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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

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.

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.

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).

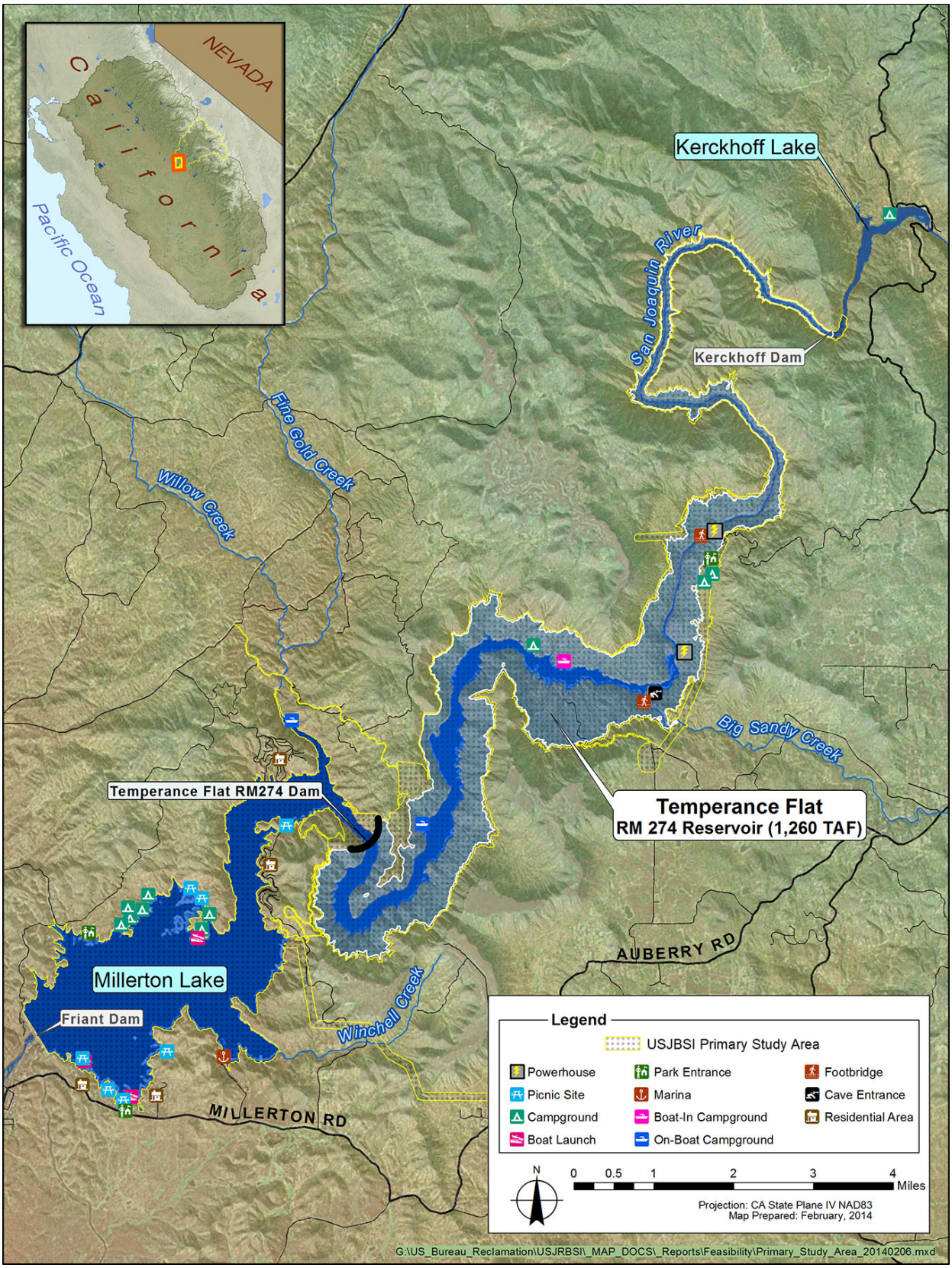


Figure ES-1. Primary Study Area and Temperance Flat RM 274 Reservoir

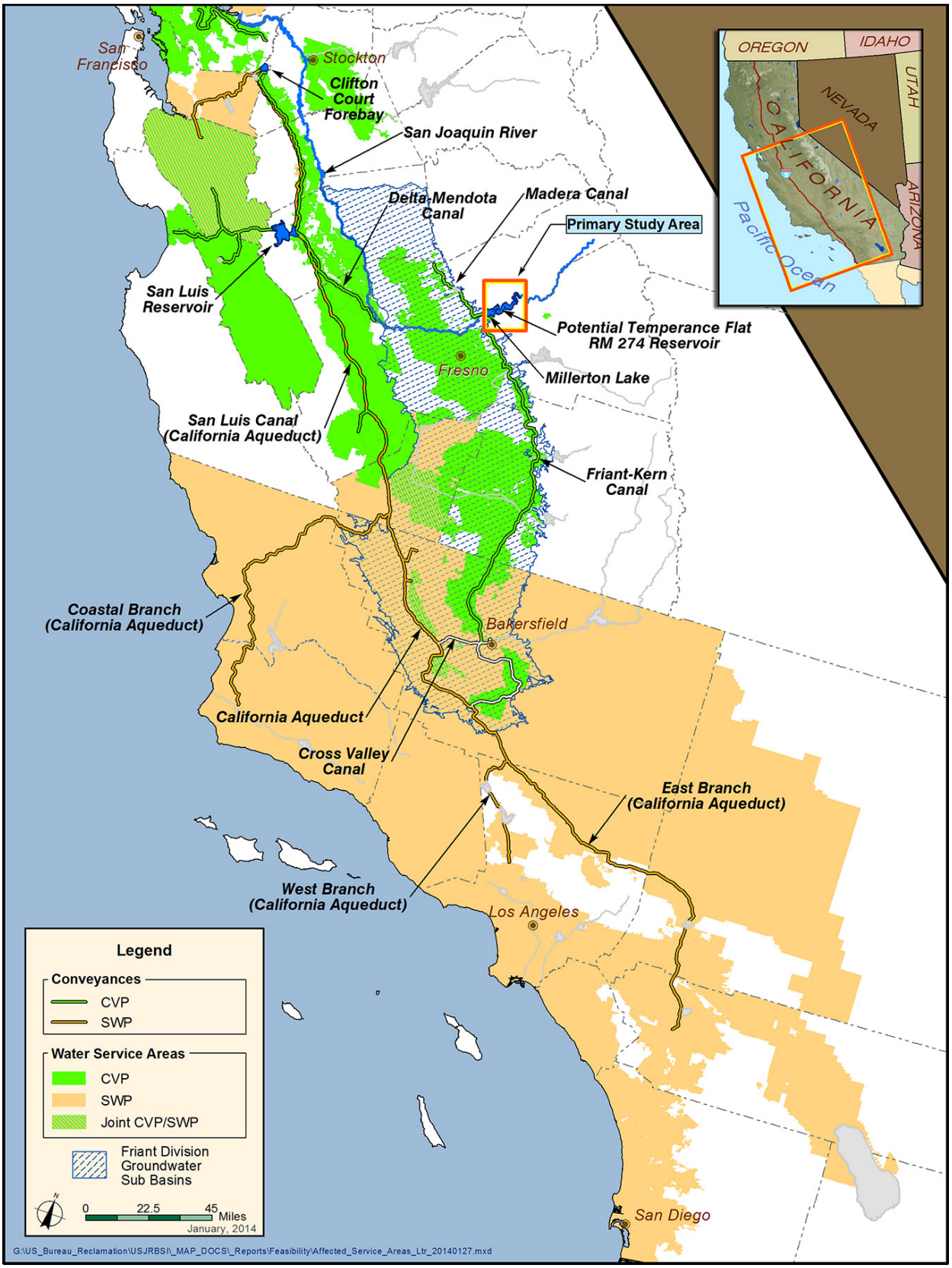


Figure ES-2. Extended Study Area

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.

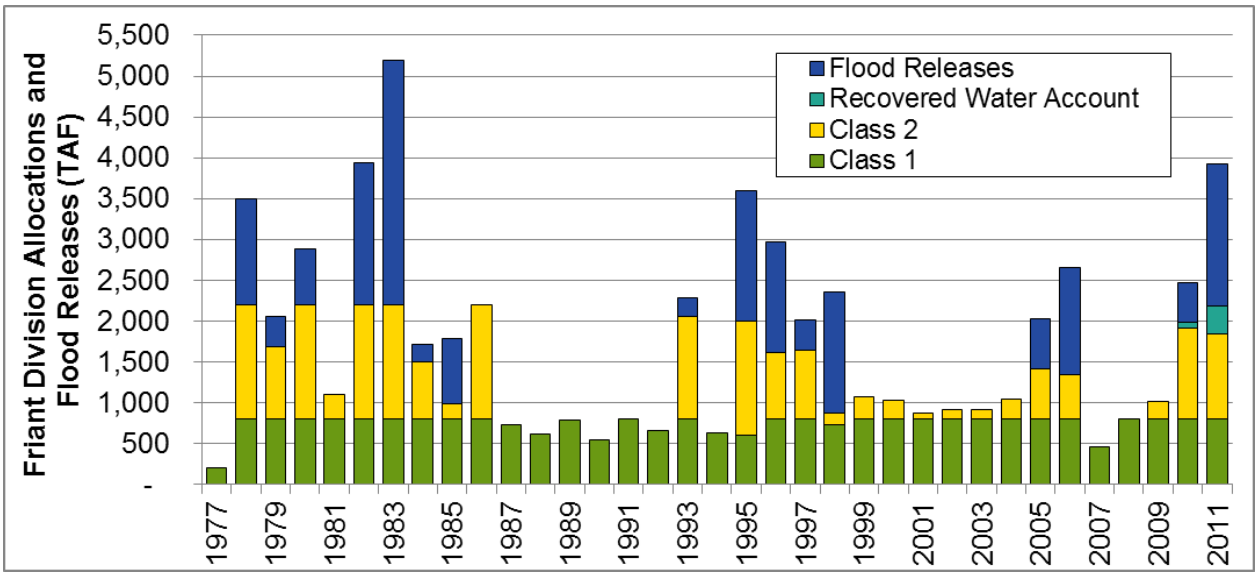


Figure ES-3. Friant Division Allocations and Flood Releases, 1977 – 2011

San Joaquin River Ecosystem

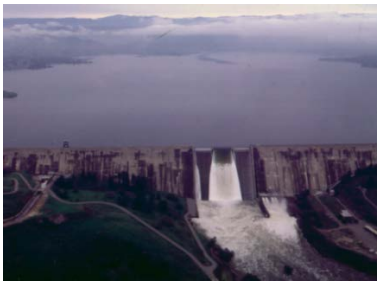
After construction of Friant Dam and before implementation of the San Joaquin River Restoration Program (SJRRP), the San Joaquin River between Friant Dam and the Merced River confluence did not support a continuous riparian and aquatic ecosystem. Generally unhealthy ecosystem conditions for the native 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.

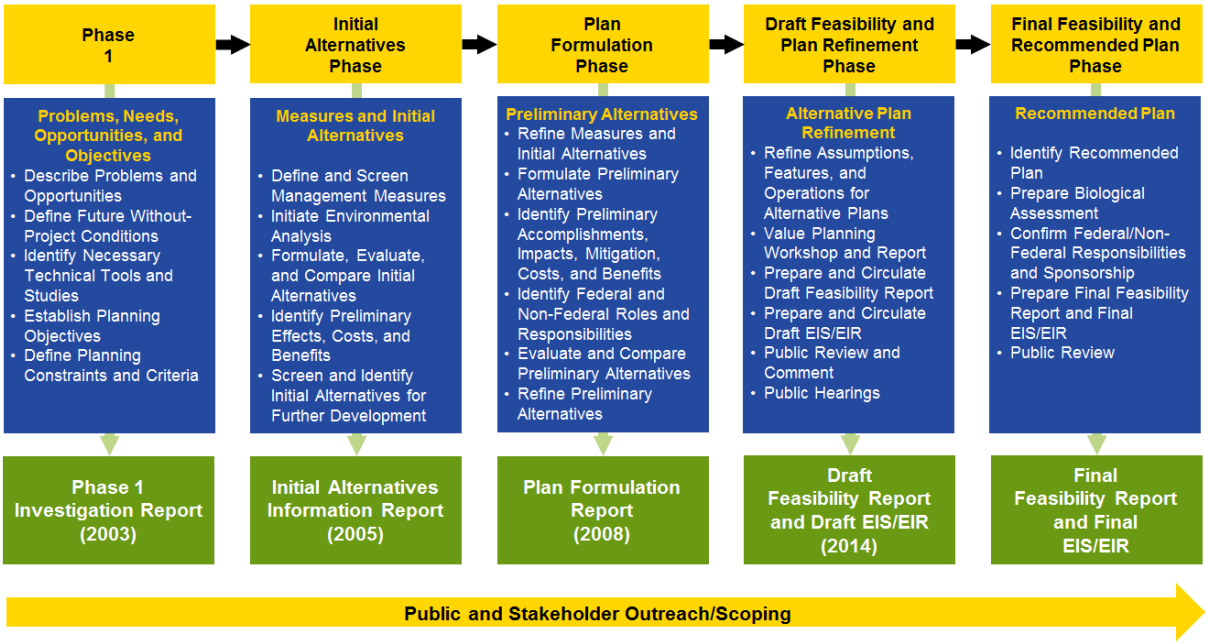


Figure ES-4. Plan Formulation Process

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).

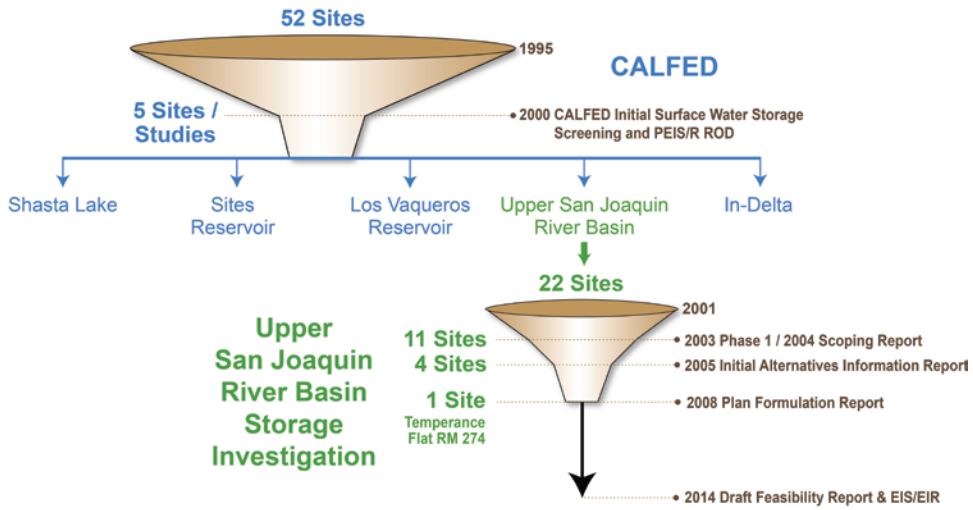


Figure ES-5. Site Selection Process for Temperance Flat RM 274 Reservoir

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.

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

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

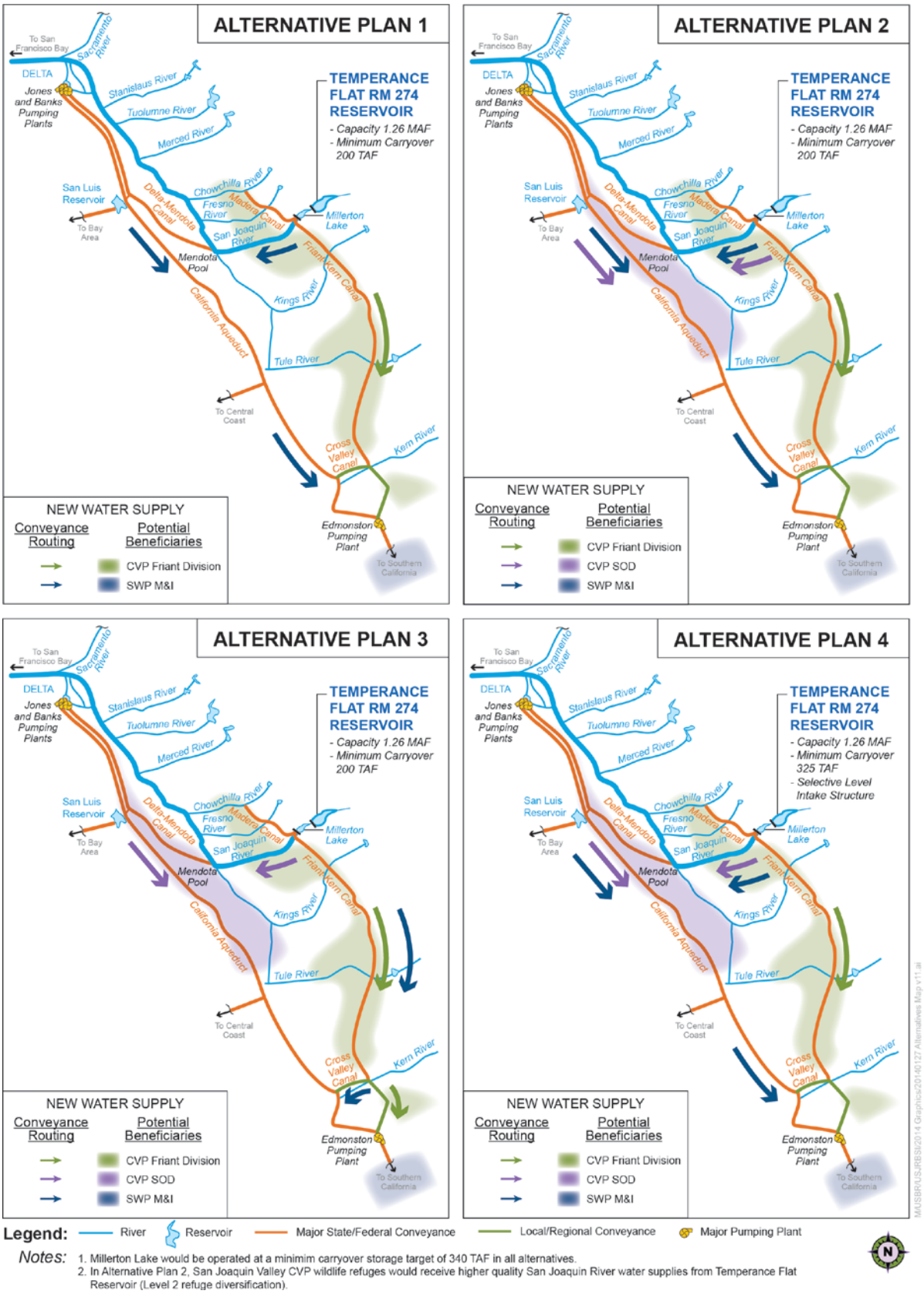


Figure ES-6. South-of-Delta Systemwide Operations of Alternative Plans

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 Ammortization[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

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.

Friant Dam and Millerton Lake

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

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.

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

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					
	Benefits[1,2]	Specific Costs[3]	Remaining Benefits[4]	Allocated Joint Costs[5]	Overall Cost Allocation	Total Allocated Costs[6]	Reimbursable		Nonreimbursable			
									Federal		State/Local	
							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

Risk and Uncertainty

Millerton Lake

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.

San Joaquin River near Kerckhoff Powerhouse

- **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.

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.

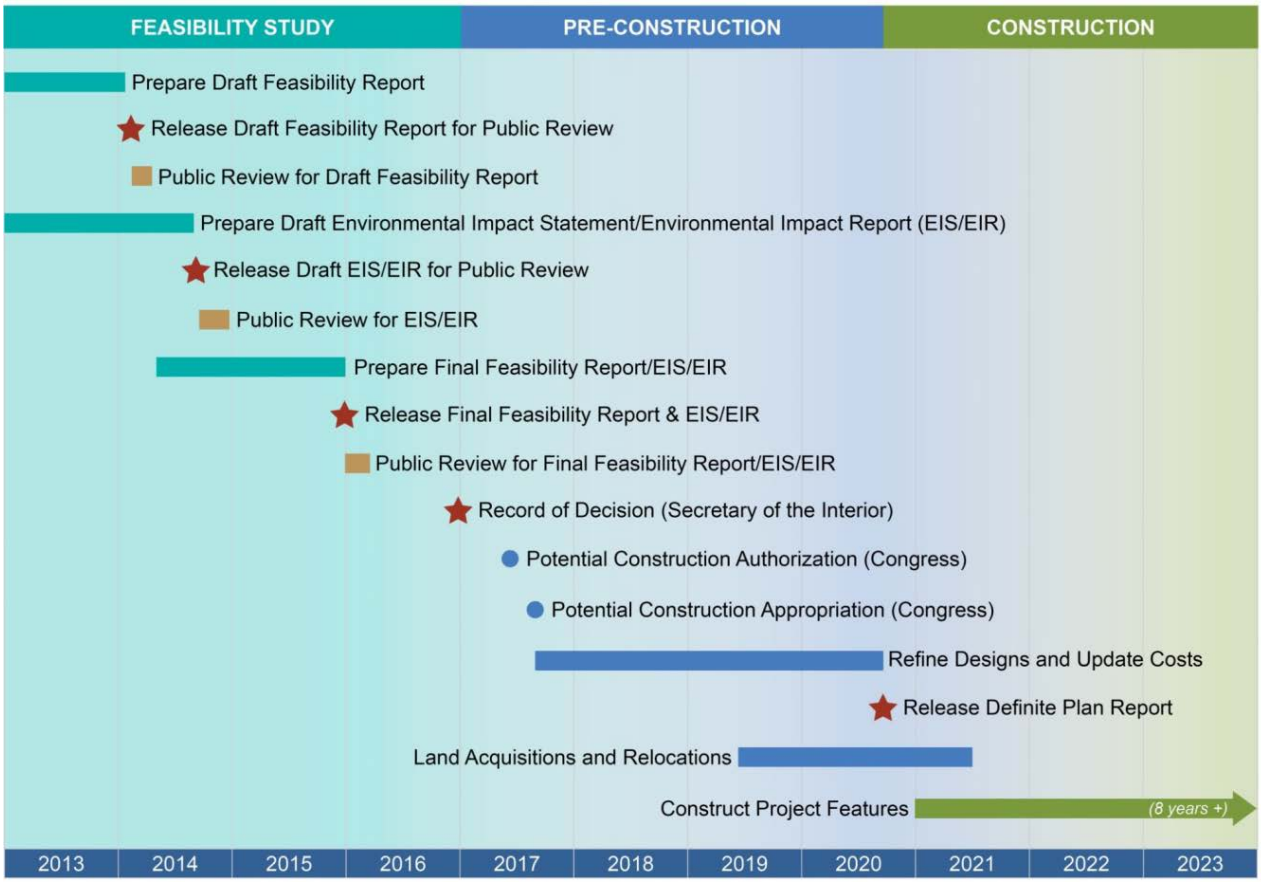


Figure ES-7. Upper San Joaquin River Basin Storage Investigation Project Timeline

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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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