investigation and to solicit ideas and comments. An Environmental Scoping Report was prepared consistent with Reclamation guidance and in compliance with NEPA requirements, and released in December 2004 (Reclamation 2004d). The report describes the scoping process, comments received during scoping, and how these comments would be addressed as part of the Investigation.

Stakeholder Outreach

Meetings and workshops with the stakeholder community play a major role in the Investigation's overall study process. Each meeting or workshop has been scheduled at critical milestones of the investigation. However, between milestones, the PCT continues to conduct numerous focused meetings and presentations aimed at maintaining frequent stakeholder communication regarding study status, results to date, and direction.

Stakeholder outreach activities completed to date include briefings for congressional representatives, local elected officials, Native American tribal groups, immediate Study Area interests, water and hydropower interests, and environmental interests. Additionally, the following sections describe workshops, study area tours, interviews with local stakeholders, and ongoing stakeholder and agency briefings to support stakeholder outreach.

Study Area Tours

Several study area tours of Millerton Lake and the proposed Temperance Flat RM 274 Dam and Reservoir area were conducted for stakeholder groups during the Investigation.

Investigation representatives have participated in a number of tours of Millerton Lake, the upper San Joaquin River, and the Friant Division service area. Many of the tours were organized by groups with an interest in regional water resources issues, including the Friant Water Authority, California Agricultural Irrigation Association, California Latino Water Coalition, and State legislators and their staff. During each tour, Investigation staff provided updates on Investigation status and recent technical findings. The tours provided interested parties a firsthand view of several of the surface storage sites under consideration, the San Joaquin River, and other features of interest in the eastern San Joaquin Valley. As the Investigation proceeds, participation will continue in regional events that address water and other natural resources management issues to the greatest extent possible.

Interviews with Local Stakeholders

As part of the approach to identify and evaluate conjunctive management opportunities that have the potential to support Investigation purposes, DWR staff conducted one-on-one interviews with local stakeholders regarding regional, cooperative opportunities for groundwater storage and banking. These interviews identified a high level of interest among the stakeholders. During the interviews, some possible projects were identified that could be considered for their applicability to support Investigation objectives and opportunities. In addition, many stakeholders made note of important physical and legal constraints that could affect implementation of conjunctive management options and suggested programmatic concepts to address institutional and financial barriers to increasing conjunctive management.

Ongoing Stakeholder and Agency Briefings

Outreach and briefings for the Investigation have been organized by Reclamation and at the request of agencies and stakeholder groups to present information on study topics of interest. The purpose of the briefings is to update stakeholders on completed analyses and evaluations, upcoming efforts and studies, and overall project status and schedule. Briefings also serve as a mechanism for gathering comments and providing responses to interested parties.

Agency Coordination

Agency consultation and involvement has occurred throughout the study to date, both informally and formally. The Investigation study management structure includes the active participation of numerous cooperating agencies pursuant to NEPA, representatives from resources agencies, and other stakeholders.

Key elements of agency coordination activities are the Draft EIS/EIR, the Planning Aid Memorandum and Coordination Act Report (documents to be issued by USFWS), and documents to be issued by USACE under CWA Section 404. Cooperating agencies are participating in coordination meetings and are being requested to comment on Draft EIS/EIR sections under development that are within their jurisdiction, expertise or authority. The USFWS submitted a Planning Aid Memorandum outlining areas of potential concern to Reclamation (2007). During 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.

Coordination with Tribal Governments and Native American Representatives

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 have met periodically with Native American tribes to provide updates on progress and to receive input on issues of concern. In general, tribal briefings coincide with public meetings at key Investigation milestones. As the Investigation proceeds, coordination will continue with the tribes in accordance with Federal guidance.

Public and Agency Review and Comment

Public and agency outreach and involvement in the Investigation for this Draft Feasibility Report, the separate pending Draft EIS/EIR, and their appendices will include stakeholder workshops to brief attendees on key findings.

As the Investigation progresses toward completion of the Draft and Final EIS/EIR, public involvement and coordination with stakeholders and agencies to improve understanding of the Investigation, benefits, and impacts will intensify. These activities, particularly those to support preparation of the EIS/EIR, will be geared toward continued compliance with NEPA, Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), and the president's April 29, 1994, memorandum regarding the engagement of federally recognized tribal governments.

Once the Draft EIS/EIR is available, a Notice of Availability will be published in the Federal Register and select newspapers, in compliance with NEPA and CEQA, and formal workshops and public hearings will be held at that time to receive comments. The Feasibility Report and EIS/EIR will be finalized considering responses to public and agency comments.

Chapter 8
Findings

This chapter summarizes major findings of the Draft Feasibility Report. In conjunction with this Draft Feasibility Report, a Draft EIS/EIR is being prepared for separate distribution and public review. At this stage of the planning process, none of the alternatives have been selected or recommended for implementation, or identified as a preferred alternative.

Feasibility

The Investigation is a joint feasibility study by Reclamation, in cooperation with DWR, and includes development, evaluation, and comparison of alternatives consistent with the P&G (WRC 1983). This section summarizes major findings of related to evaluations of the technical, environmental, economic, and financial feasibility of the alternative plans.

Technical Feasibility

The alternative plans are projected to be technically feasible, constructible, and can be operated and maintained:

- Designs and cost estimates of project features in this Draft Feasibility Report have been developed primarily to a feasibility-level, but will not be suitable for use for congressional authorization and appropriation until the Final Feasibility Report.

- Additional review, including a feasibility-level DEC review, will be completed once Draft Feasibility Report comments on engineering features from the public, public agencies, stakeholders, and other interested parties have been addressed.

- Operations of the representative plan are technically feasible under existing laws, infrastructure, and operating agreements. Potential refinements to the operations of the representative plan may include further consideration of the balance between active storage and carryover storage, and/or additional scenarios that balance economic and financial feasibility based on stakeholder input.

Environmental Feasibility

Environmental analyses conducted to date suggest that the alternative plans would be environmentally feasible:

- Environmental analysis conducted to date includes terrestrial biological resources analyses, wetland delineations, aquatic biological resources analyses, and cultural resources analyses.
- Environmental impacts of the alternative plans will be evaluated further in the pending Draft EIS/EIR, and the analyses are anticipated to further demonstrate environmental feasibility.
- Environmental effects will be evaluated and mitigation measures for each alternative plan will be identified. An environmentally preferable alternative, consistent with NEPA, will be identified in the Final EIS/EIR.

Economic Feasibility

The alternative plans are estimated to be economically feasible:

- All alternative plans would provide estimated benefit values that exceed the estimated costs, with the exception of Alternative Plan 3 under high SAR conditions.
- Alternative Plan 4 has the highest net benefits of the alternatives evaluated in this Draft Feasibility Report and is currently estimated to be the most economically feasible.
- The monetary valuation of ecosystem benefits is challenging, but the range of benefits clearly illustrates that the ecosystem benefits are sufficient to demonstrate economic feasibility.
- Additional monetary benefit categories could be analyzed for the Final Feasibility Report, if any are identified, and a valuation methodology agreed upon.
- Potential supplemental refinements to alternative plan features, hydropower mitigation strategies, and their associated cost estimates for the Final Feasibility Report will also have an effect on the relative economic feasibility of the alternatives.

Financial Feasibility

Based on preliminary analyses of the representative plan, the alternative plans are projected to be financially feasible, depending upon the approach to recover costs. Financial feasibility analyses will be refined for the Final Feasibility Report.

- For CVP agricultural water supply, the marginal increase in the cost of water for existing agricultural contractors would be approximately $3.95 per acre-foot ($3 for repayment and $0.95 for other annualized costs). If new contracts were required, agricultural water costs would be approximately $212 per acre-foot ($161 for repayment and $51 for other annualized costs). Based on current CVP and SWP operational assumptions and studies to date with the representative plan, agricultural water supply beneficiaries only have the ability to pay the marginal increase in the cost of water.

- For M&I water supply, if new contracts were required, M&I water costs for the project would be approximately $1,305 per acre-foot ($1,054 for repayment, and $251 for other annualized costs).

- The benefits of the alternative plans affect more than one party and implementation of an alternative plan would require non-Federal partner(s).

Alternatives

Key findings related to iterative formulation and evaluation of alternative plans in this Draft Feasibility Report are summarized in this section. Consideration of comments received on the Draft Feasibility Report and pending Draft EIS/EIR related to the alternative plans will be reflected in the Final Feasibility Report.

Alternatives Formulation

- The alternative plans were formulated to provide a representative range of potential features, operations, and benefits of Temperance Flat RM 274 Reservoir.

- All alternative plans include constructing Temperance Flat RM 274 Dam and Reservoir in the upstream portion of Millerton Lake. The alternative plans vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and minimum carryover storage targets) and intake feature configurations (fixed low level or selective level). Variations in other physical features were considered during the development of feasibility designs and cost estimates, but the preferred approaches were identified during feasibility-level design and are reflected consistently in the alternative plans.

- The formulation of potential operations scenarios for Temperance Flat RM 274 Reservoir is based on meeting the primary planning objectives of water supply reliability and ecosystem improvements, followed by secondary objectives of hydropower, recreation, flood damage reduction, and water quality. Accordingly, operations are intended to balance the primary and secondary objectives, which can be challenging with many trade-offs between competing objectives. Each alternative plan addresses the planning objectives in varying degrees.

- The alternative plans evaluated in this report were formulated to be largely independent of Delta export operations with a focus on development of San Joaquin River water supplies only. Plan formulation involved balancing traditional economic benefits dependent on active storage capacity (water supply and flood damage reduction) and public benefits influenced by minimum carryover storage target (cold-water pool, emergency water supply, recreation, and hydropower). This balancing was intended to increase net benefits and potential public benefits, and incorporate the various planning objectives.

Alternatives Evaluations – Accomplishments and Benefits

- All alternative plans would provide accomplishments and benefits for water supply reliability, enhancement of the San Joaquin River ecosystem, emergency water supply, hydropower, recreation, and flood damage reduction.

- The accomplishments and benefits of the alternative plans highlight trade-offs between traditional benefits related to total active storage and public benefits related to carryover storage. Agricultural, M&I, and refuge water supply increase with greater active storage, which would capture more San Joaquin River flood flows. For ecosystem improvements, greater active storage correlates to more new water supply and, therefore, more potential flow-related improvements, while greater carryover storage can support better water temperature-related improvements. San Joaquin River ecosystem improvements are also related to water supply routing, and increase when using the river as a water supply conveyance route.

- The alternative plans formulated in this Draft Feasibility Report are estimated to be feasible, but have been formulated conservatively and independent of Delta operations. The amount of new water supply that could be developed by Temperance Flat RM 274 Reservoir is strongly influenced by a variety of factors, including minimum carryover storage, CVP and SWP operating conditions in the Delta, and conveyance improvements. Results from sensitivity evaluations were included to demonstrate the range of variability that could be expected under a wider range of operations conditions.

- Integration of Temperance Flat RM 274 Reservoir operations with the CVP and SWP is not included in the alternative plans; however, previous evaluations show that doing so would significantly increase water supply and other benefits under potential future conditions with increased flexibility for Delta export operations.

- Climate change could affect water supply reliability and other resources in the No Action Alternative and all alternative plans.

Alternatives Evaluations – Four Accounts

- The alternative plans were evaluated according to the four accounts established in the P&G (WRC 1983). Economic benefits were quantified for NED and RED accounts, and additional unquantified economic benefits of alternative plans were discussed under the EQ and OSE accounts, or under other unquantified benefits.

- All of the alternative plans provide positive NED benefits, with the exception of Alternative Plan 3 under high SAR conditions. The total estimated average annual NED monetary benefits of the alternative plans range from $81.3 to $100.9 million without ecosystem benefits and from $94.8 to $160.5 million with ecosystem benefits (California level). The resulting net economic benefits for alternative plans (with the exception of one condition for Alternative Plan 3) range from $0.6 to $41.0 million, with ecosystem benefits.

- A recommended plan is not identified in this report; Alternative Plan 4 is the alternative plan with the greatest net NED benefits of those evaluated and is used as a representative plan for financial feasibility and other analyses. Alternative Plan 4 was not optimized for accomplishments, benefits, or repayment, and was not maximized for net NED benefits.

- The RED, EQ, and OSE accounts are not estimated to have a material bearing on the plan selection process for the Investigation.

- For the RED account, all alternative plans provide positive employment and personal income RED benefits to the southern San Joaquin Valley region and the State. Short-term estimated average annual jobs supported by construction activities in the southern San Joaquin Valley would range from 1,605 to 1,656 with the alternative plans. Long-term estimated average annual additional jobs supported by increased agricultural production, recreational visitation, and O&M activities in the southern San Joaquin Valley would range from 456 to 472 with the alternative plans. Long-term estimated average annual jobs supported by increased agricultural production in the State under the alternative plans would range from 256 to 303.

- For the EQ account, all alternative plans are similar in the types of potential environmental effects, although the level of some effects would vary in the primary study area and across different portions of the extended study area depending on water operations for alternative plans. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures.

- Both the beneficial and adverse effects in the OSE account are expected to be similar across all alternative plans.

Alternatives Evaluations – Effects on Other Programs

- The alternative plans would not interfere with implementation of the SJRRP, but would change water management at Friant Dam and would provide beneficial effects in support of the Restoration Goal and Water Management Goal of the Settlement being implemented through the SJRRP.

- For the Restoration Goal, the alternative plans would improve operational flexibility in the management of Restoration Flows; reduce gravel replenishment requirements, sediment accumulation, and gravel pit connectivity; and enhance San Joaquin River habitat for anadromous fish through providing a larger cold-water pool, improving the capability, reliability, and flexibility to release water at suitable water temperatures downstream from Friant Dam, and providing additional flow from Friant Dam to Mendota Pool (for water supply exchanges). The overall net effects of the alternative plans on the Restoration Goal and San Joaquin River ecosystem would be positive; however, the beneficial effects of the alternative plans from providing improved water temperatures and additional flow could be slightly offset by a reduction in floodplain rearing habitat for salmonids in Reaches 1 and 2.

- For the Water Management Goal, the alternative plans could increase the volume of Restoration Flows eligible for downstream recapture, but could reduce the availability of $10 water under Paragraph 16(b) of the Settlement.

- The alternative plans may have effects on other projects or programs, and the potential effects will be evaluated in the Draft EIS/EIR.

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Chapter 9
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